

**CIOERT SEADESC II Report
Extreme Corals 2011: South Atlantic Deep Coral Survey**

**NOAA Ship *Pisces* Cruise PC-11-03 (11)
May 31 – June 11, 2011**

**NOAA Deep-Sea Coral Research and Technology Program
(CIOERT Project #: II-CO-DCE-5)**

**NOAA Office of Ocean Exploration and Research
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This provides the following data for each dive site: cruise and ROV dive metadata, figures showing each ROV dive track and habitat zone overlaid on multibeam sonar maps, dive track data (start and end latitude, longitude, depth), objectives, general description of the habitat and biota, and images of the biota and habitat that characterize the dive site. In addition, this SEADESC Level II Report provides quantitative analyses of each dive site including: 1) CPCe 4.1[©] Coral Point Count analysis of percent cover of benthic biota and substrate type, 2) densities of benthic macro-fauna (# organisms/m² for each species), and 3) densities of fish populations (# individuals/km for each species).

EXECUTIVE SUMMARY

In June 2011, a 12 day research cruise was conducted by NOAA National Marine Fisheries in collaboration with the Cooperative Institute for Ocean Exploration, Research, and Technology (CIOERT) at Harbor Branch Oceanographic Institute, Florida Atlantic University (HBOI-FAU), and other academic and federal partners (including NOAA NCCOS, Florida State University, and University of Louisiana), using the NOAA Ship *Pisces* and the NOAA Southwest Fisheries Science Center's ROVs. This cruise is part of an ongoing study of deep-sea coral habitats off the coast of the southeast United States. Primary research objectives of the multi-year science plan include mapping and characterizing coral and fish populations inside and adjacent to new managed areas. The focus of the 2011 expedition is to explore hard grounds out to 550 m depth off south Florida, with emphasis on assessing areas that are coral/sponge habitat and areas that are still open to bottom fishing activities (Allowable Fishing Areas) within the managed areas.

This Final Cruise Report provides a detailed analysis of the benthic habitats, biota, and fish populations at each dive site based on the ROV photo/video transects, CTD casts, and multibeam sonar surveys. This report also provides a SEADESC Level II Report (Appendix 2) for each dive site which includes: cruise and ROV dive metadata, figures showing each ROV dive track and habitat zone overlaid on multibeam sonar maps, dive track data (start and end latitude, longitude, depth), objectives, general description of the habitat and biota, and images of the biota and habitat that characterize the dive site. In addition, the SEADESC Level II Report provides quantitative analyses of each dive site including: 1) CPCe 4.1[©] Coral Point Count analysis of percent cover of benthic biota and substrate type, 2) densities of benthic macro-fauna (# organisms/m² for each species), and 3) densities of fish populations (# individuals/km for each species).

A total of 10 ROV dives were conducted from June 1 to June 10, 2011, resulting in a total bottom time of 31.0 hours, covering 112 km, at depths from 56 to 375 m (Table 3, Fig. 1). A total of 4,445 in situ digital images were taken and included 339 general habitat and species photos, and 4,104 quantitative transect photos which were used for the SEADESC Level II analyses. Six sites were surveyed with multibeam sonar and covered a total area of 112 km² (Table 1). These sites had never been surveyed previously with high-resolution multibeam sonar. Georeferenced sonar maps were made for the North Florida MPA site, the Jacksonville *Lophelia* coral mound site, St. Lucie MPA, and portions of the Miami Terrace CHAPC. In addition two regions of deepwater *Oculina* coral reefs were mapped for the first time north and outside of the current boundaries of the *Oculina* HAPC. These new *Pisces* sonar maps and ROV dives enabled us to discover and ground-truth many new deepwater *Oculina* coral reefs that had not been documented previously, and these are now under consideration by the South Atlantic Fishery Management Council for addition to the OHAPC.

Ultimately the primary benefits of these data are to characterize and document the habitat, benthic and fish communities within Habitat Areas of Particular Concern (HAPCs; including the deepwater Coral HAPCs and *Oculina* HAPC) and the shelf-edge Marine Protected Areas (MPA) along the southeastern U.S. from North Carolina to south Florida. These data may then be compared to previous and future research cruises and to areas adjacent to the protected areas to better understand the long-term health and status of these important deepwater coral/sponge

ecosystems. These data will be of value to the SAFMC, NOAA Fisheries, NOAA DSCRTP, NOAA CRCP, and NOAA Mesophotic Reef Ecosystem Program for management decisions on these habitats and managed key species.

ACKNOWLEDGEMENTS

We gratefully acknowledge the NOAA Cooperative Institute for Ocean Exploration, Research, and Technology (CIOERT) at Harbor Branch Oceanographic Institute, Florida Atlantic University (HBOI-FAU), and thank the Robertson Coral Reef Research and Conservation Program at HBOI. The crews of the NOAA Ship *Pisces* and the NOAA Southwest Fisheries Science Center's ROV are thanked for their support and efforts which made this cruise a success.

CIOERT gratefully acknowledges funding provided by the NOAA Office of Ocean Exploration and Research (OER Grant #: NA09OAR4320073). The NOAA Deep Sea Coral Research and Technology Program (DSCRTP; CIOERT Project #: II-CO-DCE-5) provided funding for the ROV, data management, data analysis and development of this SEADESC Cruise Report. The NOAA Office of Marine and Aviation Operations (OMAO) provided support for ship time. Funding for data analysis of the shelf-edge MPA and HAPC sites was also provided in part by the NOAA Coral Reef Conservation Program (CRCP) through the South Atlantic Fishery Management Council (Grant #: NA11NMF4410061). Funding by NOAA DSCRTP also co-sponsored the 2012 Fifth International Deep Sea Coral Symposium at which some of these data were presented.

DELIVERABLES

This Final Cruise Report and SEADESC Level II Report finalizes the deliverables required by our grant from NOAA DSCRTP and provides data for our NOAA CRCP/SAFMC grant. Other deliverables were completed and detailed in the Preliminary Cruise Report.

CIOERT/NOAA COLLABORATION

The primary focus of this CIOERT Cruise is to advance NOAA OER goals while complementing the management objectives of NOAA DSCRTP, NOAA Mesophotic Reef Ecosystem Program, and the South Atlantic Fishery Management Council (SAFMC).

For this cruise we collaborated with NOAA NMFS (Andrew David, Stacey Harter, Panama City) in order to assess habitat and fish communities, targeting grouper, snapper and tilefish. Other NOAA collaborators included: Laura Kracker, NOAA-NCCOS; Jeff Hyland, NOAA-NCCOS; Stephen Roth, NOAA-NCCOS; James Daugomah, NOAA-NCCOS; Cindy Cooksey, NOAA-NCCOS; John Butler, NMFS-La Jolla; Scott Mau, NMFS-La Jolla; Kevin Stierhoff, NMFS-La Jolla; and David Murfin, NMFS-La Jolla.

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PROJECT OVERVIEW

Deep and shallow coral ecosystems are ocean hot spots for biodiversity and productivity, and provide essential habitat for fish and other marine life. Recent research has revealed the extent and ecological importance of deep-sea coral communities and the threats they face. Sound management of these ecosystems requires scientifically based information on their condition. In 2010, the Department of Commerce and the South Atlantic Fishery Management Council designated the largest (23,000 nm²) marine managed area on the U.S. east coast to protect deep coral ecosystems from North Carolina to Florida. In 2009-2011, NOAA's Deep Sea Coral Science and Technology Program (DSCRTP) partnered with several federal and academic partners to explore deep-sea coral ecosystems off the Southeast U.S. Research objectives of the multi-year science plan included to mapping and characterizing coral and fish populations in and adjacent to the new managed areas. Previous expeditions in 2009 and 2010 (<http://cioert.org/xcorals>) explored deep coral ecosystems from North Carolina to Florida. This CIOERT *Extreme Corals 2011* cruise continues support for the DSCRTP southeast regional program. In support of the DSCRTP's 2011 Science Plan, major objectives included: map coral habitat and describe fish communities in and outside the CHAPCs with emphasis on Allowable Fishing Areas, use *Pisces'* ME70 sonar system for assessing pelagic communities associated with DSCE, quantify the benthic infaunal community adjacent to deep coral habitats, and look for contaminants in sediments near DSCE close to and remote from population centers along the SE coast.

OBJECTIVES

Objectives for this 2011 NOAA *Pisces* expedition included:

1. Explore unique and likely coral habitats with ROV, ground-truth sonar maps, and obtain video, photos, and samples that can be used to describe habitats and faunal assemblages in depths from 50 to 500 m.
2. Conduct ME-70 Echosounder surveys to study diel patterns of mid-water nekton biomass to study associations with hard bottom and coral habitat.
3. Collect sediment samples to study animal-sediment relationships and chemical contaminants.
4. Describe faunal changes along transects across hard bottom habitat areas and adjacent soft bottom areas.
5. Collect new and unusual species for taxonomic, genetic, biomedical, life history studies, and educational purposes.
6. Collect samples of corals, sponges, mollusks, decapods and other taxa for genetic analyses and to elucidate patterns of recruitment.
7. Develop data management and educational materials from the cruise.

OUTREACH AND EDUCATION

The goal of the expedition's education and outreach activities was to promote ocean literacy, knowledge of deep coral ecosystems and challenges of exploring and managing deep ocean frontiers, for public and classroom audiences. Related outreach/education activities included:

- Expedition web site (cioert.org/xcorals2011)
- News media—press kit and news releases
- Promote ocean literacy, knowledge of deep coral ecosystems and challenges of exploring and managing deep ocean frontiers, for classroom audiences; NOAA Teacher-at-Sea; Skype live-link with classrooms; web materials.

METHODS

Quantitative and qualitative ROV video and photographic surveys were made at each site to ground-truth bottom sonar maps, quantify and characterize the benthic habitats, sessile fauna, fish populations, and coral/sponge cover. Shipboard multibeam echo-sounder (ME70) surveys were conducted at dive sites where there was no previous multibeam sonar maps. Prior to each ROV dive the georeferenced sonar maps were uploaded to the ROV navigation software; the co-PIs (J. Reed and A. David) then selected pre-dive waypoints which were overlaid on the map for ROV dive targets.

ROV Operations

Initially the deep-water (550 m depth limit) *Arc* ROV owned and operated by NOAA Fisheries SWFSC was used. The ROV was equipped with high-definition digital video and digital still cameras with parallel lasers for scale, CTD, and a single-function manipulator. Two ROV dives were planned each day; approximately 0800-1200 and 1400-1800. Unfortunately during the third dive the umbilical cable became twisted breaking the fiber optics to the Hi-Def video

camera. Luckily the ROV team had a backup ROV which is a very rare event. The remainder of the cruise used the *Phantom* ROV which only had standard definition video.

ROV Transects

During each dive the primary objectives were to document benthic habitat and fauna (fish, corals, sponges), collect samples, and conduct photo/video transects which were used for quantitative analyses of the benthic macro-biota, fish, and habitat types. During the photo/video transects, we attempted to keep the ROV <1 m off bottom with a speed over ground of $\sim\frac{1}{4}$ knot. Variable, strong currents often made this difficult.

The video footage was recorded continuously throughout each dive from surface to surface. The camera was typically angled down $\sim 30^\circ$ to view both near and far to the horizon for fish aggregations and habitat. A headset microphone was used for continuous audio annotations by the PIs describing events, habitat, and fauna which were recorded onto the video recordings and later transcribed into a Microsoft Access 2010 database. Along with being used as the main “pilot” view, the video was the primary data source for the quantitative analysis of the fish populations.

Benthic Data Survey and Analysis

Quantitative photo transects were conducted at each ROV dive site using the digital still camera pointing straight down (or perpendicular to the substrate as possible) with parallel lasers (20 cm) for scale. In general, two digital images were taken per minute (depending on the recycling rate of the strobe). Each photo filename was coded with corresponding UTC time and date code (using Stamp 2.8 by Tempest Solutions[©]) which was imported into MS Access and linked to the ROV navigation data for site specific data of coordinates and depth and then imported into ArcGIS[™] 10.0. Species-specific or general habitat photos were not included in the quantitative analyses. Poor and unusable photos (blurred, black, off bottom) or overlapping photos were removed from the analyses. Images were analyzed by three methods: 1) species occurrence (presence/absence), 2) percent cover, and 3) density (number of organisms per m^2). Some common species could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phyla.

Percent cover of substrate type and benthic macro-biota was determined by analyzing the images with Coral Point Count with Excel extensions (CPCe 4.1[©], Kohler and Gill, 2006), and following protocols established by Vinick et al. (2012) for offshore, deepwater surveys in this region. Random points overlaid on each image were identified as substrate type and biota. Substrate categories included: soft bottom (unconsolidated sand, mud) and hard bottom which was subdivided into rock (pavement, boulder, ledge), rock rubble/cobble (generally, 5-20 cm), coral rubble, and framework coral (standing coral colonies). The density of the benthic biota was then analyzed using CPCe[©] to calculate the area of each image using the parallel lasers for scale. All macro-benthic biota (usually >3 cm) were identified to the lowest taxa level possible. For this, some colonial taxa and thin encrusting taxa were counted accordingly: 1) thin, encrusting algae (Corallinales, Peyssonneliaceae, or Chlorophyta) were counted as individual clusters if >3 cm diameter. 2) Solitary cup corals (which were often quite abundant) were counted as 1 = few (1-10), 5 = common (10-20), 10 = abundant (>20). Hydroida and Hemichordates were counted as clusters.

Summary of ROV Survey Protocol

- 1) During the photo/video transects, we attempted to keep the ROV <1 m off bottom with a speed over ground of $\sim\frac{1}{4}$ knot.
- 2) Underwater video was viewed in real time on the support vessel by biologists familiar with the local deep-water fauna; the audio descriptions were recorded onto the video and transcribed into a MS Access database.
- 3) Still images were captured with the digital still camera $\sim 2/$ minute depending on the recycling rates of the strobe.
- 4) Field notes and video images were reviewed and summarized to identify habitats and fauna. These summaries were compiled in GIS format and used to produce a habitat maps.
- 5) Still images captured from the photo transects were analyzed using CPCe[®] software to determine relative percent cover of benthic biota and habitat types. Organisms larger than 3 cm were enumerated for density analysis.
- 6) Video transects were used for analysis of fish populations.

Multibeam Sonar Mapping and Fisheries Acoustic Surveys

Table 1. Multibeam and split beam sonar surveys conducted during 2011 *Pisces* cruise: South Atlantic Deep Coral Survey (L. Kracker, NOAA).

Site	Total length of transects (nmi)	Extent (km²)	ME-70 Multibeam Bathymetric survey	EK-60 Split-beam Fisheries survey
Jacksonville	42	18	X	X
North Florida MPA	31	15	X	X
Daytona <i>Oculina</i> Pinnacles	78	19	X	X
Titusville <i>Oculina</i> Pinnacles	52	16	X	X
St. Lucie MPA	29	27	X	X
Miami Terrace	50	17	X	X

NOAA Acoustic surveys using both split beam sonar (Simrad EK-60) to collect water column data and multibeam sonar (Simrad ME-70) for bathymetric data were run concurrently at all ROV dive sites where multibeam maps were not available. The main objective of the sonar surveys was to provide background maps to guide ROV exploration at dive sites. Maps of benthic features along with information on fish distribution at each site will be beneficial in terms of understanding the relationship between biota and benthic features. The ME-70 as configured on the NOAA ship *Pisces* was not intended to be used for bathymetric mapping without the Bathymetry software module. A Matlab routine, developed and provided by Randy Cutter (NOAA, SWFSC), was applied to this data to detect and extract bottom depths. The output was then imported into Fledermaus 3D visualization software and converted to geotiffs. The Ek-60 split beam data will be analyzed in Echoview[®] software to examine relative abundance of fish detected along survey tracks. These data will be reported elsewhere (L. Kracker, NOAA).

CTD Operations

One CTD continuous profile of conductivity, temperature, pH, dissolved oxygen, and depth was cast at each sediment station. These CTD data were used for the multibeam sonar surveys (sound velocity). The ROV's also recorded CTD data at each dive site for site characterization. A summary of these data are shown for each dive in Appendix 2.

Sediment Grab Sampling

Sediment sampling was conducted using a 200-lb Van Veen grab which included one 0.1 m² sampler in the frame. Contents of the grabs were used for analysis of benthic macro-infaunal communities, concentration of sediment contaminants, % sand- silt-clay, and total organic-carbon content (TOC). Three Van Veen grab samples were taken at each station to acquire adequate sediment for both benthic infaunal analysis and chemistry/granulometric analyses. Benthic grab samples were collected at locations deemed appropriate from the visual ROV observations. The approach was to take samples as close to the reefs as possible without impacting coral. These data will be reported elsewhere (J. Hyland, NOAA).

Table 2. Benthic grab sample sites conducted during 2011 *Pisces* cruise: South Atlantic Deep Coral Survey (J. Hyland, NOAA).

Grab Station	Latitude	Longitude	Depth (m)	Date	Location
PC11001	30.3818	-80.2181	65	40696	N-FL MPA
PC11002	30.0229	-80.1967	246	40697	Jacksonville Lophelia Coral Site; 250 m S of top of feature
PC11004	30.0274	-80.1964	244	40697	250 m N of top of feature
PC11005	30.0286	-80.1961	248	40698	375 m N of top of feature
PC11006	29.2389	-80.1672	90	40699	Daytona Oculina Reef Site; 90 m site; flat area between Peaks 4&5
PC11007	29.1822	-80.1511	86	40699	Daytona Oculina Reef Site; 25 m SE of base of reef
PC11008	28.7548	-80.069	88	40700	Cape Canaveral Oculina Reef Site; ~150 m SE of base of Peak 1
PC11009	28.7549	-80.0708	88	40700	~50-60 m S of base of Peak 1
PC11010	28.7579	-80.071	84	40700	~100 m N of base of Peak 1 & 100 m S of base of Peak 2.
PC11011	27.6066	-79.9859	73	40701	Inside Oculina MPA; ~350 m S of NW end of Chapman's Reef
PC11012	27.6091	-79.9864	62	40701	Inside Oculina MPA; ~50 m S of NW end of Chapman's Reef
PC11013	27.5414	-79.9784	81	40701	Inside Oculina MPA; ~100 m S of base of Peak 1 along Jeff's Reef
PC11014	25.6232	-79.9984	330	40704	SW corner of Miami Terrace; within HAPC and at western-most edge of Allowable Fishing Zone; ~5.5 nm west of start of ROV transect

RESULTS

Study Areas

The pre-cruise dive plans were to survey deepwater sites primarily within the deepwater coral Habitat Areas of Particular Concern (CHAPCs) and shelf-edge MPA sites off eastern Florida and also targeting alternate sites within the Allowable Fishing Corridors within the CHAPCs. After the first dives were made in deeper water (200 m *Lophelia* site off north Florida), we found that the this small ROV could not operate in deeper water with the strong Florida Current. Plans were revised by the Chief Scientist and Co-PI with approval by NOAA DSCRTP to move inshore, out of the stronger currents, to survey the shelf-edge MPA sites and deepwater *Oculina* coral habitat.

Cruise Summary

A total of 10 ROV dives were conducted from June 1 to June 10, 2011, during CIOERT's 2011 *Pisces* cruise resulting in a total bottom time of 31.0 hours, covering 112 km, at depths from 56 to 375 m (Table 3, Fig. 1a,b). A total of 44:51 hours of ROV dive videotapes with audio annotations were recorded on hard drives (14) and DVDs (44) for backup. A total of 4,445 in situ digital images were taken and included 441 general habitat and species photos, and 4,104 quantitative transect photos which were used for the SEADESC Level II Report (Appendix 2). Only a few specimens were collected as the ROV only had a single function manipulator. A total of 10 benthic specimens were collected, including 2 Cnidaria (1 Scleractinia and 1 Antipatharia), 6 Arthropoda, 1 Mollusca, and 1 Polychaeta.

Six sites were surveyed with multibeam and split beam sonar by L. Kracker (NOAA) and the *Pisces* survey team and covered a total area of 112 km² (Table 1). These sites had never been surveyed previously with high-resolution multibeam sonar. Georeferenced maps were made for the Jacksonville *Lophelia* coral mound site, the North Florida MPA, St. Lucie MPA, and portion of the Miami Terrace CHAPC. In addition, two regions of deepwater *Oculina* coral reefs were mapped for the first time, north and outside of the current boundaries of the *Oculina* HAPC. These new *Pisces* sonar maps and ROV dives enabled us to discover and ground-truth many new deepwater *Oculina* coral reefs that had not been previously documented and these are now under consideration by the SAFMC for addition to the OHAPC.

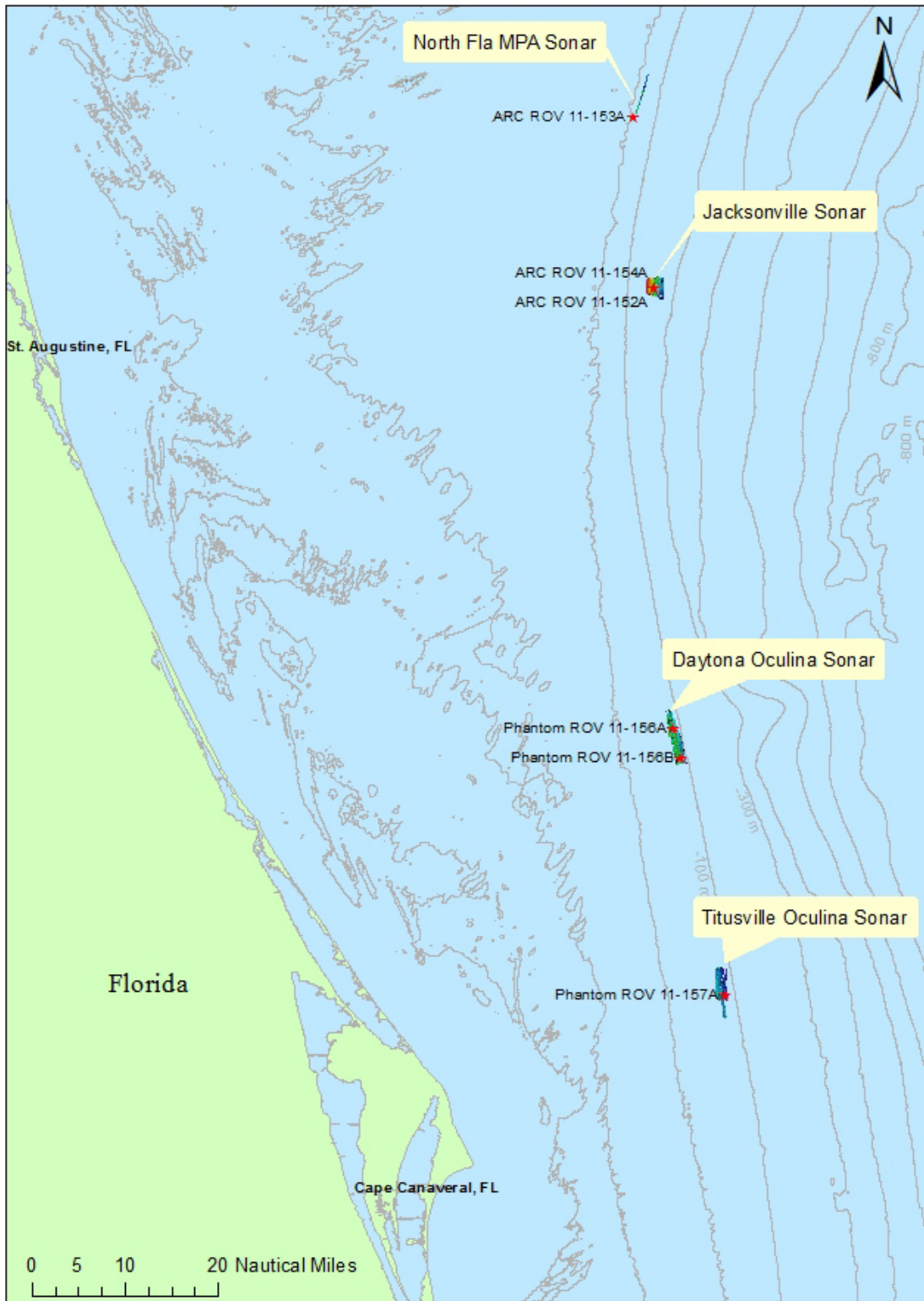


Figure 1a. Locations of ROV dive sites and multibeam sonar surveys during 2011 *Pisces* cruise: South Atlantic Deep Coral Survey, May 31-June 11, 2011. North Florida sites.

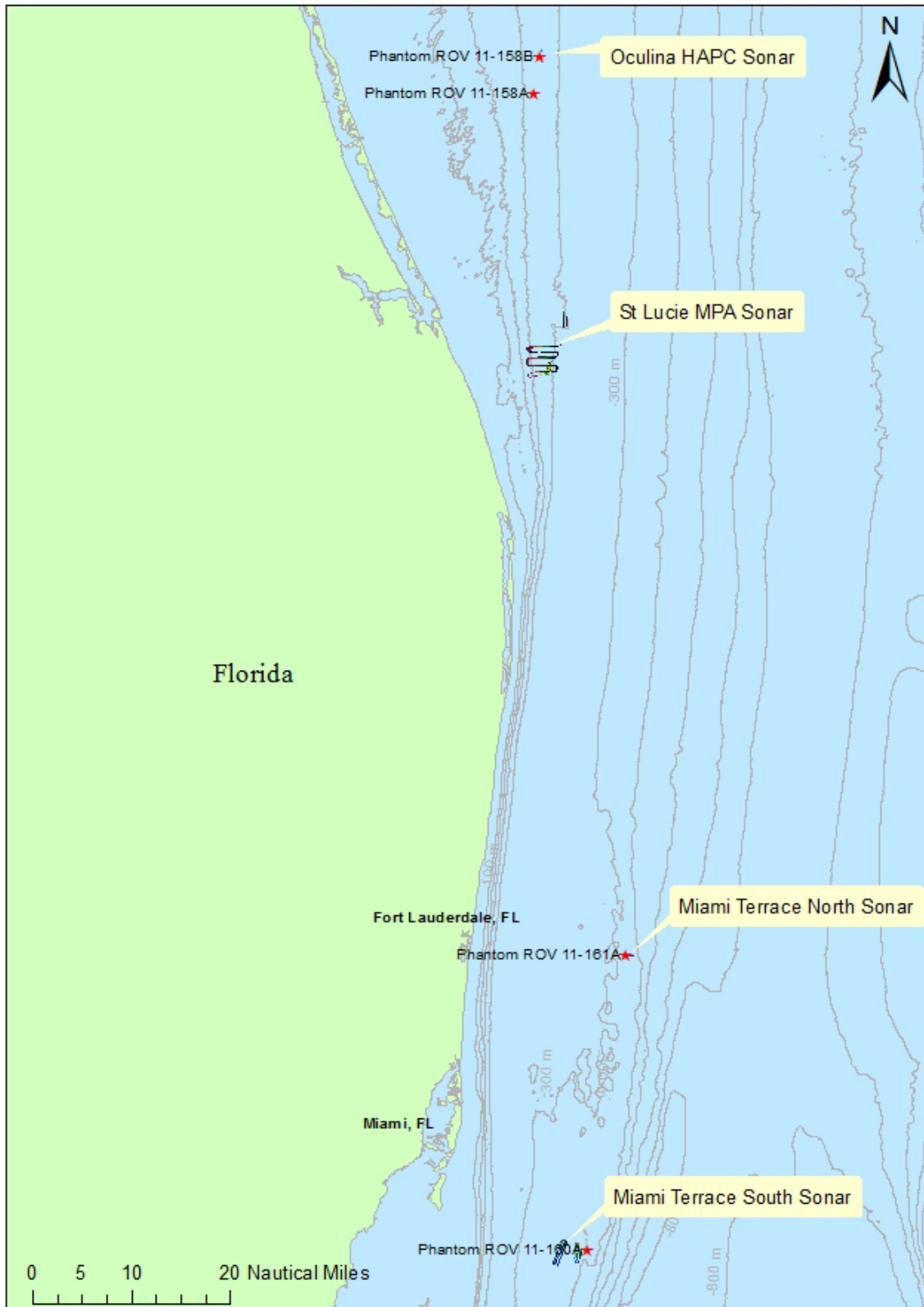


Figure 1b. Locations of ROV dive sites and multibeam sonar surveys during 2011 *Pisces* cruise: South Atlantic Deep Coral Survey, May 31-June 11, 2011. Central and south Florida sites.

Table 3. ROV dive stations during 2011 *Pisces* cruise: South Atlantic Deep Coral Survey.

SITE NUMBER (DATE + SITE #)	LATITUDE	LONGITUDE	METHOD	DEPTH RANGE (Feet)		NUMBER of SAMPLES
1-VI-11-1	30 01.5060'N	80 11.8000'W	ARC ROV 11-152A	702	699	0
2-VI-11-1	30 23.6400'N	80 24.7620'W	ARC ROV 11-153A	213	184	0
3-VI-11-1	30 01.5060'N	80 11.8000'W	ARC ROV 11-154A	1017	682	0
5-VI-11-1	29 14.1700'N	80 09.8020'W	Phantom ROV 11-156A	295	230	3
5-VI-11-2	29 10.9482'N	80 09.0585'W	Phantom ROV 11-156B	292	230	0
6-VI-11-1	28 45.4971'N	80 04.2835'W	Phantom ROV 11-157A	289	210	7
7-VI-11-1	27 32.8000'N	79 59.7000'W	Phantom ROV 11-158A	308	223	0
7-VI-11-2	27 36.5944'N	79 59.1923'W	Phantom ROV 11-158B	262	210	0
9-VI-11-1	25 35.8290'N	79 54.2900'W	Phantom ROV 11-160A	1279	810	0
10-VI-11-1	26 05.6560'N	79 50.3890'W	Phantom ROV 11-161A	1036	820	0

SEADESC II REPORT- Habitat and Benthic Biota Characterizations

The SEADESC Level II Report (Southeastern United States Deep-Sea Corals) is presented in Appendix 2. This provides the following data for each dive site: cruise and ROV dive metadata, figures showing each ROV dive track and habitat zones overlaid on multibeam sonar maps, dive track data (start and end latitude, longitude, depth), objectives, general description of the habitat and biota, and images of the biota and habitat that characterize the dive site. In addition, this SEADESC Level II Report provides quantitative analyses of each dive site including: 1) CPCe 4.1[©] analysis of percent cover of benthic biota and substrate types, 2) densities of benthic macrofauna (# organisms/m² for each species), and 3) densities of fish populations (# individuals/km for each species).

Terminology

For this SEADESC II Report we used the following terminology. Hard bottom is sometimes referred to as live bottom due to the amount of living organisms attached to these substrates (SAFMC, 1998). Hard bottom provides anchorage for sessile or semi-sessile organisms (e.g., corals, octocorals, anemones, hydroids). Coral is defined by NOAA [Lumsden, S.E., T. Hourigan, A. Bruckner, and G. Dorr, eds., 2007, The state of deep coral ecosystems of the United States. NOAA Technical Memorandum CRCP-3] as hard corals (stony corals-Scleractinia) and other taxa with solid calcareous skeletons (e.g., Stylasteridae), as well as non-accreting taxa such as octocorals (Alcyonacea- Gorgonacea) and black coral (Antipatharia). Hard-bottom habitat includes various sizes of rock (rubble, cobble, boulders, and slabs), rock pavement, ledges, coral rubble, and framework coral (standing live and/or dead coral colonies). Vertical relief of bottom features (e.g., boulders, ledges, mounds) are reported in this report as low relief (<0.5 m), moderate relief (0.5-1.0 m), or high-relief features (>1.0 m). These are relative terms and depend on the size of features within an area and field of view. Soft substrates are defined as unconsolidated sediments (sand or mud).

Species List and Density of Benthic Macro-Biota

Appendix 1 lists all of the benthic macro-invertebrates and algae that were identified and counted from the quantitative photo transects at each dive site. Density of each species (# organisms/m²) was calculated based on the area of each digital image from the photo transects. These are discussed in detail for each dive in Appendix 2. As discussed in the Methods, some common taxa could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phylum. Sponges, gorgonians, and black coral are especially difficult to identify without a specimen in hand. In these cases a general descriptive taxa was used, e.g., “brown lobate sponge” or “unidentified Demospongiae”, which could consist of numerous species. These designations should not be considered equivalent to species level and should not be used for diversity (H') indices calculations. Many deepwater species in this region look nearly identical, such as fan sponges which are polyphyletic and actually include different classes.

Deepwater *Oculina* Coral Reef Dives

Due to strong currents, we were unable to dive successfully on the deeper reef sites within the deepwater coral HAPC as planned. The deeper sites were near the axis of the Florida Current, often 2-3 knots, and we were unable to station-keep the ship with the ROV. Although we made three deep dives: one on the 200 m deep *Lophelia* coral reef site off Jacksonville, and two sites on Miami Terrace, it was very difficult to keep the ROV on the bottom or to maneuver at slow speeds (<0.5 kn). We were, however, able to dive on several shelf-edge reef sites instead, including the North Florida MPA site and several deepwater *Oculina* reef sites.

A total of 5 dives were made on the shelf-edge deepwater *Oculina* coral reef sites. Two new multibeam sonar maps were made with the NOAA ship *Pisces* off Daytona and Titusville which are north of the boundaries of the current *Oculina* HAPC. The PI suspected that the *Oculina* reef system actually extended north of the northern OHAPC boundary at Cape Canaveral, and this was the first time we had the capabilities to map and ground-truth these northern *Oculina* reef sites. Three dives were made outside of the *Oculina* HAPC and were used to ground-truth the new sonar maps (Daytona site- Dives 156A, 156B; Titusville site- Dive 157A). Two dives were made within the *Oculina* HAPC boundaries which was originally designated in 1984. Appendix 2 describes each of these dives in detail but we have summarized some of the data below to compare the sites within the *Oculina* HAPC to sites outside of the OHAPC boundaries.

Table 4. Summary *Oculina* reef dives comparing coral, sponge, and fish fauna within and outside of the *Oculina* Habitat Area of Particular Concern (OHAPC). CPCe analysis of the quantitative digital still images was used to calculate percent cover of fauna, and density analysis calculated the number of organism/m². Each cell shows the range of percent cover or density for the various habitat zones for that dive (Coral Mound Peak, Slope, Base), the number in parenthesis is the average for the entire dive. Total Coral Substrate includes framework coral (living *Oculina varicosa* and standing dead *Oculina*) and coral rubble; Alcyonacea coral (primarily Gorgonacea and some soft corals); Antipatharia (black coral); Porifera (sponges); Estimated Total # Live is based on the video analysis and extrapolating to the entire reef area.

Dive Site	Total Coral Substrate (% Cover)	Framework Coral (% cover)	Live <i>Oculina</i> Coral (Density-#/m ²)	Standing Dead <i>Oculina</i> Coral (Density-#/m ²)	Alcyonacea (Density-#/m ²)	Antipatharia (Density-#/m ²)	Porifera (Density-#/m ²)	Est. Total # Live <i>Oculina</i> Colonies	Fish (# spp./density-#/km)
Daytona North	59.1	2.26-7.41 (5.15)	0.09-0.29 (0.14)	0.34-0.89 (0.72)	.86-4.03 (2.36)	0 - 0.46 (0.11)	1.29-5.40 (2.31)	217.8	25 / 485
Daytona South	73.1	2.70-6.35 (4.27)	0.09-0.47 (0.25)	0.74-2.32 (1.83)	0.32-0.85 (0.54)	0-0.85 (2.36)	1.27-2.84 (2.07)	107.0	15 / 223
Titusville	56.2	2.71-13.89 (4.68)	0.04-0.21 (0.14)	0.55-2.65 (0.68)	0.28-1.42 (0.97)	0.16-0.40 (0.45)	0.22-2.05 (1.73)	114.1	26 / 812
Chapman's Reef-OHAPC	51.7	36.14-43.71 (37.85)	7.32-4.23 (6.12)	1.00-1.45 (1.18)	4.72-14.55 (10.72)	0.28-0.44 (0.97)	26.28-39.17 (34.16)	Abundant	33 / 2739
Jeff's Reef-OHAPC	45.0	26.29-29.48 (28.67)	4.12-4.19 (4.13)	1.09-1.98 (1.22)	8.83-10.67 (9.09)	0.38-0.73 (10.72)	9.60-11.51 (9.87)	Abundant	24 / 1160

There are considerable differences in the fauna at the *Oculina* reef sites within the OHAPC compared to those outside of the OHAPC. Overall, all of the sites are comprised of coral mounds (10-30 m relief) that are bioherms, that is, they were built up over thousands of years of coral growth. The exposed exterior of the mounds are predominately coral, both within and outside the OHAPC, ranging from 45% to 73% cover of both standing coral, termed framework coral, and coral rubble. However, there are striking differences in the amount standing coral framework between the sites: the HAPC sites have 37.8 and 28.6% cover of standing coral compared to 5.5-4.35% at the non-HAPC sites. The density of the coral is also much different between the sites: the HAPC sites have 6.1 and 4.1 colonies/m² of live *Oculina*; the non-protected sites have 0.14 to 0.25 colonies/m². Gorgonaceans (Alcyonacea) are also more abundant at the HAPC sites (10.7-9.1), as are Porifera (34.1-9.9). The fish populations which are described in more detail below had similar numbers of species among the sites, but densities were up to 10 times greater at the HAPC sites.

In addition to these analyses of the digital still images, a total count of live standing *Oculina* coral colonies was made from the forward-looking video camera for each entire dive within the non-protected *Oculina* coral reef sites (Table 4). The majority of the live *Oculina* at these sites were much smaller in size compared to the HAPC sites, ranging in size of ~15 to 30 cm, which is equivalent to possibly 10-20 years old. So it appears that the impact to these reefs occurred primarily in the 1970s or 80s. Since the actual video field-of-view is just a small portion of the total mound area, we calculated the estimated field-of-view area for each dive [field-of-view width (~10 m) x transect length = area of the video transect]. From this we estimated the total number of live *Oculina* corals that may occur over the entire mound area at that dive site. In ArcGIS we calculated the total planar surface area of the coral mounds that were transected during the dive. We then multiplied the density of coral in the video by the total mound surface area. Table 4 shows this estimate of possible number of live coral colonies that are on the coral mounds for each of the non-protected *Oculina* coral reef sites (218 to 107 coral colonies).

Figures 2 and 3 use one-way analysis of similarity (ANOSIM, Bray Curtis) to compare the density of the benthic macro-biota from the quantitative photo transects of the dive sites within the *Oculina* HAPC and the sites outside the OHAPC. The density of each species for each dive was entered in PRIMER. The table was filtered to include the five *Oculina* coral reef dives (11-156A, 11-156B, 11-157A, 11-158A, 11-158B). The table was square root transformed and factors of “No Protection” or OHAPC were added (11-156A, 11-156B, 11-157A = No Protection; and 11-158A, 11-158B = OHAPC). A resemblance matrix was calculated using S17 Bray Curtis similarity between Samples (dives). A 2D MDS Plot was created and resulted in 0 stress (Figure 2 shows the MDS with the cluster overlaid). A cluster dendrogram was created for the Samples (dives) with SIMPROF (Fig. 2). SIMPROF shows significant difference between the OHAPC sites (11-158A, 11-158B) and the No Protection Sites (11-156A, 11-156B, 11-157A) (at 74.96; Pi: 0 Sig(%): 100).

These analyses clearly show the disparity of the protected *Oculina* reef sites within the OHAPC compared to the sites outside of the OHAPC, and provide evidence that the OHAPC is working to protect the coral habitat, benthic biota, and fish populations. The protected *Oculina* reef sites compared to the unprotected reef sites have greater abundances of standing coral framework, gorgonian corals, sponges, and much greater densities of fish. However, the newly discovered reef sites (non-OHAPC) show recent coral growth where most of the live *Oculina* coral colonies are 10-30 cm diameter. Previous research has shown that a single coral colony of about 20 cm diameter can provide habitat to nearly 2000 animals including juvenile fish and hundreds of species (Reed et al., 1982, 1987, 2002 a,b). Scleractinian corals as well as colonies of gorgonians, black corals, and sponges attract large numbers of fish and invertebrates. The high biodiversity associated with deepwater coral communities is intrinsically valuable and provides essential fish habitat for many commercially and recreationally important fish species, and as well, may provide numerous targets for chemical and biological research on marine organisms. However, the presence of dead coral should not be used to discount the habitat value. For example, the Southeastern United States Deep-Sea Coral Initiative (SEADSC) committee described 14 habitats found on the continental slope and concluded the presence of live versus standing dead coral did not matter in habitat classification (see Partyka et al. 2007). Live coral, standing dead coral, and even coral rubble all provide habitat and substrate for hundreds of species of invertebrates and juvenile fish (e.g., Reed et al., 1982, 1987, 2002 a,b; Ross and Quattrini, 2007), in addition to commercially valuable species (e.g., Reed and Farrington, 2010).

These data suggest that these small *Oculina* coral colonies at the non-OHAPC sites have recently settled as larvae and are growing on the coral rubble as long as the rubble is not overturned by bottom longlines or trawls. As a result of the new multibeam sonar maps made during the 2011 NOAA Ship *Pisces* cruise and ground-truth data collected by the ROV dives, the South Atlantic Fishery Management Council is now considering adding these newly discovered deepwater *Oculina* coral reefs to the *Oculina* HAPC. Given the presence of relatively young *Oculina* coral colonies, black coral, gorgonian coral, and sponges found on the newly discovered *Oculina* coral mounds, gives hope that these deepwater reefs could rebound after years of impact from bottom fishing and fisheries, especially in the 1970s and early 80s.

Human Debris

During the density analysis of the quantitative digital images from the photo transects, categories were included for 'human debris' and subcategories for fishing gear included fishing line, long line, fish traps/crab traps, nets, anchor line, bottles/cans, and other. The density of human debris (number/m²) is plotted in Figures 4 and 5 showing all dives with debris (North Florida MPA site= dive 153A; *Oculina* coral reef sites outside of the OHAPC = 156 A, 156 B, and 157 A; the *Oculina* HAPC sites = 158A and 158 B). All these sites showed impact from human debris and primarily from fishing gear and even anchors. The other deeper sites which had no debris are probably too far offshore for most fishers. All of the *Oculina* reef sites showed fishing gear or litter on the bottom. Unfortunately both of the sites within the *Oculina* HAPC had the most fishing gear including bottom trawl nets. This could be in part that these sites are closest to shore and had very limited enforcement or surveillance prior to 2000. The age of this gear is unknown but we have evidence of trawling occurring at site 158B after the deployment of artificial Reef Blocks in 1997 (C. Konig, personal communication) and poachers using bottom

trawls were caught in the area of these reefs in early 2000; shrimp, bottom fish, lobster and even *Oculina varicosa* coral were confiscated by NMFS.

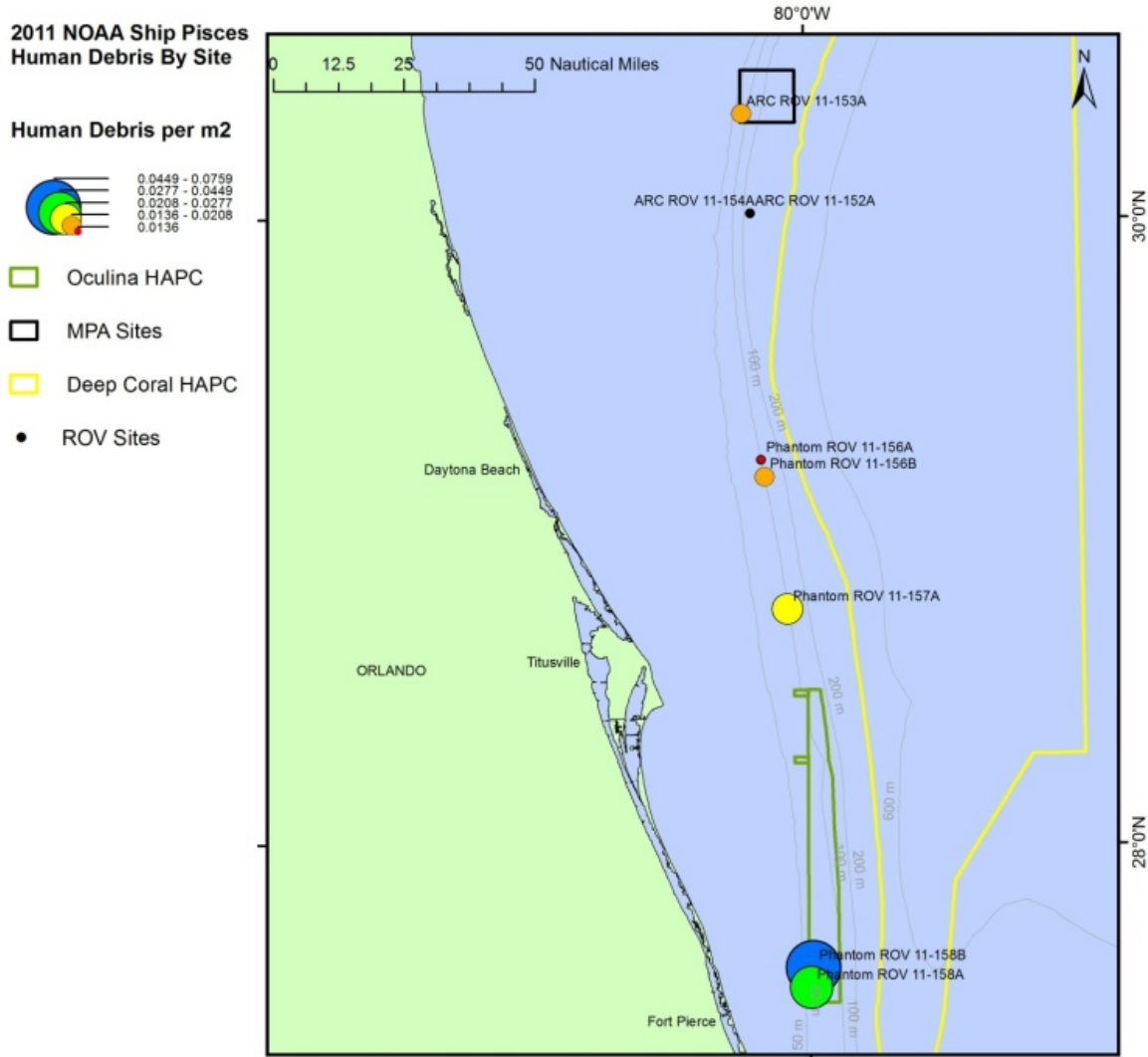


Figure 4. Plot of human debris at each ROV dive site during the 2011 NOAA Ship *Pisces* cruise. Numbers indicate number of points calculated from density analysis of digital images from the quantitative photo transects.

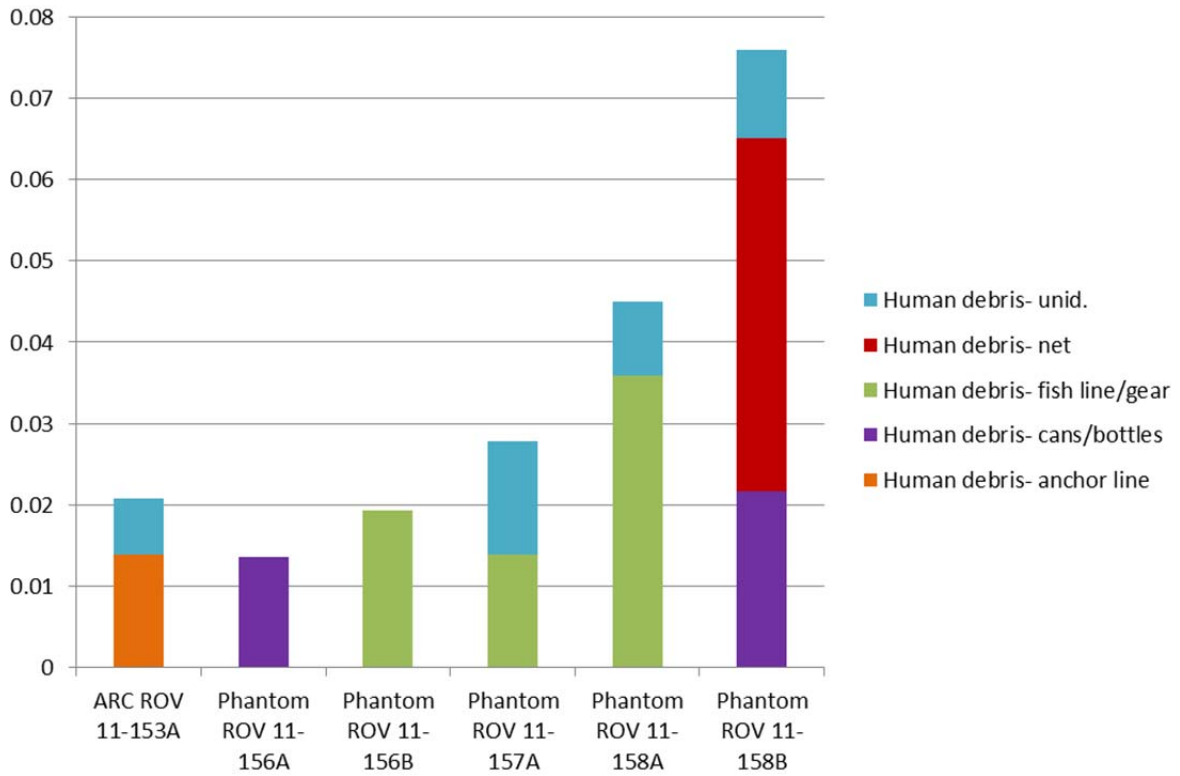


Figure 5. Graph of distribution of human debris at the ROV dive sites based on density ($\#/m^2$) from the quantitative photo transects.

FISH POPULATIONS ANALYSIS (Andy David, Stacey Harter)

Methods

Video transects were used to analyze the fish populations and densities. Protocol for the fish analyses was to divide the continuous video into 5 minute segments, or whenever there was a change in habitat type, whichever came first, so each video segment only contained one habitat type (see Methods for details). These were also correlated with the habitat types used for the benthic analyses. All fish were identified for each ROV dive to species level and counted. The total distance (km) of each dive was used to calculate the density (# individuals/km) of each fish species. A species list and densities are listed for each dive in the attached SEADESC II Report (Appendix 2).

Eight ROV dives were used in this fish analysis. Dives 152A and 161A were too short to be included in the analysis. Three reef types were examined on this cruise. One dive was on the shelf-edge North Florida MPA site (Dive 153A), five dives were made on the deepwater *Oculina* coral reefs (3 outside the OHAPC and 2 inside the OHAPC; Dives 156A to 158B), and 2 deep dives (200 m *Lophelia* coral mound site- Dive 154A, and Miami Terrace CHAPC- Dive 160A).

The dives on deepwater *Oculina* coral habitat were further analyzed to compare sites within the *Oculina* HAPC and the newly discovered *Oculina* reef sites outside of the OHAPC boundaries. A one-way ANOVA was run for each of the major managed species (amberjack, *Centropristes* spp., scamp, and snowy grouper) to test for differences in densities within and outside of the OHAPC. In addition, all fish species were counted and analyzed for each dive site. These are grouped by reef type (shelf edge MPA site, *Oculina* sites, and deep sites). Then each reef type was analyzed with PRIMER to show differences within the various habitat types (e.g., sand, rock pavement, ledges, coral) of each particular reef type.

Essential Fish Habitat

A total of 1196 grouper and snapper were observed in both the shelf-edge and *Oculina* reef types (1150 of these were vermilion snapper). No snapper or grouper were observed on the deep reefs (*Lophelia* site and CHAPC site). The following is a breakdown of species observed by reef type and inside vs. outside the *Oculina* HAPC. Scamp was the most abundant grouper and they were more abundant inside the *Oculina* HAPC compared to outside. Snowy grouper, however, were more abundant outside the *Oculina* HAPC.

Table 5. Managed fish species at North Florida MPA and deepwater *Oculina* coral reef sites.

<u>Shelf-Edge</u>		<u>Oculina</u>			
		<u>Outside OHAPC</u>		<u>Inside OHAPC</u>	
vermilion snapper	1149	scamp	17	scamp	23
scamp	16	snowy grouper	14	snowy grouper	2
snowy grouper	3			gag grouper	1
snapper - <i>Lutjanus</i>	1			vermilion snapper	1

Table 6. Densities of managed fish species for each dive site and ANOVA comparisons of species within and outside the Oculina HAPC.

****Numbers Inside the Table Represent Densities (#/km)**

These are all of the managed species observed on this cruise. No managed species were observed on the 2 deep dives.

Dive	amberjack - mix of greater and almaco jacks	Centropristis sp. - mix of black and bank sea bass	gag grouper	grey triggerfish	hogfish	red porgy	scamp	snowy grouper	tomtate	vermilion snapper	Reef Type	HAPC
1	2.7	17.8	0	1.1	0.8	23.9	2.6	0.5	96.2	185.7	Shelf-Edge	
3	1.6	373.6	0	0	0	1.6	6.3	0.8	0	0	Oculina	Outside
4	0.7	38.9	0	0	0	0	0	0.7	0	0	Oculina	Outside
5	4.8	707.8	0	0	0	4.8	0.8	2.9	0	0	Oculina	Outside
6	2.9	38.1	0.6	0	0	0	12.7	1.2	0	0	Oculina	Inside
7	0.5	70.1	0	0	0	0	1.6	0	0	0	Oculina	Inside

ANOVAs were run to test for differences in densities inside vs. outside the Oculina HAPC for amberjack, Centropristis sp., scamp, and snowy grouper

Amberjack

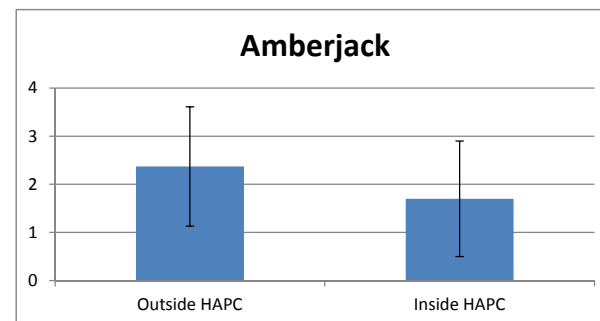
Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Outside HAPC	3	7.1	2.366666667	4.64333333
Inside HAPC	2	3.4	1.7	2.88

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.533333333	1	0.533333333	0.1315068	0.7409177	10.12796
Within Groups	12.16666667	3	4.055555556			
Total	12.7	4				



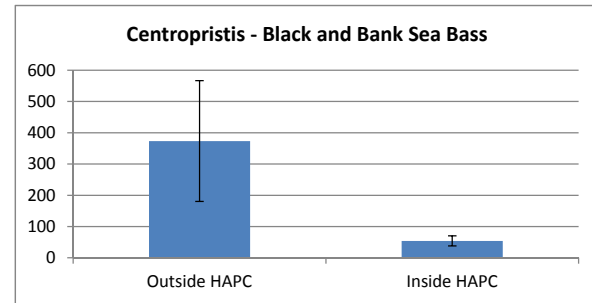
Centropristis sp. Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Outside HAPC	3	1120.3	373.4333333	111856.82
Inside HAPC	2	108.2	54.1	512

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	122368.5333	1	122368.5333	1.637215	0.2906926	10.12796
Within Groups	224225.6467	3	74741.88222			
Total	346594.18	4				



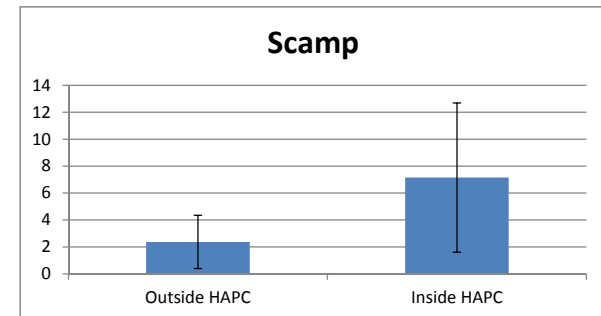
Scamp Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Outside HAPC	3	7.1	2.366666667	11.763333
Inside HAPC	2	14.3	7.15	61.605

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	27.45633333	1	27.45633333	0.9675483	0.3978224	10.12796
Within Groups	85.13166667	3	28.37722222			
Total	112.588	4				



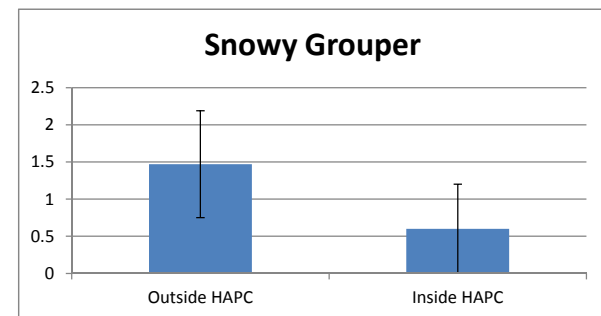
Snowy Grouper Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Outside HAPC	3	4.4	1.466666667	1.5433333
Inside HAPC	2	1.2	0.6	0.72

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.901333333	1	0.901333333	0.7103327	0.4612231	10.12796
Within Groups	3.806666667	3	1.268888889			
Total	4.708	4				



Fish Community Analyses

PRIMER was used to analyze fish assemblages from all hardbottom transects by reef type. A non-metric multi-dimensional scaling (MDS) ordination of ROV transects was constructed from a Bray-Curtis similarity matrix of presence/absence data for all fish species.

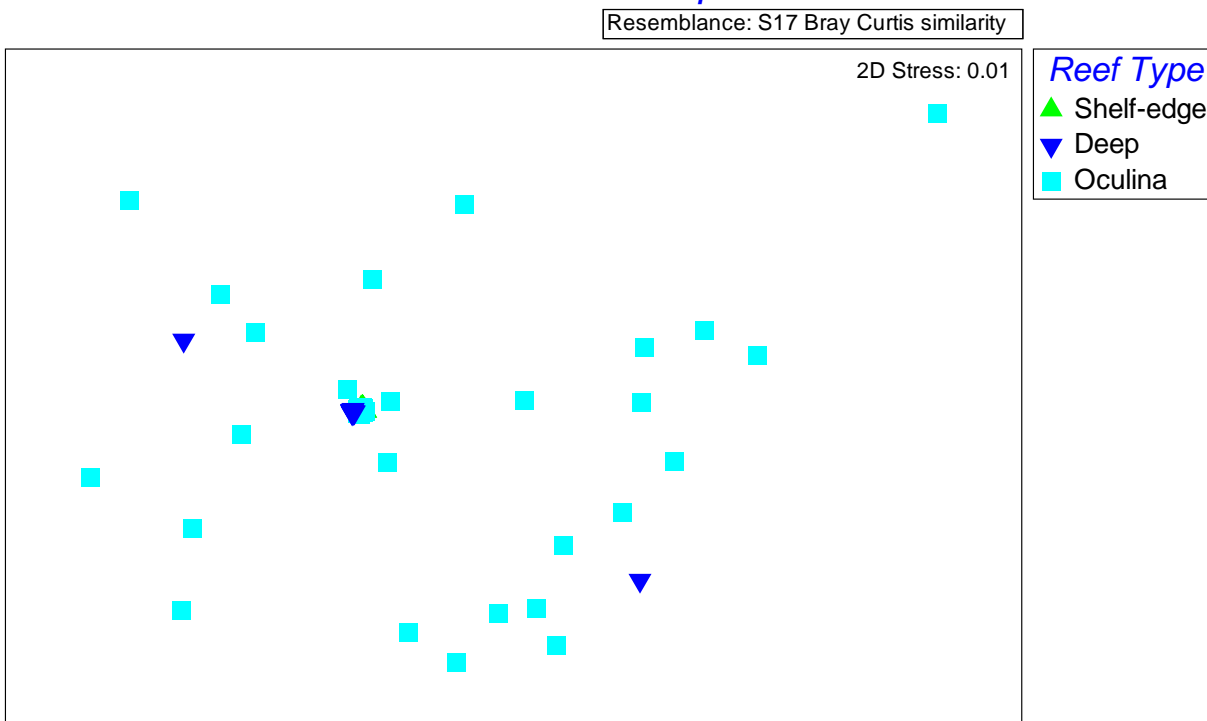
Table 7. Species list of all fish taxa at each reef site from 2011 *Pisces* cruise.

Common Name	Species Name	Shelf-edge	Oculina	Deep
almaco jack	<i>Seriola rivoliana</i>	X	X	
amberjack	<i>Seriola</i> sp.	X	X	
anthiid	<i>Anthias</i> sp.			X
anthiid	Anthiinae		X	X
apricot bass	<i>Plectranthias garrupellus</i>		X	
bandtail puffer	<i>Sphoeroides spengleri</i>	X		
bank butterflyfish	<i>Chaetodon aya</i>	X	X	
bank sea bass	<i>Centropristis ocyurus</i>	X	X	
barracuda	<i>Sphyaena barracuda</i>	X		
batfish	<i>Ogcocephalus</i> sp.		X	
beardfish	<i>Polymixia</i> sp.			X
belted sand bass	<i>Serranus subligarius</i>		X	
bigeye	<i>Priacanthus arenatus</i>	X		
black sea bass	<i>Centropristis striata</i>		X	
blackbar drum	<i>Pareques iwamotoi</i>		X	
blackbar soldierfish	<i>Myripristis jacobus</i>	X		
blackbelly rosefish	<i>Helicolenus dactylopterus</i>			X
blue angelfish	<i>Holacanthus bermudensis</i>	X	X	
cardinalfish	<i>Apogon</i> sp.	X		
catshark	<i>Scyliorhinus</i> sp.			X
chain catshark	<i>Scyliorhinus retifer</i>			X
conger eel	<i>Conger</i> sp.		X	
creole-fish	<i>Paranthias furcifer</i>	X		
cubbyu	<i>Equetus umbrosus</i>	X	X	
cusk eel	Ophidiidae		X	
deepwater flounder	<i>Monolene sessilicauda</i>			X
flounder	Bothidae		X	
gag grouper	<i>Mycteroperca microlepis</i>		X	
greater amberjack	<i>Seriola dumerili</i>	X	X	
grey triggerfish	<i>Balistes capriscus</i>	X		
hake	Phycidae			X
hogfish	<i>Lachnolaimus maximus</i>	X		
lionfish	<i>Pterois volitans</i>	X		
lizardfish	<i>Synodus</i> sp.		X	

longnose batfish	<i>Ogcocephalus corniger</i>		X	
mora	<i>Laemonema melanurum</i>			X
mora	<i>Laemonema sp.</i>			X
moray eel	Muraenidae		X	
ocellated moray	<i>Gymnothorax saxicola</i>		X	
orangeback bass	<i>Serranus annularis</i>	X	X	
porcupinefish	<i>Didon hystrix</i>		X	
purple reeffish	<i>Chromis scotti</i>	X	X	
red barbier	<i>Hemanthias vivanus</i>		X	
red hogfish	<i>Decodon puellaris</i>		X	
red porgy	<i>Pagus pagrus</i>	X	X	
reef butterflyfish	<i>Chaetodon sedentarius</i>	X		
reticulate moray eel	<i>Muraena retifera</i>		X	
	<i>Pronotogrammus</i>			
rough tongue bass	<i>martinicensis</i>	X	X	
saddle bass	<i>Serranus notospilus</i>		X	
sand diver	<i>Synodus intermedius</i>	X	X	
sand tilefish	<i>Malacanthus plumieri</i>	X		
scamp	<i>Mycteroperca phenax</i>	X	X	
scorpionfish	Scorpaenidae	X	X	
scrawled cowfish	<i>Lactophrys quadricornis</i>	X		
sea bass	<i>Centropristis sp.</i>		X	
searobin	Triglidae		X	
sharpnose puffer	<i>Canthigaster rostrata</i>	X		
short bigeye	<i>Pristigenys alta</i>	X	X	
shortbeard codling	<i>Laemonema barbatulum</i>			X
shortnose greeneye	<i>Chlorophthalmus agassiz</i>			X
snake eel	Ophichthidae		X	
snapper	<i>Lutjanus sp.</i>	X		
snowy grouper	<i>Epinephelus niveatus</i>	X	X	
soldierfish	Holocentridae	X	X	
spotfin butterflyfish	<i>Chaetodon ocellatus</i>	X		
spotfin hogfish	<i>Bodianus pulchellus</i>	X		
spotted hake	<i>Urophycis regius</i>			X
squirrelfish	Holocentridae	X		
sunshinefish	<i>Chromis insolatus</i>	X		
swallowtail bass	<i>Anthias woodsi</i>			X
tattler	<i>Serranus phoebe</i>	X	X	
tilefish	<i>Caulolatilus sp.</i>		X	
toadfish	<i>Opsanus sp.</i>		X	
tomtate	<i>Haemulon aurolineatum</i>	X		
trunkfish	<i>Lactophrys sp.</i>	X		
twospot cardinalfish	<i>Apogon pseudomaculatus</i>	X		

vermilion snapper	<i>Rhomboplites aurorubens</i>	X	X
wrasse	<i>Halichoeres</i> sp.	X	X
wrasse bass	<i>Liopropoma eukrines</i>	X	X
yellowtail reeffish	<i>Chromis enchrysurus</i>	X	X

2011 Pisces Deep Coral



The shelf-edge transects (green triangle) are not visible on this MDS plot, but they are all located beneath the middle of the deep reef transects. The low stress value indicates that there is very good graphical representation of the data (the points aren't randomly put on the map), however it is apparent there is a lot of variability among the *Oculina* transects as well as a considerable amount among the deep reef transects.

ANOSIM (Analysis of Similarity) was used to test for differences among the reef types and the results from the MDS were made clearer. There are some differences in fish assemblages among reef types.

One-Way Analysis

Factor Values

- Factor: Reef Type
- Shelf-edge
- Deep
- Oculina

Global Test

Sample statistic (Global R): 0.216

Significance level of sample statistic: 0.1%

Number of permutations: 999 (Random sample from a large number)

Number of permuted statistics greater than or equal to Global R: 0

Pairwise Tests

Groups	R Number >= Statistic	Significance Level %	Possible Permutations	Actual Permutations	
Observed					
Shelf-edge, Deep	0.928	0.1	Very large	999	0
Shelf-edge, <i>Oculina</i>	0.063	4.5	Very large	999	44
Deep, <i>Oculina</i>	0.452	0.1	Very large	999	0

While the overall R value is fairly low (0.216), R values among a couple of the pairwise comparisons are quite high. There are obviously some differences in fish assemblages between the deep reefs and both the shelf-edge (R = 0.928) and *Oculina* reefs (0.452).

SIMPER (Similarity Percentages) analysis was used to see what fish species were responsible for those differences. The deep reef transects had a completely different fish species list from the other two reef types. They did not even have 1 fish species in common (average dissimilarity = 100.00, the highest it can be).

Deepwater *Oculina* Reef Dives (Dives 156A, 156B, 157A, 158A, and 158B)

Transects for these dives were divided between “on mound” and “in between mound” habitats. Habitats that were found on the mounds were rubble, rock outcrop, and live & standing dead *Oculina*. Habitats that were found in between the mounds (or “off mound”) were sand, pavement, rubble, and low relief outcrops (<1 m relief).

PRIMER was used to analyze fish assemblages from hardbottom transects to look for differences on vs. off mound. A non-metric multi-dimensional scaling (MDS) ordination of ROV transects was constructed from a Bray-Curtis similarity matrix of presence/absence data for all fish species, however no significant differences were noted. An ANOSIM was also run to confirm this. These analyses were run with presence/absence data. It is possible that if abundance or density data were used instead, there may be some significant differences between fish assemblages on and off mounds.

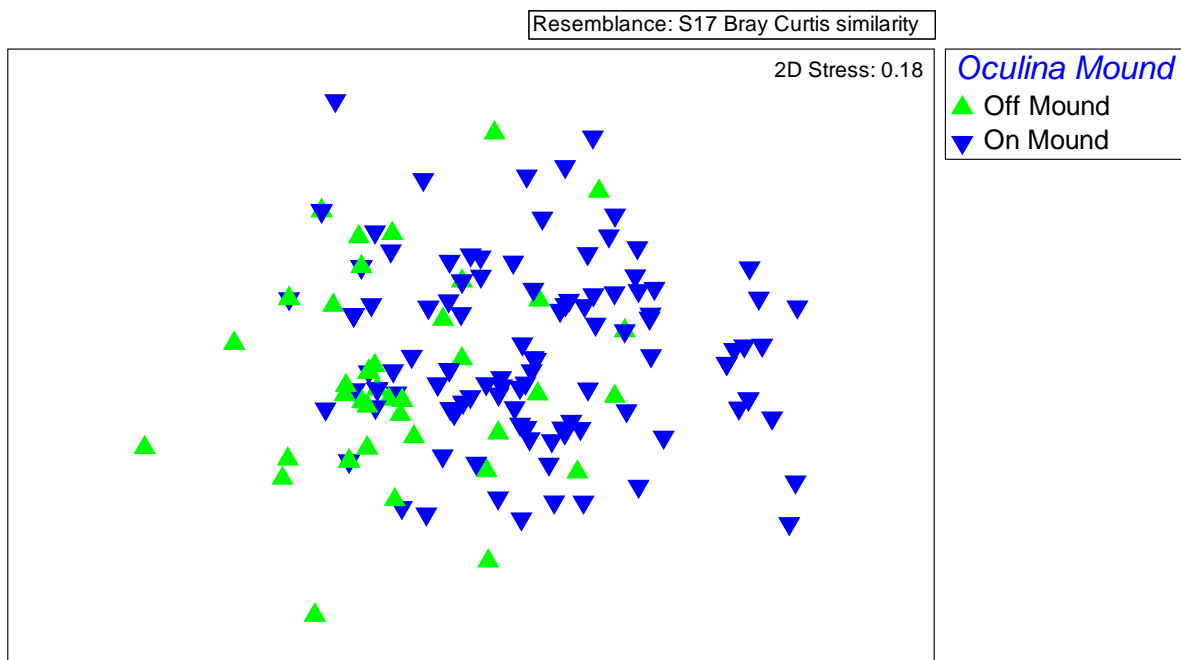
Table 8. Comparison of fish taxa at various habitat types within the *Oculina* reef ecosystem.

Common Name	Species Name	On Mound			In Between Mounds			
		rubble	rock outcrop	live & standing dead <i>Oculina</i>	sand	pavement	rubble	low relief outcrops
amberjack	<i>Seriola</i> sp.	X		X				
anthiid	Anthiinae	X		X	X	X		

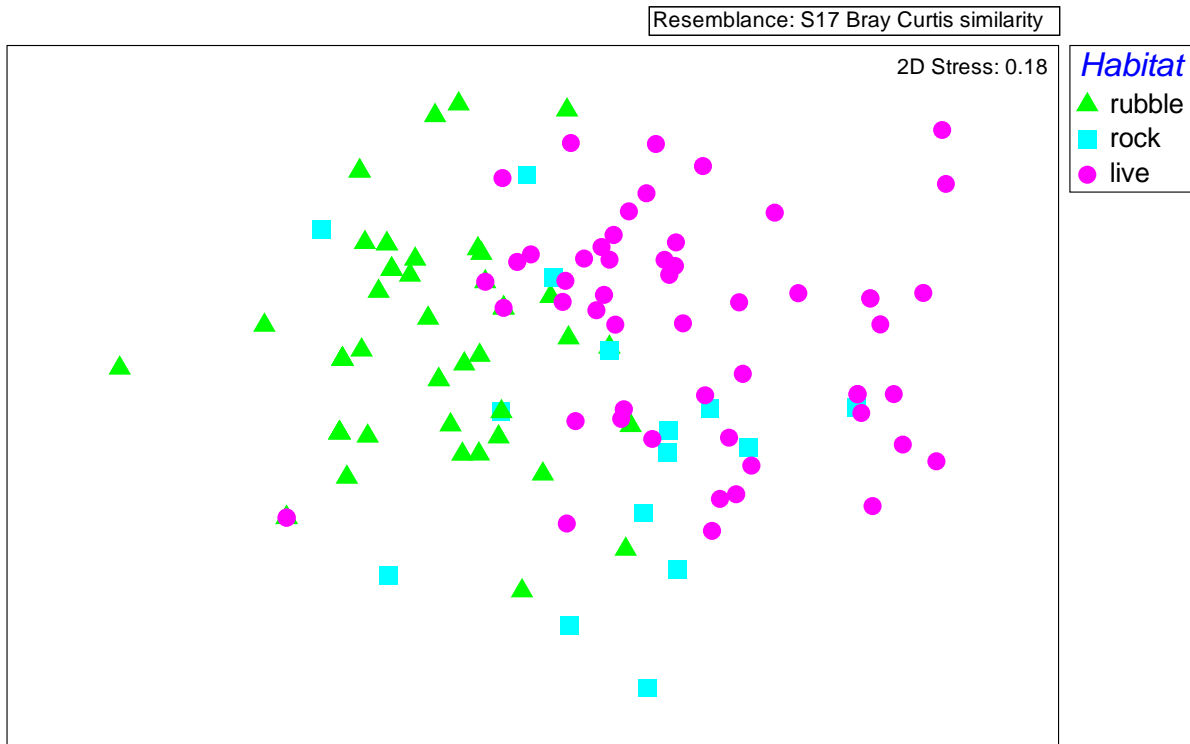
apricot bass	<i>Plectranthias garrupellus</i>	X		X				
bank butterflyfish	<i>Chaetodon aya</i>	X	X	X		X	X	X
bank sea bass	<i>Centropristis ocyurus</i>	X	X	X	X	X	X	X
batfish	<i>Ogcocephalus</i> sp.	X			X		X	
belted sand bass	<i>Serranus subligarius</i>			X				
black sea bass	<i>Centropristis striata</i>	X	X	X	X	X	X	X
blackbar drum	<i>Pareques iwamotoi</i>							X
blue angelfish	<i>Holacanthus bermudensis</i>	X	X	X				
conger eel	<i>Conger</i> sp.		X					
cusk eel	Ophidiidae		X					
flounder	Bothidae				X			
gag grouper	<i>Mycteroperca microlepis</i>			X				
greater amberjack	<i>Seriola dumerili</i>			X	X			
lizardfish	<i>Syndodus</i> sp.			X				
longnose batfish	<i>Ogcocephalus corniger</i>				X			
moray eel	Muraenidae	X		X				
ocellated moray	<i>Gymnothorax saxicola</i>						X	
orangeback bass	<i>Serranus annularis</i>			X				
porcupinefish	<i>Diodon hystrix</i>			X				
purple reeffish	<i>Chromis scotti</i>			X				
red barbier	<i>Hemanthias vivanus</i>		X	X				X
red hogfish	<i>Decodon puellaris</i>		X	X		X		X
red porgy	<i>Pagrus pagrus</i>	X	X		X		X	X
reticulate moray	<i>Muraena retifera</i>			X				
roughtongue bass	<i>Pronotogrammus martinicensis</i>	X	X	X		X	X	X
saddle bass	<i>Serranus notospilus</i>		X		X	X	X	
sand diver	<i>Synodus intermedius</i>			X	X			
scamp	<i>Mycteroperca phenax</i>	X	X	X			X	X

scorpionfish	Scorpaenidae	X	X	X			X	X
sea bass	<i>Centropristis</i> sp.	X	X	X		X	X	X
searobin	Triglidae				X			
sea bass	<i>Serranus</i> sp.			X	X			
short bigeye	<i>Pristigenys alta</i>		X	X		X	X	X
snake eel	Ophichthidae				X			
snowy grouper	<i>Epinephelus niveatus</i>		X	X		X	X	X
soldierfish	Holocentridae			X				
tattler	<i>Serranus phoebe</i>	X	X	X	X	X	X	X
tilefish	<i>Caulolatilus</i> sp.				X			
toadfish	<i>Opsanus</i> sp.		X			X		
wrasse	<i>Halichoeres</i> sp.	X	X	X			X	
wrasse bass	<i>Liopropoma eukrines</i>		X	X		X	X	X
yellowtail reeffish	<i>Chromis enchrysurus</i>	X		X			X	X

Oculina Transects



Oculina Transects



“On mound” and “off mound” transects were compared to determine whether there were any differences in fish assemblages among habitat types. There were no differences among the habitat types found in between mounds, but there were some among “on mound” habitats.

ANOSIM – Oculina On Mound
Analysis of Similarities

One-Way Analysis

Factor Values

Factor: Habitat

rubble

rock

live

Global Test

Sample statistic (Global R): 0.392

Significance level of sample statistic: 0.1%

Number of permutations: 999 (Random sample from a large number)

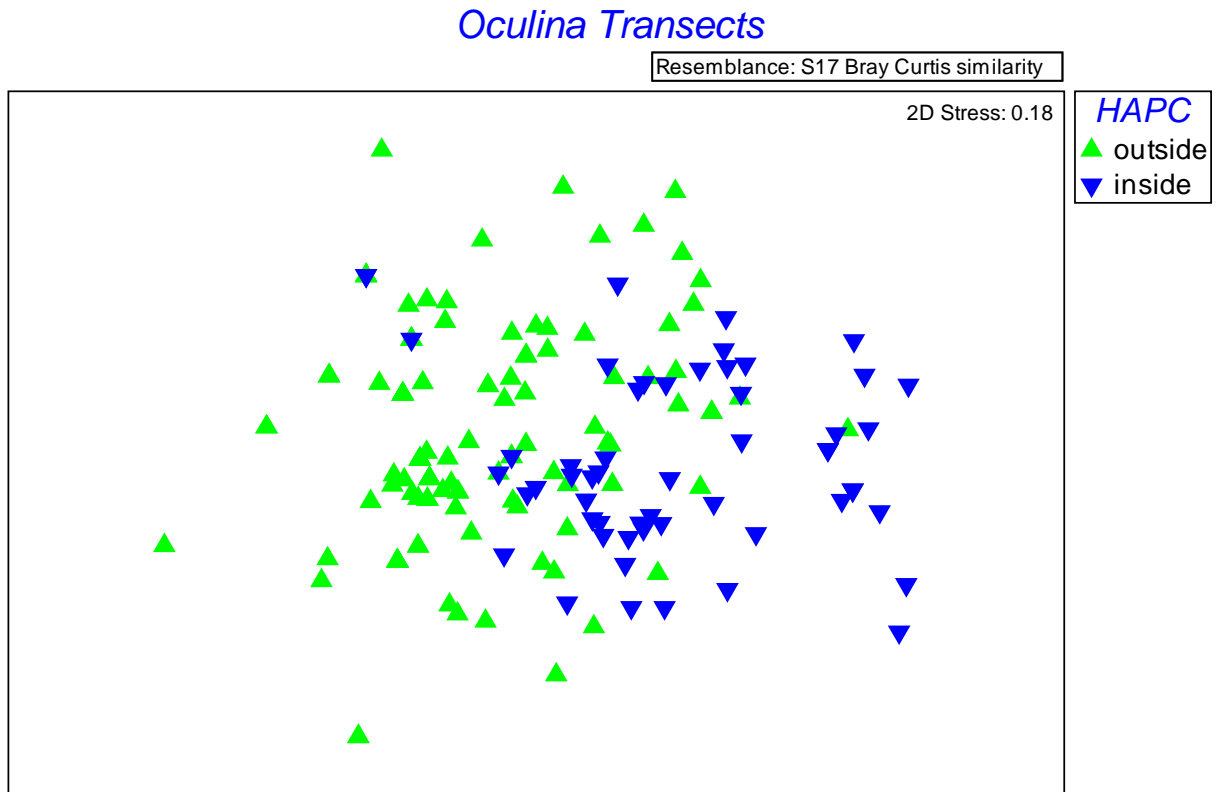
Number of permuted statistics greater than or equal to Global R: 0

Pairwise Tests

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
rubble, rock	0.506	0.1	Very large	999	0
rubble, live	0.425	0.1	Very large	999	0
rock, live	0.16	2	Very large	999	0

In particular, it appears fish assemblages were different on rubble habitat compared to both rock outcrops, and live/standing dead *Oculina*. SIMPER analyses demonstrated that these differences were due to higher abundances of anthiids, bank butterflyfish, and scamp on rock or live/standing dead *Oculina* compared to rubble as well as higher abundances of black and bank sea bass on rubble.

The following compares the fish assemblages inside and outside the *Oculina* HAPC.



ANOSIM – *Oculina* Inside vs. Outside HAPC
Analysis of Similarities
One-Way Analysis

Factor Values
Factor: HAPC
outside
inside

Global Test

Sample statistic (Global R): 0.321

Significance level of sample statistic: 0.1%

Number of permutations: 999 (Random sample from a large number)

Number of permuted statistics greater than or equal to Global R: 0

The MDS plot and ANOSIM demonstrate there may be some differences in fish assemblages inside and outside the OHAPC. SIMPER analyses indicate that these difference are primarily due to higher abundances of anthiids, bank butterflyfish, and scamp inside the OHAPC while bank sea bass and black sea bass are more abundant outside the OHAPC.

On one dive (158B), the ROV crossed over several of artificial reef blocks (concrete reef blocks deployed in the late 1990s by Chris Koenig). Several of these had new growth of *Oculina* coral colonies. Fish species that were found on the reef blocks include: bank butterflyfish, blue angelfish, cubbyu, reticulate moray eel, scamp, short bigeye, vermilion snapper, and yellowtail reeffish.

Shelf-Edge Reef Dive (North Florida MPA Site, Dive 153A)

Five habitat types were identified from the shelf-edge dive. Sand, pavement (flat but with obvious signs of hardbottom, sometimes cracks/crevices are present), low relief outcrops (rock outcrops < 1 m relief), moderate relief outcrops (rock outcrops between 1 and 3m relief), high relief ledge (rock outcrops >3 m relief).

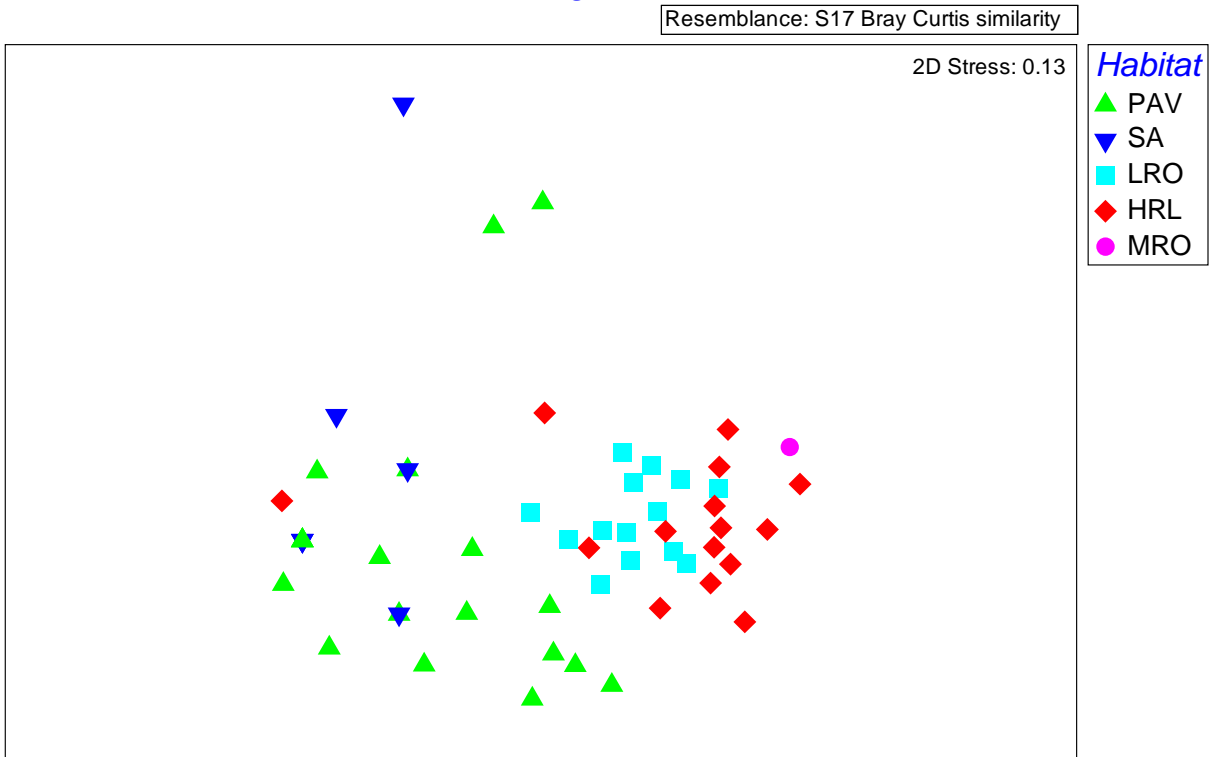
PRIMER was used to analyze fish assemblages from all shelf-edge transects by habitat type. A non-metric multi-dimensional scaling (MDS) ordination of ROV transects was constructed from a Bray-Curtis similarity matrix of presence/absence data for all fish species.

Table 9. Comparison of fish taxa at various habitat types within N. Florida MPA site.

Common Name	Species Name	Sand	Pavement	Low relief outcrops	Moderate relief outcrops	High relief ledge
almaco jack	<i>Seriola rivoliana</i>	X		X		
amberjack	<i>Seriola</i> sp.		X	X	X	
bandtail puffer	<i>Sphoeroides spengleri</i>					X
bank butterflyfish	<i>Chaetodon aya</i>			X		X
bank sea bass	<i>Centropristis ocyurus</i>		X	X		X
barracuda	<i>Sphyraena barracuda</i>		X			
bigeye	<i>Priacanthus arenatus</i>		X			X
blackbar soldierfish	<i>Myripristis jacobus</i>			X		X
blue angelfish	<i>Holacanthus bermudensis</i>		X	X	X	X
cardinalfish	<i>Apogon</i> sp.		X	X		
creole-fish	<i>Paranthias furcifer</i>				X	

cubbyu	<i>Equetus umbrosus</i>			X	X	X
greater amberjack	<i>Seriola dumerili</i>	X		X		X
grey triggerfish	<i>Balistes capriscus</i>		X			X
hogfish	<i>Lachnolaimus maximus</i>			X		
lionfish	<i>Pterois volitans</i>			X	X	X
orangeback bass	<i>Serranus annularis</i>					X
purple reeffish	<i>Chromis scotti</i>			X	X	X
red porgy	<i>Pagrus pagrus</i>		X	X	X	X
reef butterflyfish	<i>Chaetodon sedentarius</i>		X	X	X	X
	<i>Pronotogrammus</i>					
rougtongue bass	<i>martinicensis</i>			X		
sand diver	<i>Synodus intermedius</i>		X			
sand tilefish	<i>Malacanthus plumieri</i>		X			
scamp	<i>Mycteroperca phenax</i>			X	X	X
scorpionfish	Scorpaenidae				X	
scrawled cowfish	<i>Lactophrys quadricornis</i>					X
sharpnose puffer	<i>Canthigaster rostrata</i>			X	X	X
short bigeye	<i>Pristigenys alta</i>	X	X	X		
snapper	<i>Lutjanus sp.</i>			X		
snowy grouper	<i>Epinephelus niveatus</i>					X
soldierfish	Holocentridae				X	
spotfin butterflyfish	<i>Chaetodon ocellatus</i>					X
spotfin hogfish	<i>Bodianus pulchellus</i>			X	X	X
squirrelfish	<i>Holocentrus adscensionis</i>		X	X	X	X
squirrelfish	<i>Holocentrus sp.</i>			X		X
sunshinefish	<i>Chromis insolatus</i>			X		X
tattler	<i>Serranus phoebe</i>	X	X	X		X
tomtate	<i>Haemulon aurolineatum</i>			X	X	X
trunkfish	<i>Lactophrys sp.</i>		X	X		
twospot						
cardinalfish	<i>Apogon pseudomaculatus</i>		X			
vermilion snapper	<i>Haemulon aurolineatum</i>		X	X	X	X
wrasse	<i>Halichoeres sp.</i>	X	X	X	X	X
wrasse bass	<i>Liopropoma eukrines</i>			X		X
yellowtail reeffish	<i>Chromis enchrysurus</i>	X	X	X		X

Shelf-edge Transects



The stress value on this MDS plot is slightly higher than is ideal, but it shows there are some distinct fish assemblages. High relief ledge, moderate relief outcrops, and low relief outcrops are all spatially separate from sand and pavement transects indicating there may be differences in the fish assemblages between those habitat types. The same holds true for low relief outcrops and moderate relief outcrops.

An ANOSIM was run on this data and these differences in fish assemblages were confirmed.

ANOSIM – Shelf-Edge
Analysis of Similarities

One-Way Analysis

Factor Values

Factor: Habitat

PAV

SA

LRO

HRL

MRO

Global Test

Sample statistic (Global R): 0.434

Significance level of sample statistic: 0.1%

Number of permutations: 999 (Random sample from a large number)
 Number of permuted statistics greater than or equal to Global R: 0

Pairwise Tests

Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
PAV, SA	-0.03	56.4	888030	999	563
PAV, LRO	0.5	0.1	Very large	999	0
PAV, HRL	0.523	0.1	Very large	999	0
PAV, MRO	0.734	4.8	21	21	1
SA, LRO	0.899	0.1	116280	999	0
SA, HRL	0.737	0.1	170544	999	0
SA, MRO	0.66	12.5	8	8	1
LRO, HRL	0.241	0.1	77558760	999	0
LRO, MRO	0.765	6.7	15	15	1
HRL, MRO	-0.041	43.8	16	16	7

The Global R (0.434) is probably high enough to indicate some significant differences among habitat types. Differences in fish communities are probably evident in those habitats where pairwise tests displayed $R \geq 0.5$. SIMPER analysis to see what fish species were responsible for those differences.

Deep Reef Dives (*Lophelia*- Dive 154A; Miami Terrace CHAPC- Dive 160A)

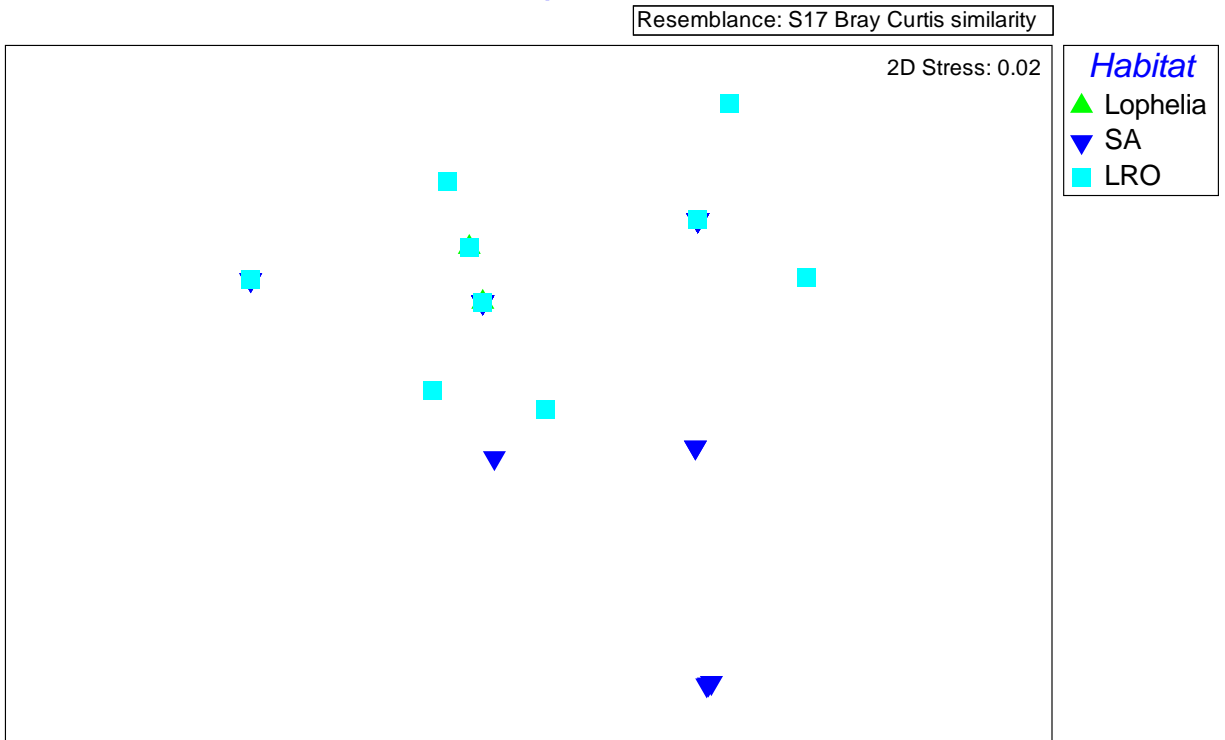
Three habitat types were identified from the deep dives. Sand, low relief outcrops (rock outcrops <1m relief), and live *Lophelia*. PRIMER was used to analyze fish assemblages from all deep transects by habitat type. A non-metric multi-dimensional scaling (MDS) ordination of ROV transects was constructed from a Bray-Curtis similarity matrix of presence/absence data for all fish species, however no significant differences were noted. An ANOSIM was also run to confirm this.

Table 10. Comparison of fish taxa at various habitat types within the deepwater reef sites.

Common Name	Species Name	Sand	Low Relief	
			Rock Outcrops	<i>Lophelia</i>
anthiid	<i>Anthias</i> sp.		X	
anthiid	Anthiinae			X
beardfish	<i>Polymixia</i> sp.		X	
	<i>Helicolenus</i>			
blackbelly rosefish	<i>dactylopterus</i>	X	X	X
catshark	<i>Scyliorhinus</i> sp.		X	
chain catshark	<i>Scyliorhinus retifer</i>	X		
deepwater flounder	<i>Monolene sessilicauda</i>	X	X	
hake	Phycidae	X	X	
mora	<i>Laemonema</i>		X	

	<i>melanurum</i>			
mora	<i>Laemonema</i> sp.	X	X	X
	<i>Laemonema</i>			
shortbeard codling	<i>barbatulum</i>	X	X	X
	<i>Chlorophthalmus</i>			
shortnose greeneye	<i>agassiz</i>		X	
spotted hake	<i>Urophycis regius</i>	X	X	
swallowtail bass	<i>Anthias woodsi</i>		X	

Deep Transects



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APPENDIX 1

Species List and Density of Benthic Macro-Biota

Appendix 1 lists all of the benthic macro-invertebrates and algae that were identified and counted from the quantitative photo transects for each dive. Density of each species (# organisms/m²) was calculated based on the area of each digital image from the photo transects.

Density Phylum/Class/Order/Scientific Name	Site										Total
	11-152A	11-153A	11-154A	11-156A	11-156B	11-157A	11-158A	11-158B	11-160A	11-161A	
Porifera		6.14	0.13	2.31	2.07	1.73	34.16	9.87	3.66	2.76	62.83
Demospongiae		6.13	0.13	2.31	2.07	1.73	34.16	9.87	1.70	2.76	60.86
Astrophorida							29.39	6.37	0.27	0.11	36.14
Astrophorida									0.19		0.19
Astrophorida- fan									0.07	0.11	0.18
Erylus sp.							26.66	5.57			32.22
Geodia- flat top							1.82	0.37			2.19
Geodia- flat top red							0.23	0.16			0.40
Geodia- flat top yellow							0.57	0.26			0.84
Geodia sp.							0.03	0.01	0.01		0.04
Geodia sp.- tan sp ap pore							0.07				0.07
Pachastrellidae									0.01		0.01
Chondrosida					0.73	0.24	0.03				1.00
Chondrosia sp.					0.73	0.24	0.03				1.00
Dictyoceratida		0.43		0.03	0.02				0.01		0.48
Dictyoceratida		0.05									0.05
Ircinia campana		0.09		0.01							0.10
Ircinia felix				0.01							0.01
Ircinia sp.		0.28			0.02				0.01		0.31
Ircinia strobilina		0.01									0.01
Hadromerida		2.71		1.23	0.12		3.15	2.76			9.96
Cliona sp.		0.01									0.01
Placospongia sp.		0.04									0.04
Spirastrellidae		2.66		1.23	0.12		3.15	2.76			9.91
Halichondrida									0.07		0.07
Phakellia sp.									0.07		0.07
Haplosclerida		0.03							0.15		0.18
Haplosclerida		0.03									0.03
Oceanapia sp.									0.07		0.07
Petrosia sp.									0.07		0.07
Lithistida									0.10		0.10
Lithistida									0.10		0.10
Poecilosclerida		0.03					0.24	0.04	0.01	2.43	2.76
Clathria sp.		0.02									0.02
Hymedesmia sp.- blue morph										0.33	0.33
Hymedesmia sp.- yellow morph									0.01		0.01
Poecilosclerida		0.01					0.24	0.04			0.30
Raspailiidae- fan mesh										2.10	2.10
Spirophorida		0.01									0.01
Cinachyra sp.		0.01									0.01
Verongida		0.02					0.02				0.04
Aplysina sp.		0.01					0.02				0.03
Verongida		0.01									0.01
Demospongiae		2.89	0.13	1.05	1.20	1.50	1.33	0.71	1.09	0.22	10.12
Demospongiae		2.74	0.13	1.05	1.20	1.42	1.14	0.68	1.09	0.22	9.67
Demospongiae- am white							0.05	0.02			0.08
Demospongiae- orange sphere						0.08					0.08
Demospongiae- tan starlet thick encrusting		0.15									0.15
Demospongiae- thin curtain									0.01		0.01
Demospongiae- ye brain		0.01									0.01
Demospongiae- ye lobate							0.13				0.13
Hexactinellida									1.96		1.96
Hexactinosida									0.61		0.61
Aphrocallistes beatrix									0.03		0.03
Farrea sp.									0.58		0.58
Lyssacinosisida									0.06		0.06
Hertwigia falcifera									0.02		0.02
Nodastrella nodastrella									0.01		0.01
Vazella pourtalesii									0.04		0.04
Hexactinellida									1.29		1.29
Hexactinellida									1.15		1.15
Hexactinellida- curtain									0.12		0.12
Hexactinellida- fan									0.02		0.02
Homoscleromorpha		0.01									0.01
Homosclerophorida		0.01									0.01
Plakortis sp.		0.01									0.01

Density Phylum/Class/Order/Scientific Name	Site										Total
	11-152A	11-153A	11-154A	11-156A	11-156B	11-157A	11-158A	11-158B	11-160A	11-161A	
Cnidaria		5.37	4.91	10.47	8.11	8.85	22.12	17.24	4.71	5.19	86.99
Anthozoa		3.21	4.80	8.96	6.58	5.98	20.64	16.36	3.23	4.42	74.19
Actiniaria		0.01	1.75	0.37	0.23	1.00	1.29	0.14	0.21	0.77	5.77
Actiniaria		0.01	1.09	0.37	0.23	1.00	0.76	0.14	0.20	0.66	4.46
Actiniaria- mat anemone							0.53				0.53
Actinoscyphia sp.									0.01		0.01
Liponema sp.										0.11	0.11
Sagartiidae			0.66								0.66
Alcyonacea		0.50	1.62	2.36	0.54	0.97	10.72	9.09	1.55	1.77	29.13
Alcyonacea				0.20	0.02	0.01	0.02	0.01	0.16		0.42
Alcyonacea- brown sphere										0.88	0.88
Anthomastus sp.									0.32	0.55	0.87
Callipodium rubens (=Anthopodium rubens)							0.06	0.09			0.15
Capnella sp.									0.10		0.10
Diodogorgia sp.		0.31		0.01			0.57	0.30			1.20
Ellisella barbadensis		0.01									0.01
Ellisellidae		0.01	0.11			0.28		0.01	0.18	0.11	0.69
Eunicella sp.						0.08			0.30		0.39
Gorgonacea (accepted as Alcyonacea)		0.04	0.05	0.01	0.08	0.10	9.76	7.48	0.16	0.11	17.79
Isididae										0.11	0.11
Leptogorgia sp.							0.01				0.01
Muricea sp.		0.05									0.05
Nicella sp.		0.02					0.01	0.01			0.04
Nidalia occidentalis				0.10	0.08	0.32	0.28	1.19	0.01		1.97
Nidalia sp.		0.01									0.01
Paramuricea sp.									0.01		0.01
Plexauridae		0.01									0.01
Plexauridae- purple		0.03									0.03
Plumarella sp.									0.09		0.09
Primnoidae			1.46						0.22		1.68
Telesto sp.		0.01		2.03	0.37	0.18	0.01				2.60
Titanideum frauenfeldii		0.01									0.01
Antipatharia		2.43	0.03	0.11	0.15	0.29	0.34	0.68			4.04
Antipathidae		0.03	0.03	0.01	0.06	0.11	0.03	0.22			0.49
Stichopathes lutkeni				0.05	0.04	0.10	0.27	0.40			0.86
Stichopathes sp.		2.21									2.21
Tanacetipathes hirta		0.19		0.04	0.06	0.08	0.04	0.07			0.49
Ceriantharia			0.03	0.18	0.75	0.68	0.48	0.21			2.32
Cerianthidae			0.03	0.18	0.75	0.68	0.48	0.21			2.32
Corallimorpharia		0.11	0.08	0.29	0.04	0.09	0.09	0.23	0.04		0.87
Corallimorpharia		0.11							0.04		0.14
Corallimorphus sp.				0.08	0.29	0.04	0.09	0.23			0.73
Pennatulacea		0.07									0.07
Virgularia sp.		0.07									0.07
Scleractinia		0.17	1.25	2.68	3.36	1.19	7.31	5.47	0.60	1.88	23.90
Cladocora sp.				1.17	1.04	0.22	0.01				2.45
Lophelia pertusa			0.42						0.10	0.22	0.75
Lophelia- standing dead									0.12		0.12
Madracis myriaster (=Madracis mirabilis)		0.02									0.02
Oculina varicosa				0.14	0.25	0.14	6.12	4.13			10.78
Oculina varicosa- dead standing				0.72	1.83	0.68	1.18	1.22			5.63
Phyllangia americana				0.40	0.02		0.01	0.10			0.52
Scleractinia- unid colonial								0.01	0.06		0.07
Scleractinia- unid cup		0.15	0.82	0.25	0.21	0.15		0.01	0.32	1.66	3.56
Zoanthidea		0.03	0.03	3.18	1.26	1.80	0.40	0.54	0.83		8.08
Palythoa sp.				0.05							0.05
Zoanthidae		0.03	0.03	3.13	1.26	1.80	0.40	0.54	0.83		8.03
Hydrozoa		2.16	0.11	1.52	1.53	2.87	1.48	0.88	1.48	0.77	12.80
Anthoathecata		0.03							1.35	0.66	2.05
Stylasteridae		0.03							1.35	0.66	2.05
Leptothecata						0.60					0.60
Aglaophenia trifida						0.60					0.60
Hydrozoa		2.13	0.11	1.52	1.53	2.28	1.48	0.88	0.13	0.11	10.16
Hydroidolina		2.13	0.11	1.39	1.53	2.28	1.48	0.88	0.13	0.11	10.03
Hydroidolina- long pine				0.12							0.12

Density Phylum/Class/Order/Scientific Name	Site										Total
	11-152A	11-153A	11-154A	11-156A	11-156B	11-157A	11-158A	11-158B	11-160A	11-161A	
Annelida		4.67	0.42	5.26	3.71	6.30	0.06	0.73			21.15
Polychaeta		4.67	0.42	5.26	3.71	6.30	0.06	0.73			21.15
Amphinomida				0.01		0.01		0.01			0.04
Amphinomida				0.01							0.01
Hermodice carunculata						0.01		0.01			0.02
Sabellida		2.45		1.60	1.78	3.12	0.06	0.27			9.29
Filograna sp.		1.61									1.61
Sabellidae		0.74		0.90	1.10	2.97	0.06	0.27			6.04
Serpulidae		0.01		0.70	0.68	0.15					1.53
Spirobranchus giganteus		0.10									0.10
Polychaeta		2.22	0.42	3.65	1.93	3.16		0.44			11.83
Mollusca	0.27	0.02	0.53	0.20	0.23	0.06	0.04	0.02	0.04		1.41
Bivalvia					0.06						0.06
Pectinoida					0.02						0.02
Plicatula gibbosa					0.02						0.02
Bivalvia					0.04						0.04
Cephalopoda			0.05								0.05
Octopoda			0.05								0.05
Gastropoda	0.27	0.02	0.48	0.20	0.17	0.06	0.04	0.02	0.04		1.30
Caenogastropoda				0.11							0.11
Vermicularia knorrii				0.11							0.11
Littorinimorpha							0.04	0.02	0.01		0.06
Cypraea sp.							0.04	0.02			0.06
Cypraeidae									0.01		0.01
Neogastropoda				0.03							0.03
Murex sp.				0.03							0.03
Umbraculida					0.04						0.04
Umbraculum sp.					0.04						0.04
Gastropoda	0.27	0.02	0.48	0.07	0.14	0.06			0.04		1.07
Calliostoma sp.				0.01							0.01
Gastropoda	0.27	0.02	0.48	0.05	0.14	0.06			0.04		1.05
Arthropoda	0.27	0.17	0.45	1.27	1.72	3.25	0.59	0.27	0.05	0.11	8.16
Malacostraca	0.27	0.06	0.45	1.16	1.35	2.98	0.49	0.14	0.05	0.11	7.07
Amphipoda				1.00	0.93	2.78	0.25	0.01			4.96
Corophiidea				1.00	0.93	2.78	0.25	0.01			4.96
Chelicerata								0.05			0.05
Pycnogonida								0.05			0.05
Decapoda	0.27	0.06	0.45	0.16	0.42	0.21	0.23	0.08	0.05	0.11	2.05
Brachyura					0.04						0.04
Cancer sp.			0.05								0.05
Chaceon fenneri			0.03						0.01		0.04
Decapoda				0.01	0.02		0.15	0.02		0.11	0.32
Eumunida sp.			0.19								0.19
Majidae				0.01	0.02	0.01					0.05
Paguroidea		0.04	0.19	0.05	0.33	0.17	0.01		0.04		0.82
Parthenope sp.				0.01							0.01
Rochinia sp.	0.27										0.27
Stenocionops sp.				0.01							0.01
Stenorhynchus seticornis		0.02		0.05	0.02	0.03	0.07	0.05			0.25
Maxillopoda		0.11				0.08					0.19
Maxillopoda		0.11				0.08					0.19
Cirripedia		0.11				0.08					0.19
Pycnogonida				0.11	0.37	0.18	0.11	0.13	0.01		0.90
Pantopoda				0.11	0.37	0.18	0.11	0.13	0.01		0.90
Anoplodactylus lentus				0.11	0.37	0.18	0.11	0.13	0.01		0.90
Bryozoa		0.45		0.05					0.04		0.55
Gymnolaemata		0.03		0.05							0.09
Cheilostomatida		0.03		0.05							0.09
Hippoporidra		0.02		0.05							0.08
Schizoporella sp.		0.01									0.01
Bryozoa		0.42							0.04		0.46

Density Phylum/Class/Order/Scientific Name	Site										Total
	11-152A	11-153A	11-154A	11-156A	11-156B	11-157A	11-158A	11-158B	11-160A	11-161A	
Echinodermata		0.06	0.16	5.28	5.39	5.58	1.19	1.71	1.42	10.83	31.63
Asteroidea		0.01		0.22	0.44	0.22	0.48	1.31	0.02		2.70
Forcipulatida				0.01			0.48	1.09	0.01		1.58
Coronaster briareus									0.01		0.01
Coscinasterias tenuispina				0.01			0.48	1.09			1.57
Valvatida				0.18	0.27	0.12		0.01			0.58
Goniasteridae				0.16	0.27	0.12		0.01			0.57
Narcissia trigonaria				0.01							0.01
Asteroidea		0.01		0.03	0.17	0.10		0.22	0.01		0.53
Asteroidea		0.01		0.01	0.17	0.10		0.18	0.01		0.49
Asteroidea- red spotted				0.01				0.03			0.05
Crinoidea						0.01			0.04	0.22	0.28
Comatulida						0.01			0.04	0.22	0.28
Echinoidea		0.03	0.11	5.02	4.60	5.07	0.06	0.18	0.01	1.22	16.30
Arbacioida				1.31	1.85	2.85	0.04	0.04			6.10
Arbacia punctulata				1.31	1.85	2.85	0.04	0.04			6.10
Arbacioida						0.02					0.02
Coelopleurus floridanus						0.02					0.02
Cidaroida		0.01	0.11	3.60	2.63	2.14	0.01	0.01		1.22	9.72
Cidaroida			0.11		0.14	0.12				1.22	1.58
Eucidaris tribuloides		0.01		3.60	2.49	2.01	0.01	0.01			8.14
Diadematoidea				0.08	0.08	0.08	0.01	0.13			0.38
Centrostephanus longispinus				0.08	0.08	0.08	0.01	0.13			0.38
Echinoidea		0.02		0.03	0.02				0.01		0.07
Holothuroidea		0.01					0.31	0.13			0.45
Aspidochirotida							0.31	0.11			0.42
Holothuria lengtiginosa							0.31	0.10			0.40
Isostichopus badionotus							0.01	0.01			0.02
Dendrochirotida		0.01									0.01
Paraclochirus mysticus		0.01									0.01
Holothuroidea								0.02			0.02
Ophiuroidea		0.01	0.05	0.04	0.35	0.28	0.34	0.09	1.35	9.39	11.90
Euryalida				0.03	0.02	0.06	0.20	0.05			0.35
Asteropora annulata				0.03	0.02	0.06	0.20	0.05			0.35
Ophiurida					0.29	0.22	0.01		0.01		0.53
Ophioderma devaneyi					0.29	0.22					0.51
Ophioderma sp.									0.01		0.01
Ophiothrix sp.							0.01		0.01		0.02
Ophiuroidea		0.01	0.05	0.01	0.04		0.13	0.03	1.34	9.39	11.02
Chordata	0.27	2.34		0.03		0.22	0.15	0.14	0.07		3.23
Actinopterygii	0.27										0.27
Anguilliformes	0.27										0.27
Synphobranchidae	0.27										0.27
Ascidiacea		2.34		0.03		0.22	0.15	0.14	0.07		2.96
Aplousobranchia		2.33				0.19	0.02	0.02			2.56
Didemnidae		0.01				0.14	0.02	0.02			0.19
Eudistoma sp.		0.01									0.01
Trididemnum sp.		2.31				0.06					2.36
Ascidiacea		0.01		0.03		0.03	0.13	0.12	0.07		0.40
Human debris		0.02		0.01	0.02	0.03	0.04	0.08			0.20
Human debris		0.02		0.01	0.02	0.03	0.04	0.08			0.20
Human debris		0.02		0.01	0.02	0.03	0.04	0.08			0.20
Human debris- anchor line		0.01									0.01
Human debris- cans/bottles				0.01				0.02			0.04
Human debris- fish line/gear					0.02	0.01	0.04				0.07
Human debris- net								0.04			0.04
Human debris- unid.		0.01				0.01	0.01	0.01			0.04
Cyanophyta		0.01					0.51	0.27			0.79
Chlorophyta		0.01									0.01
Rhodophyta		0.37				0.36		0.11			0.84
Floriophyceae						0.01					0.01
Rhodymeniales						0.01					0.01
Rhodymenia sp.						0.01					0.01
Rhodophyta		0.37				0.35		0.11			0.83
Rhodophyta		0.37				0.35		0.11			0.83
Corallinales or Peyssonneliaceae		0.22				0.35		0.07			0.63
Rhodophyta		0.15									0.15
Rhodophyta- flat oval								0.04			0.04
Total	0.81	19.65	6.61	24.89	21.24	26.38	58.88	30.45	9.99	18.90	217.79

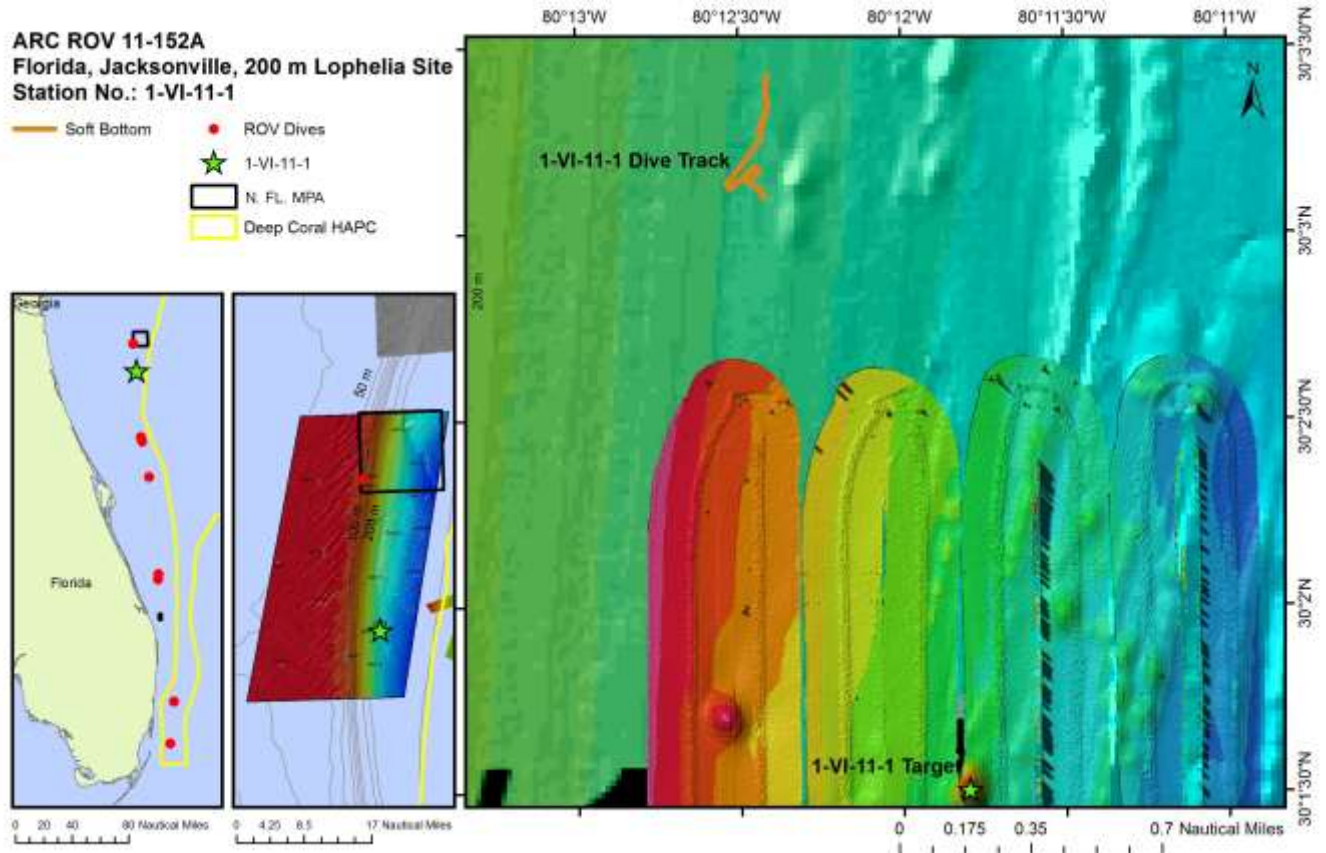
APPENDIX 2

SEADESC II REPORT- Habitat and Benthic Biota Characterizations

Provides the following data for each dive site: cruise and ROV dive metadata, figures showing each ROV dive track and habitat zone overlaid on multibeam sonar maps, dive track data (start and end latitude, longitude, depth), objectives, general description of the habitat and biota, and images of the biota and habitat that characterize the dive site. In addition, this SEADESC Level II Report provides quantitative analyses of each dive site including: 1) CPCE 4.0[©] Coral Point Count analysis of percent cover of benthic biota and substrate type, 2) densities of benthic macro-fauna (# organisms/m² for each species), and 3) densities of fish populations (# individuals/km for each species).

Dive Number: ARC ROV 11-152A **Location:** USA, Florida, Jacksonville, 200 m Lophelia Site

General Location and Dive Track:



Site Overview:

Project: 2011 Extreme Corals, NOAA DSCP
Principal Investigator: Andrew W. David
PI Contact Info: 3500 Delwood Beach Rd. Panama City FL 32408
Website: <http://coralreef.noaa.gov/deepseacorals>
Scientific Observers: Andrew W. David, Charles Messing, Diego Figueroa, Jana Thoma, John Reed, Stephanie Farrington
Data Management: Access Database, Excel Spreadsheet, WinFrog
ROV Navigation Data: WinFrog
Ship Position System: DGPS
Report Analyst: John Reed, Stephanie Farrington

Dive Overview:

Vessel: NOAA Ship *Pisces*
Sonar Data: Jacksonville: 1C_dusk.tif
Purpose: Map and characterize DSCE off SE USA
ROV: NOAA SW Fisheries ARC ROV
Sensors Used: Temperature (°C), Dissolved Oxygen (ml/l), Salinity (PSU), Conductivity
Date of Dive: 6/1/2011
Specimens: 0
Digital Photos: 2
DVD: 0
Hard Drive: 1
Date Compiled: 2/20/2013

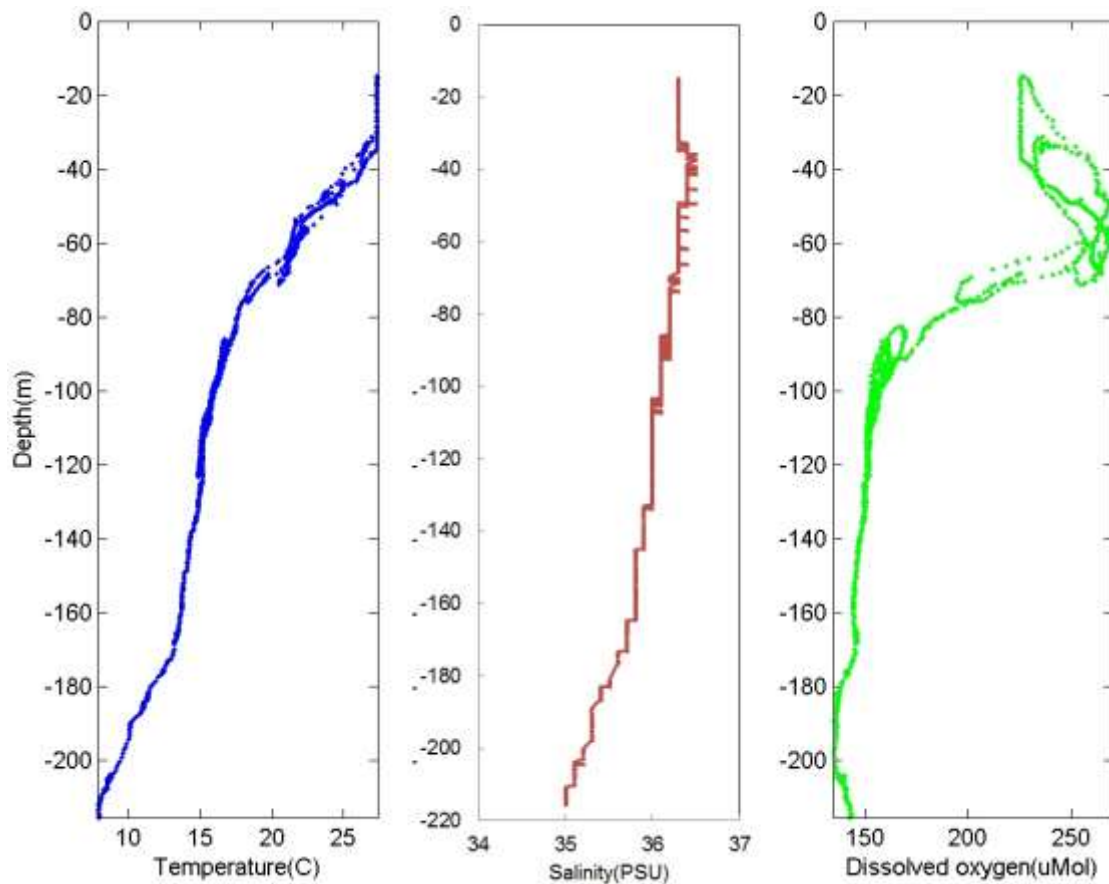
Dive Number: ARC ROV 11-152A **Location:** USA, Florida, Jacksonville, 200 m Lophelia Site

Dive Data:

Minimum Bottom Depth (m): 213	Total Transect Length (km): 0.745
Maximum Bottom Depth (m): 214	Surface Current (kn): 1.75
On Bottom (Time- GMT): 19:33	On Bottom (Lat/Long): 30°03.0960'N; 80°12.4200'W
Off Bottom (Time- GMT): 19:49	Off Bottom (Lat/Long): 30°03.4020'N; 80°12.4160'W
Physical (bottom); Temp (°C): 7.94	Salinity: 35.03 Visibility (ft): 30 Current (kn):

Physical Environment:

CTD Number 11-152A_CTDD



All CTD data were collected with the ARC ROV which recorded depth, temperature (°C), conductivity (salinity, PSU), pressure (mbar), sound velocity (m/sec), oxygen concentration (uMol), and oxygen saturation. These data were used both to support multibeam surveys (sound velocity) and to characterize hydrographic conditions at the dive sites.

The following values were recorded at the maximum depth of this CTD cast (215.4 m): temperature- 7.9, salinity- 35, and dissolved oxygen- 142.7. Surface temperature was 27.6 and there was a slight thermocline near 40 m depth; salinity peaked between 35 and 40 m, dissolved oxygen peaked at 60 m. Visibility was estimated at 9-12 m from the ROV video.

Dive Number: ARC ROV 11-152A **Location:** USA, Florida, Jacksonville, 200 m Lophelia Site

Dive Imagery:



Figure 1: 30°3.2561'N, 80°12.4332'W 213.4 m
Muddy soft bottom west of the *Lophelia* coral mound. Strong currents prevented the ROV from landing on the targeted coral site. Dense bioturbation from benthic fauna (bivalves, worms, crustaceans, fish) form the pits and mounds (parallel red lasers- 20 cm top, 40 cm bottom).



Figure 2: 30°3.2653'N, 80°12.4375'W 213.7 m
Rochinia? sp. spider crab on soft mud bottom with 20-40 cm diameter pits and mounds formed by benthic fauna.

Dive Number: ARC ROV 11-152A **Location:** USA, Florida, Jacksonville, 200 m Lophelia Site

Dive Notes:

Objectives, Site Description, Habitat, Fauna:

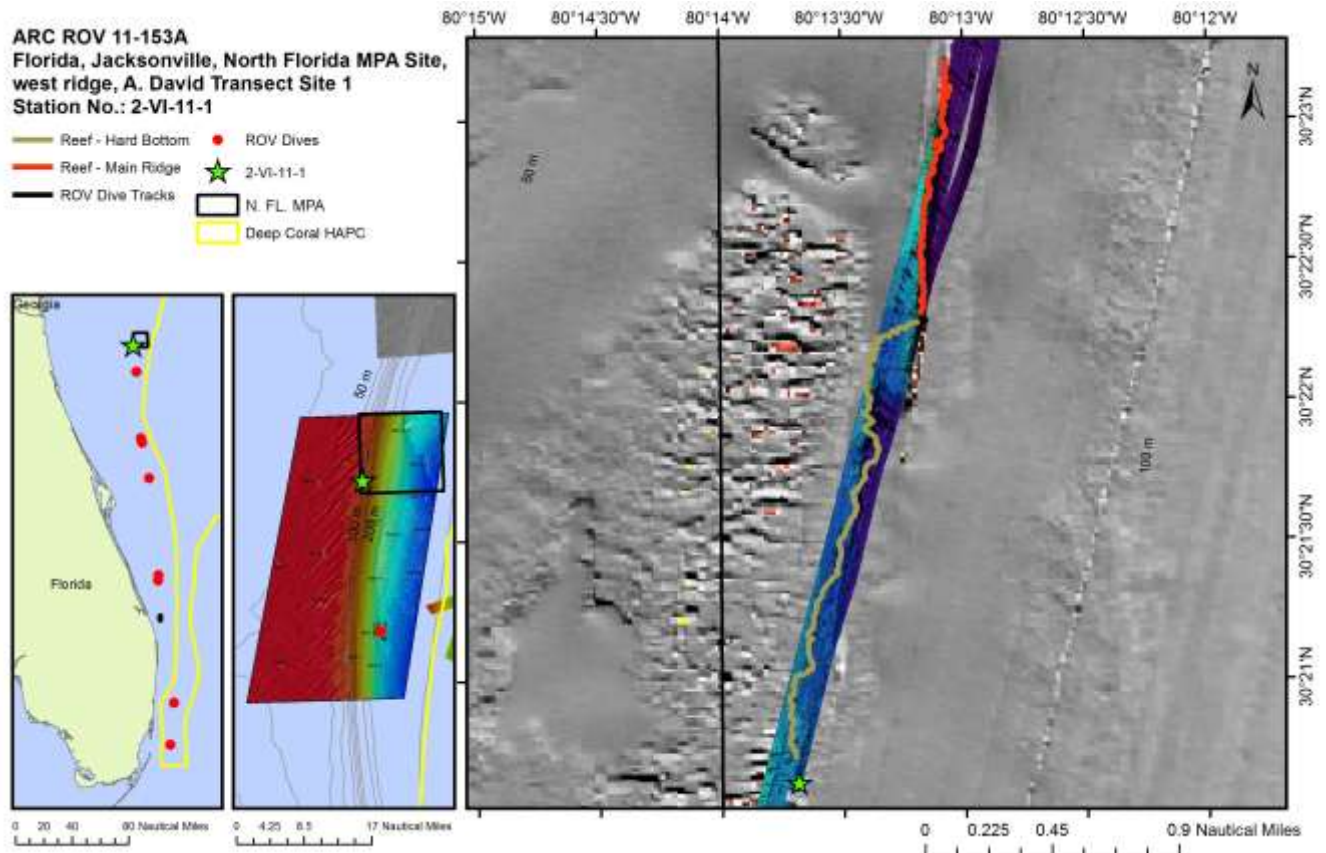
Objective: Survey *Lophelia* coral mound discovered last year on NOAA DSC cruise (Jason II-547, 11/18/2010) and ground truth *Pisces* sonar survey of site. Target site- *Lophelia* mound (from *Pisces* multibeam): 30° 1.506'N, 80° 11.8'N; 208-246 m.

Dive Events: Dive is terminated after 16 minutes on bottom due to loss of video and tracking. Umbilical cable twisted, breaking fiber optics. Drifted 1.5 nmi during 1-hour descent; difficulty station keeping, maneuvering ship and ROV in current (surface current 1.75 kn). ROV landed 1.5 nmi north of target site and 200 m west of another mound. Never reached the target site or hard bottom. Umbilical was replaced after the dive. [Note- Depth recorded on video and WinFrog displays are incorrect; add 10 m to readings; depths in this report are corrected. The Arc ROV's top parallel lasers are calibrated at 20cm, bottom lasers 40 cm.]

Site Description/Habitat/Fauna: Bottom is 100% soft sediment, flat with dense bioturbation, 10-20 cm mounds and pits; depth 213-214 m. Dominant species: Fish- *Laemonema* (codling), eels; Crustaceans- hermit crabs, *Cancer*, *Rochinia*, *Chaceon fenneri* (golden crab).

Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

General Location and Dive Track:



Site Overview: **Dive Overview:**

Project: 2011 Extreme Corals, NOAA DSCP

Principal Investator: Andrew W. David

PI Contact Info: 3500 Delwood Beach Rd. Panama City FL 32408

Website: <http://coralreef.noaa.gov/deepseacorals>

Scientific Observers: Andrew W. David, Charles Messing, Diego Figueroa, Jana Thoma, John Reed, Stephanie Farrington

Data Management: Access Database, Excel Spreadsheet, WinFrog

ROV Navigation Data: WinFrog

Ship Position System: DGPS

Report Analyst: John Reed, Stephanie Farrington

Vessel: NOAA Ship *Pisces*

Sonar Data: North Florida MPA: 2A_NFL_MPA_dusk.tif

Purpose: Map and characterize DSCE off SE USA

ROV: NOAA SW Fisheries ARC ROV

Sensors Used: Temperature (°C), Dissolved Oxygen (ml/l), Salinity (PSU), Conductivity

Date of Dive: 6/2/2011

Specimens: 0

Digital Photos: 313

DVD: 6

Hard Drive: 2

Date Compiled: 2/20/2013

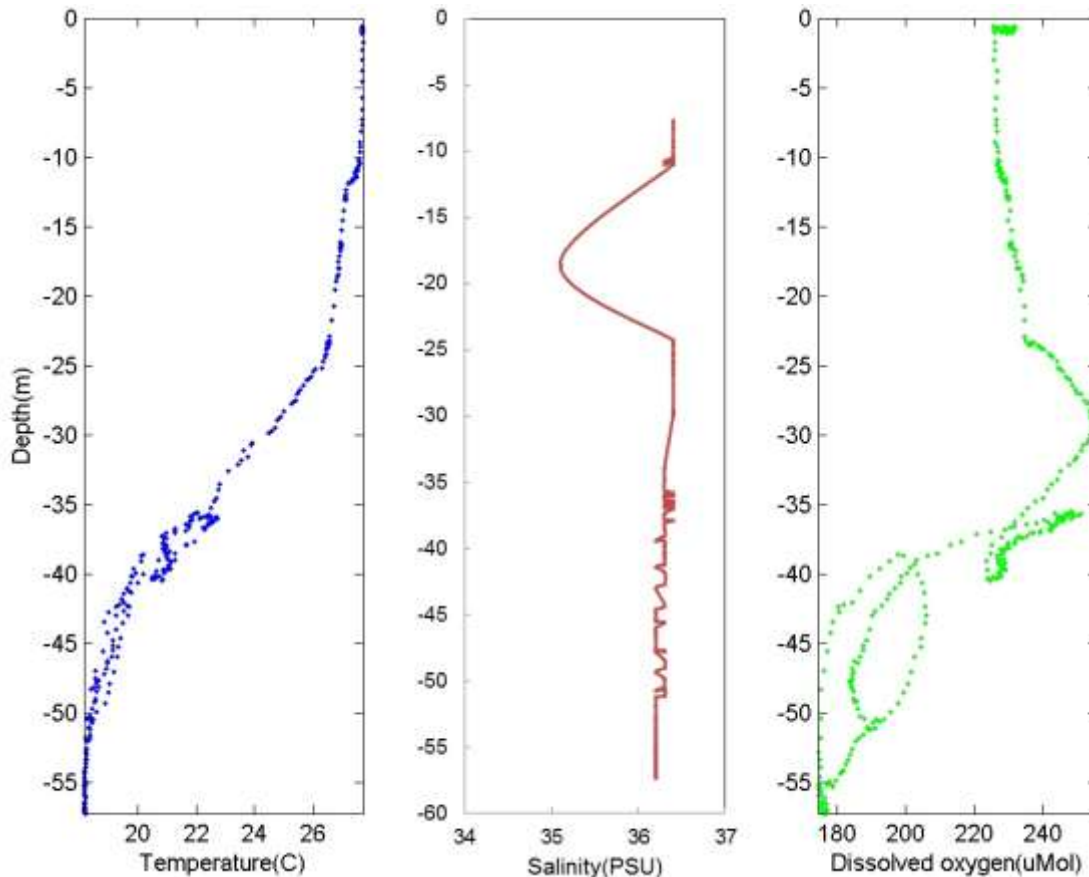
Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

Dive Data:

Minimum Bottom Depth (m): 56	Total Transect Length (km): 6.187		
Maximum Bottom Depth (m): 65	Surface Current (kn): slight		
On Bottom (Time- GMT): 18:46	On Bottom (Lat/Long): 30°20.6340'N; 80°13.6854'W		
Off Bottom (Time- GMT): 23:57	Off Bottom (Lat/Long): 30°23.2320'N; 80°13.0800'W		
Physical (bottom); Temp (°C): 19.54	Salinity: 36.29	Visibility (ft): 50	Current (kn):

Physical Environment:

CTD Number 11-153A_CTDU



All CTD data were collected with the ARC ROV which recorded depth, temperature (°C), conductivity (salinity, PSU), pressure (mbar), sound velocity (m/sec), oxygen concentration (uMol), and oxygen saturation. These data were used both to support multibeam surveys (sound velocity) and to characterize hydrographic conditions at the dive sites.

The following values were recorded at the maximum depth of this CTD cast (57.3 m): temperature- 18.2, salinity- 36.2, and dissolved oxygen- 175.8. Surface temperature was 27.2 and there was a thermocline near 25-40 m depth; salinity had a large dip at 19 m, dissolved oxygen peaked at 30 m. Visibility was estimated at 15-18 m from the ROV video.

Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

Dive Imagery:



Figure 1: 30°22.4225'N, 80°13.1684'W 58.9 m
High-relief rock ledges along main ridge of N. Florida MPA site provide habitat for a variety of sponges, corals, and fish. Black wire coral (*Stichopathes lutkeni*), polychaete worms (*Filograna* sp.- white coral like colonies), cake sponges (*Ircinia strobilina*), black coral (Antipathidae), encrusting sponges (Spirastrellidae, various unidentified Demospongiae), and coralline algae. Tomtate (*Haemulon aurolineatum*), moray eel (*Gymnothorax* sp.), vermilion snapper (*Rhomboplites aurorubens*), and reef butterflyfish (*Chaetodon sedentarius*).



Figure 2: 30°22.842'N, 80°13.118'W 57.7 m
Snowy grouper (*Epinephelus niveatus*) takes cover among the ledges of the main ridge at the N. Florida MPA site. Dense benthic fauna include sponges (*Clathria* sp.- red club; *Ircinia campana*- purple vase; *Ircinia* spp.- purple lobate; *Erylus* sp.- grey lobate; numerous unidentified Demospongiae; Spirastrellidae- red, orange encrusters), black wire coral (*Stichopathes* sp.), *Filograna* polychaetes, hydroids, and sea urchins (*Arbacia punctulata*).



Figure 3: 30°22.6369'N, 80°13.1581'W 56.8 m
Unfortunately the invasive lionfish (*Pterois volitans*) was a common sight on many of the dives. This was on the main ledge of the MPA site. Common biota included black wire coral (*Stichopathes* sp.), numerous demosponges, *Filograna* polychaete worms, hydroids, and gorgonians.



Figure 4: 30°21.7385'N, 80°13.4083'W 60.6 m
Large bushy black coral (*Tanacetipathes hirta*, 40 cm diameter), with sponges (*Clathriidae*?- yellow sphere; Dictyoceratida- spiny, brown; *Ircinia campana*- purple vase).

Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

Dive Notes:

Objectives, Site Description, Habitat, Fauna:

Objective: Survey North Florida MPA site, west ridge (A. David transect Site 1). Target site: 30° 23.64'N, 80° 24.762'W, 56 m.

Dive Events: [Note- Depth recorded on video and WinFrog displays are incorrect; add 10 m to readings; depths in this report are corrected. The Arc ROV's top parallel lasers are calibrated at 20cm, bottom lasers 40 cm.]

Site Description/Habitat/Fauna: Used *Pisces* sonar data (Jacksonville survey). N-S oriented rock ridges comprised of rock slabs, pavement, 1-2 m boulders, and ledges; total relief up to 5 m (depth 57-63 m). Dense sessile faunal cover. Dominant species: Fish- scamp (common), snowy grouper, vermillion snapper, black seabass, red porgy, hogfish, bigeye, grey trigger, barracuda, damselfish, tattler, butterfly fish, Spanish hogfish, Creole fish, bank butterfly, blue angel, queen angel, drum, wrasse bass, tomtate, scorpion fish, chain moray, cowfish, jacks, lionfish (6 noted); Algae; Sponges- *Ircinia*, Axinellidae, Petrosidae, *Clathria*; Polychaete- Filigrana; Cnidaria- *Madracis* (hard coral, several 15 cm diameter), Plexauridae, Ellisellidae, black hydroid, Antipatharia- *Tanacetipathes*, *Stichopathes*; Echinoderms- *Arbacia punctulata*; Bryozoa; Ascidiacea- Didemnidae.

Off ridge, in valleys or east of ridge- 100% soft bottom with areas of sand-shell hash, dense bioturbation; dense cover of Sabellidae polychaete tubes, Cerianthidea, Pennatulacea, Mollusca, Asteroidea, longhorn Bryozoa, some tilefish burrows (Malacanthidae).

Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

Percent Cover of Benthic Macro-Biota and Substrate:

ARC ROV 11-153A surveyed the southwest corner of the North Florida MPA site. The S-N transect followed the main rock ridge that is apparent in the multibeam sonar map. The dive transects were divided into two habitat types: on the main ridge, and off-ridge hard bottom. Point count (CPCe[®]) was used to determine percent cover (see methods for details). Figure 1 shows the percent cover of hard bottom and soft bottom substrate; points on biota were scored as the underlying substrate type. Soft bottom substrate is defined as unconsolidated mud or sand. Site 11-153A was predominately hard-bottom substrate (53% cover), consisting primarily of rock pavement, 1-2 m boulders, rock slabs, and rock ledges. Benthic macro-biota covered 56.3% of the bottom and consisted of 9.7% Porifera (Demospongiae), 3.9% non-scleractinian coral (Gorgonacea, other Alcyonacea, and Antipatharia), and 42% other organisms (Fig. 2, Table 1; see Table 2 for complete species list). Hard coral was rare and only covered 0.01% of the bottom. The bare substrate (without biota) consisted of 22.8% sediment and 20.5% hard bottom. Figure 3 shows the percent cover of substrate type for each habitat region of the dive site. The main ridge region had the greatest cover of hard-bottom habitat compared to off ridge (47% and 37%, respectively). Soft bottom covered about 23% of the bottom at both habitats. Figure 4 compares the two habitats with cover of biota. The main ridge had 53% cover of biota which was dominated by Porifera (11.1%), non-scleractinian coral (5.1%), and 36.1% other organisms. The off-ridge hard-bottom habitat had greater cover of other organisms (51.9%) but fewer sponges and gorgonians.

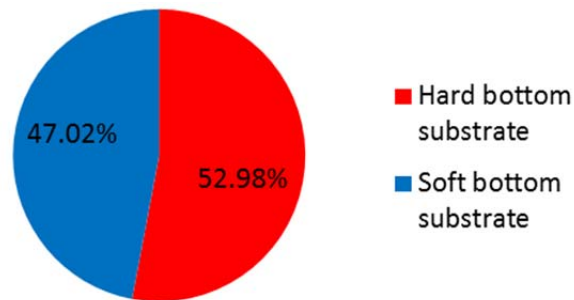


Figure 1. Percent cover of hard and soft bottom substrate at dive site 11-153A. CPCe[®] points on organisms were scored as the underlying substrate (hard or soft).

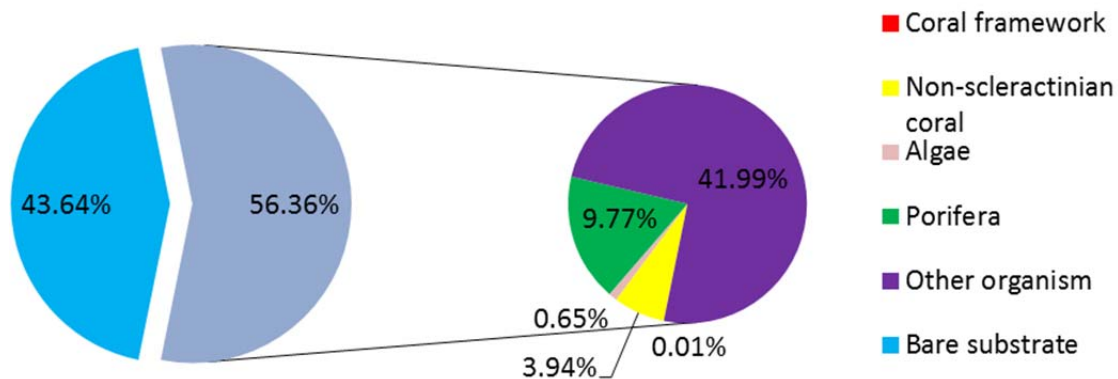


Figure 2. Percent cover of bare substrate and benthic macro-biota at dive site 11-153A. Coral framework is standing, colonial hard coral. Non-scleractinian corals are defined as Gorgonacea, other Alcyonacea, and Antipatharia.

Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

Table 1. Percent cover of benthic macro-biota and substrate types at dive site 11-153A.

Benthic macro-biota and substrate types	% Cover
Coral framework	0.01%
Scleractinia, unid	0.01%
Non-scleractinian coral	3.94%
Antipatharia	2.97%
Gorgonacea, Unid	0.97%
Porifera	9.76%
Porifera- Hexactinellida, Calcarea, or Demospongiae	9.76%
Other organism	41.97%
Algae	0.65%
Algae- green, brown, red, or cyanobacteria	0.65%
Bare substrate	43.61%
Bare Soft Bottom substrate	22.86%
Blueline Tilefish Burrow	0.18%
Coral rubble	0.01%
Rock- pavement, boulder, ledge	13.79%
Rubble	6.78%
Human debris	0.06%
Human debris- Other	0.06%
Grand Total	100.00%

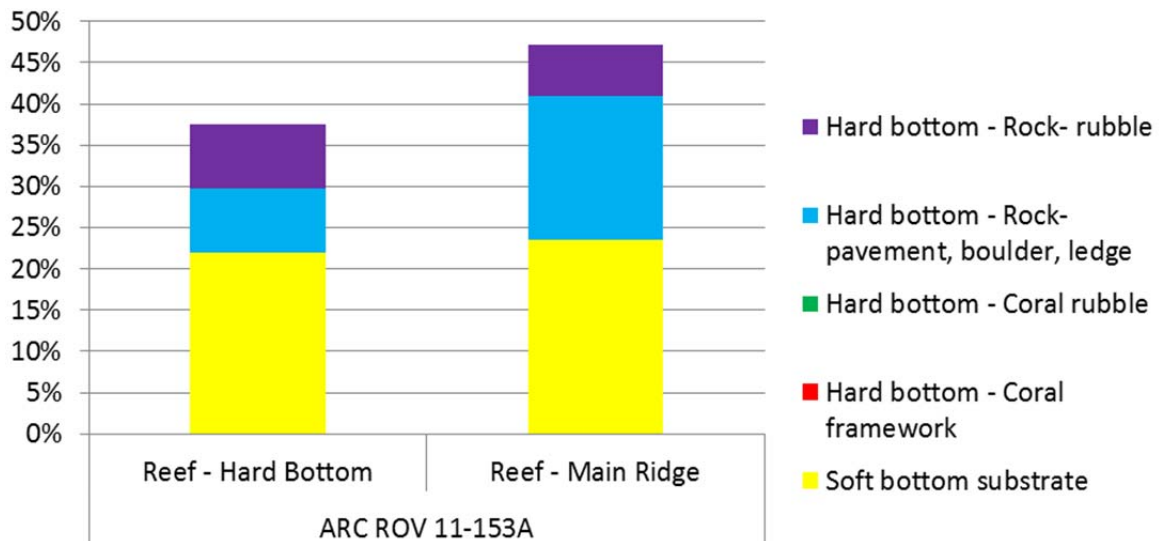


Figure 3. Percent cover of substrate types for each habitat zone at dive site 11-153A.

Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

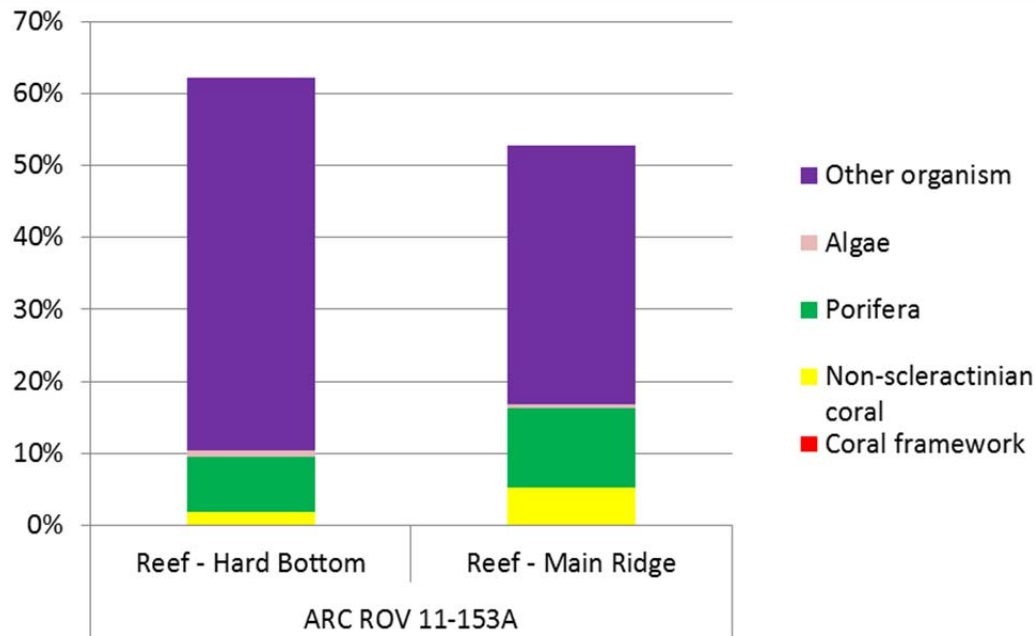


Figure 4. Percent cover of benthic macro-biota for each habitat zone at dive site 11-153A.

Density of Benthic Macro-Biota:

As discussed in the Methods, some common taxa could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phylum. Sponges, gorgonians, and black coral are especially difficult to identify without a specimen in hand. In these cases a general descriptive taxa was used, e.g., “brown lobate sponge” or “unidentified Demospongiae”, which could consist of numerous species. These designations should not be considered equivalent to species level and should not be used for diversity (H') indices calculations. Many deepwater species in this region look nearly identical, such as fan sponges which are polyphyletic and actually include different Classes.

Dive site 11-153A had a total of 60 benthic macro-fauna taxa, consisting of 17 Porifera and 21 Cnidaria (Table 2). Overall density of all benthic macro-fauna was 19.6 organisms/m². Cnidaria contributed to 27.3% of the total density at this site, and Porifera 31.2% (5.3 and 6.1 colonies/m², respectively). Black coral was also common (12.4% of the density; 2.4 colonies/m²) and gorgonians were 2.5% (0.5 colonies/m²). Gorgonians included *Diodogorgia*, *Muricea*, *Nicella*, *Plexauridae*, and *Telesto* in densities of 0.01 to 0.3 colonies/m².

Table 2. Density of benthic macro-biota at site 11-153A (# organisms, number/m², percent of total density).

Phylum/Class/Order/Scientific Name	# Organisms	#/m2	% of Site
Porifera	885	6.14	31.24%
Demospongiae	884	6.13	31.20%
Dictyoceratida	62	0.43	2.19%
Dictyoceratida	7	0.05	0.25%
Ircinia campana	13	0.09	0.46%
Ircinia sp.	41	0.28	1.45%
Ircinia strobilina	1	0.01	0.04%
Hadromerida	391	2.71	13.80%

Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

Cliona sp.	2	0.01	0.07%
Placospongia sp.	6	0.04	0.21%
Spirastrellidae	383	2.66	13.52%
Haplosclerida	5	0.03	0.18%
Haplosclerida	5	0.03	0.18%
Poecilosclerida	5	0.03	0.18%
Clathria sp.	3	0.02	0.11%
Poecilosclerida	2	0.01	0.07%
Spirophorida	1	0.01	0.04%
Cinachyra sp.	1	0.01	0.04%
Verongida	3	0.02	0.11%
Aplysina sp.	2	0.01	0.07%
Verongida	1	0.01	0.04%
Demospongiae	417	2.89	14.72%
Demospongiae	395	2.74	13.94%
Demospongiae- tan starlet thick encrusting	21	0.15	0.74%
Demospongiae- ye brain	1	0.01	0.04%
Homoscleromorpha	1	0.01	0.04%
Homosclerophorida	1	0.01	0.04%
Plakortis sp.	1	0.01	0.04%
Cnidaria	775	5.37	27.36%
Anthozoa	463	3.21	16.34%
Actinaria	1	0.01	0.04%
Actinaria	1	0.01	0.04%
Alcyonacea	72	0.50	2.54%
Diodogorgia sp.	44	0.31	1.55%
Ellisella barbadensis	1	0.01	0.04%
Ellisellidae	1	0.01	0.04%
Gorgonacea (accepted as Alcyonacea)	6	0.04	0.21%
Muricea sp.	7	0.05	0.25%
Nicella sp.	3	0.02	0.11%
Nidalia sp.	1	0.01	0.04%
Plexauridae	2	0.01	0.07%
Plexauridae- purple	4	0.03	0.14%
Telesto sp.	1	0.01	0.04%
Titanideum frauenfeldii	2	0.01	0.07%
Antipatharia	351	2.43	12.39%
Antipathidae	5	0.03	0.18%
Stichopathes sp.	318	2.21	11.22%
Tanacetipathes hirta	28	0.19	0.99%
Pennatulacea	10	0.07	0.35%
Virgularia sp.	10	0.07	0.35%
Scleractinia	24	0.17	0.85%

Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

Madracis myriaster (=Madracis mirabilis)	3	0.02	0.11%
Scleractinia- unid cup	21	0.15	0.74%
Zoanthidea	5	0.03	0.18%
Zoanthidae	5	0.03	0.18%
Hydrozoa	312	2.16	11.01%
Anthoathecata	5	0.03	0.18%
Stylasteridae	5	0.03	0.18%
Hydrozoa	307	2.13	10.84%
Hydroidolina	307	2.13	10.84%
Annelida	674	4.67	23.79%
Polychaeta	674	4.67	23.79%
Sabellida	354	2.45	12.50%
Filograna sp.	232	1.61	8.19%
Sabellidae	106	0.74	3.74%
Serpulidae	1	0.01	0.04%
Spirobranchus giganteus	15	0.10	0.53%
Polychaeta	320	2.22	11.30%
Polychaeta	320	2.22	11.30%
Mollusca	3	0.02	0.11%
Gastropoda	3	0.02	0.11%
Arthropoda	25	0.17	0.88%
Malacostraca	9	0.06	0.32%
Decapoda	9	0.06	0.32%
Paguroidea	6	0.04	0.21%
Stenorhynchus seticornis	3	0.02	0.11%
Maxillopoda	16	0.11	0.56%
Maxillopoda	16	0.11	0.56%
Cirripedia	16	0.11	0.56%
Bryozoa	65	0.45	2.29%
Gymnolaemata	5	0.03	0.18%
Cheilostomatida	5	0.03	0.18%
Hippoporidra	3	0.02	0.11%
Schizoporella sp.	2	0.01	0.07%
Bryozoa	60	0.42	2.12%
Bryozoa	60	0.42	2.12%
Bryozoa	60	0.42	2.12%
Echinodermata	9	0.06	0.32%
Asteroidea	1	0.01	0.04%
Asteroidea	1	0.01	0.04%
Asteroidea	1	0.01	0.04%
Echinoidea	5	0.03	0.18%
Cidaroida	2	0.01	0.07%

Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

Eucidaris tribuloides	2	0.01	0.07%
Echinoidea	3	0.02	0.11%
Echinoidea	3	0.02	0.11%
Holothuroidea	1	0.01	0.04%
Dendrochirotida	1	0.01	0.04%
Paracolochirus mysticus	1	0.01	0.04%
Ophiuroidea	2	0.01	0.07%
Chordata	338	2.34	11.93%
Asciacea	338	2.34	11.93%
Aplousobranchia	336	2.33	11.86%
Didemnidae	1	0.01	0.04%
Eudistoma sp.	2	0.01	0.07%
Trididemnum sp.	333	2.31	11.75%
Asciacea	2	0.01	0.07%
Asciacea	2	0.01	0.07%
Cyanophyta	1	0.01	0.04%
Cyanophyta	1	0.01	0.04%
Cyanophyta	1	0.01	0.04%
Cyanobacteria	1	0.01	0.04%
Chlorophyta	1	0.01	0.04%
Rhodophyta	54	0.37	1.91%
Rhodophyta	54	0.37	1.91%
Rhodophyta	54	0.37	1.91%
Corallinales or Peyssonneliaceae	32	0.22	1.13%
Rhodophyta	22	0.15	0.78%
Human debris	3	0.02	0.11%
Human debris	3	0.02	0.11%
Human debris	3	0.02	0.11%
Human debris- anchor line	2	0.01	0.07%
Human debris- unid.	1	0.01	0.04%
Grand Total	2833	19.65	100.00%

Dive Number: ARC ROV 11-153A **Location:** USA, Florida, Jacksonville, North Florida MPA Site, west ridge, A. David Transect Site 1

Figure 5 shows the densities of Porifera and coral for each of the habitats at dive site 11-153A. Coral is defined as hard coral (Stylasteridae and Scleractinia), Antipatharia, and Gorgonacea. The main ridge habitat had the greatest overall density (10 organisms/m²) with 6.5 Porifera/m², 2.8 Antipatharia, and 0.5 Alcyonacea (primarily Gorgonacea). Overall density was slightly lower on hard-bottom habitat off the main ridge (~6 organisms/m²), and was also dominated by Porifera (4.5 colonies/m²).

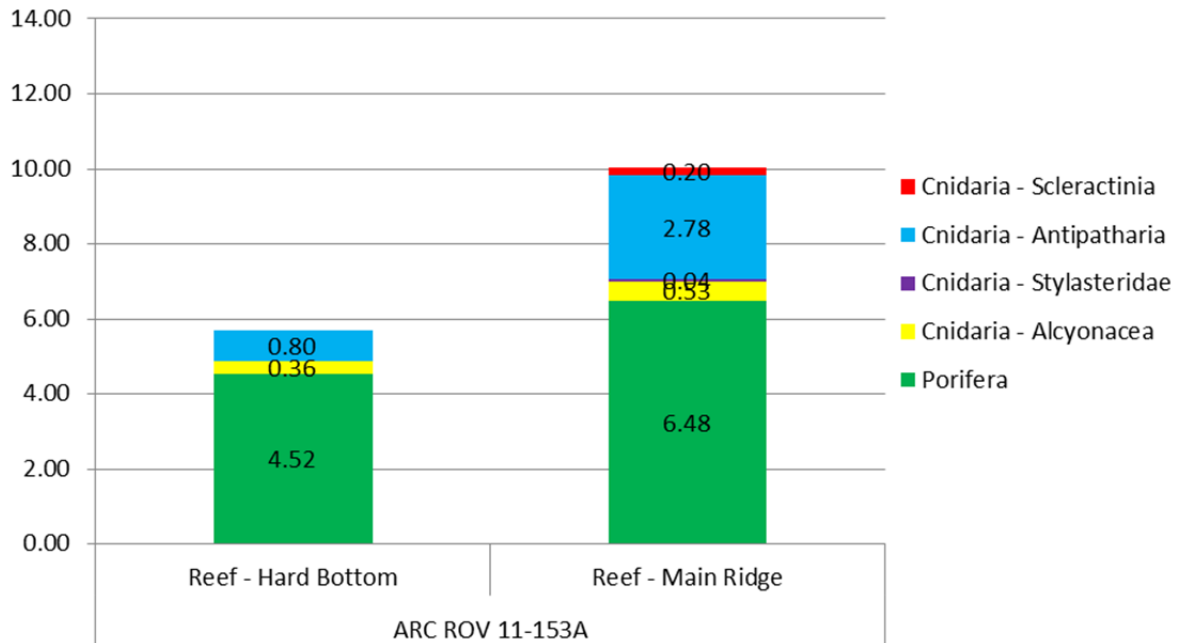


Figure 5. Density (number colonies/m²) of Porifera, hard coral (Scleractinia and Stylasteridae), Antipatharia, and Alcyonacea (Gorgonacea) for each habitat zone of dive site 11-153A.

Fish Data Analysis:

Video transects were used to analyze the fish populations and densities. Protocol for the fish analyses was to divide the continuous video into 5 minute segments, or whenever there was a change in habitat type, whichever came first, so each video segment only contained one habitat type (see Methods for details). These were also correlated with the habitat types used for the benthic analyses. All fish were identified for each ROV dive to species level and counted. The total distance (km) of each dive was used to calculate the density (# individuals/km) of each fish species. The field of view varied, but generally was 10-15 m. A total of 44 species of fish were identified from dive site 11-153A for a total density of 509 individuals/km (Table 3). These were dominated by vermilion snapper (185/km), tomtate (96), wrasse (55), and tattler (27). Managed species included red pogy (23/km), scamp (2.6), triggerfish (1.1), hogfish, almaco and greater amberjack, snowy grouper and snapper. In addition, 17 lionfish were counted on the dive (2.7/km).

Table 3. Density of fish for all transects at dive site 11-153A (number individuals/km).

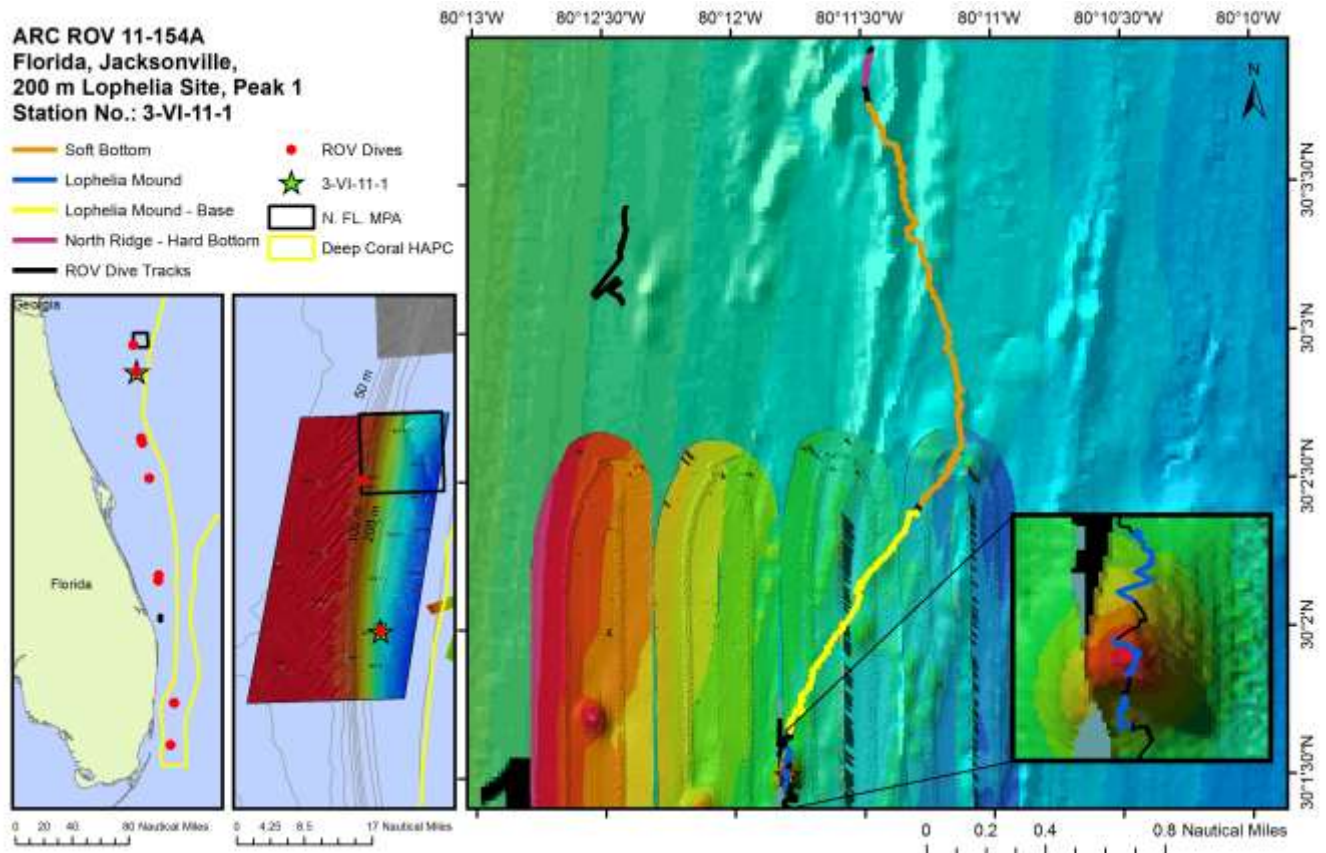
Common Name	Species Name	Density (#/km)
vermilion snapper	<i>Rhomboplites aurorubens</i>	185.7
tomtate	<i>Haemulon aurolineatum</i>	96.2
wrasse	<i>Halichoeres sp.</i>	55.8
tattler	<i>Serranus phoebe</i>	27.5
red pogy	<i>Pagrus pagrus</i>	23.9

Dive Number: ARC ROV 11-153A**Location:** USA, Florida, Jacksonville, North Florida MPA Site,
west ridge, A. David Transect Site 1

yellowtail reeffish	<i>Chromis enchrysurus</i>	23.4
reef butterflyfish	<i>Chaetodon sedentarius</i>	18.3
bank sea bass	<i>Centropristis ocyurus</i>	17.8
blue angelfish	<i>Holacanthus bermudensis</i>	7.8
spotfin hogfish	<i>Bodianus pulchellus</i>	7.4
blackbar soldierfish	<i>Myripristis jacobus</i>	5.8
cubbyu	<i>Equetus umbrosus</i>	5.5
purple reeffish	<i>Chromis scotti</i>	5.2
sharpnose puffer	<i>Canthigaster rostrata</i>	3.1
squirrelfish	<i>Holocentrus adscensionis</i>	3.1
lionfish	<i>Pterois volitans</i>	2.7
scamp	<i>Mycteroperca phenax</i>	2.6
amberjack	<i>Seriola sp.</i>	1.8
bigeye	<i>Priacanthus arenatus</i>	1.8
short bigeye	<i>Pristigenys alta</i>	1.8
rougthead bass	<i>Pronotogrammus martinicensis</i>	1.5
bank butterflyfish	<i>Prognathodes aya</i>	1.3
grey triggerfish	<i>Balistes capriscus</i>	1.1
squirrelfish	<i>Holocentrus sp.</i>	1.1
sunshinefish	<i>Chromis insolatus</i>	1.0
hogfish	<i>Lachnolaimus maximus</i>	0.8
spotfin butterflyfish	<i>Chaetodon ocellatus</i>	0.6
wrasse bass	<i>Liopropoma eukrines</i>	0.6
almaco jack	<i>Seriola rivoliana</i>	0.5
cardinalfish	<i>Apogon sp.</i>	0.5
greater amberjack	<i>Seriola dumerili</i>	0.5
snowy grouper	<i>Epinephelus niveatus</i>	0.5
trunkfish	<i>Lactophrys sp.</i>	0.5
orangeback bass	<i>Serranus annularis</i>	0.3
bandtail puffer	<i>Sphoeroides spengleri</i>	0.2
barracuda	<i>Sphyraena barracuda</i>	0.2
creole-fish	<i>Paranthias furcifer</i>	0.2
sand diver	<i>Synodus intermedius</i>	0.2
sand tilefish	<i>Malacanthus plumieri</i>	0.2
scorpionfish	<i>Scorpaenidae</i>	0.2
scrawled cowfish	<i>Lactophrys quadricornis</i>	0.2
snapper	<i>Lutjanus sp.</i>	0.2
soldierfish	<i>Holocentridae</i>	0.2
twospot cardinalfish	<i>Apogon pseudomaculatus</i>	0.2

Dive Number: ARC ROV 11-154A **Location:** USA, Florida, Jacksonville, 200 m Lophelia Site, Peak 1

General Location and Dive Track:



Site Overview:

Project: 2011 Extreme Corals, NOAA DSCP
Principal Investator: Andrew W. David
PI Contact Info: 3500 Delwood Beach Rd. Panama City FL 32408
Website: <http://coralreef.noaa.gov/deepseacorals>
Scientific Observers: Andrew W. David, Charles Messing, Diego Figueroa, Jana Thoma, John Reed, Stephanie Farrington
Data Management: Access Database, Excel Spreadsheet, WinFrog
ROV Navigation Data: WinFrog
Ship Position System: DGPS
Report Analyst: John Reed, Stephanie Farrington

Dive Overview:

Vessel: NOAA Ship *Pisces*
Sonar Data: Jacksonville: 1Ca_dusk.tif
Purpose: Map and characterize DSCE off SE USA
ROV: NOAA SW Fisheries ARC ROV
Sensors Used: Temperature (°C), Dissolved Oxygen (ml/l), Salinity (PSU), Conductivity
Date of Dive: 6/3/2011
Specimens: 0
Digital Photos: 564
DVD: 8
Hard Drive: 1
Date Compiled: 2/20/2013

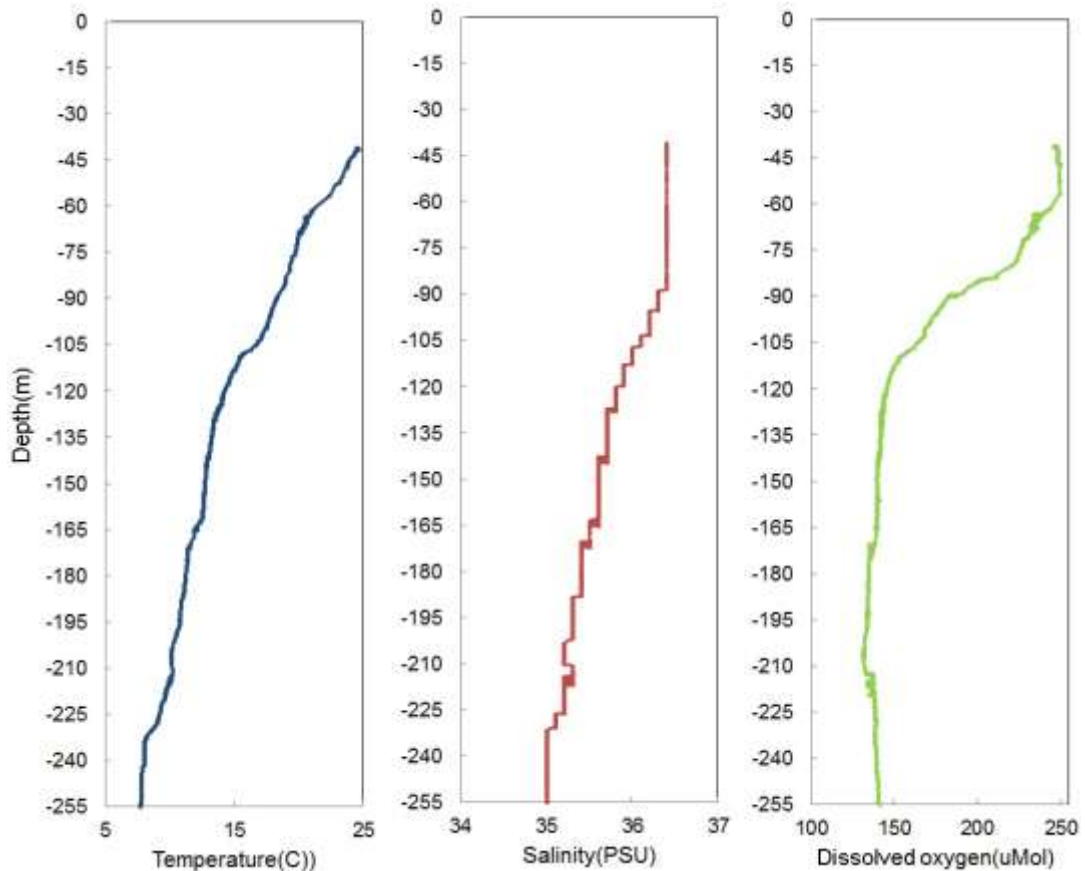
Dive Number: ARC ROV 11-154A **Location:** USA, Florida, Jacksonville, 200 m Lophelia Site, Peak 1

Dive Data:

Minimum Bottom Depth (m): 208	Total Transect Length (km): 6.195		
Maximum Bottom Depth (m): 310	Surface Current (kn): .5 - 1 kt		
On Bottom (Time- GMT): 17:43	On Bottom (Lat/Long): 30°01.3740'N; 80°11.8002'W		
Off Bottom (Time- GMT): 22:00	Off Bottom (Lat/Long): 30°03.9366'N; 80°11.4636'W		
Physical (bottom); Temp (°C): 7.61	Salinity: 34.99	Visibility (ft): 50	Current (kn):

Physical Environment:

CTD Number 11-154A_CTDD



All CTD data were collected with the ARC ROV which recorded depth, temperature (°C), conductivity (salinity, PSU), pressure (mbar), sound velocity (m/sec), oxygen concentration (uMol), and oxygen saturation. These data were used both to support multibeam surveys (sound velocity) and to characterize hydrographic conditions at the dive sites.

The following values were recorded at the maximum depth of this CTD cast (255.9 m): temperature- 7.7, salinity- 35, and dissolved oxygen- 141. The CTD did not start recording until 41 m. Temperature was 20.24 at that depth and there was no distinct thermocline below that depth; salinity peaked between 45 and 90 m, dissolved oxygen peaked at 45 m. Visibility was estimated at 15-18 m from the ROV video.

Dive Number: ARC ROV 11-154A **Location:** USA, Florida, Jacksonville, 200 m Lophelia Site, Peak 1

Dive Imagery:



Figure 1: 30°1.4737'N, 80°11.8101'W 228.2 m
South slope of Lophelia coral mound, shallowest known in western Atlantic waters (200 m depth). *Lophelia pertusa* coral (white- live, and rubble), squat crab (*Eumunida picta*), anemones (Sagartiidae), and cidaroid urchins. (Bottom red lasers = 40 cm).



Figure 2: 30°1.7429'N, 80°11.7505'W 244.8 m
Scattered phosphoritic rocks and soft bottom occur to the north of the coral mound. Gorgonaceae (*Plumerella* sp., Primnoidae) with three cutthroat eels (Synphobranchidae), solitary cup Scleractinia, various small sponges (Demospongiae, Hexactinellida). (Bottom lasers = 40 cm; station keeping with the ROV on this dive was very difficult in the current; as a result, the video and digital still images were very poor quality).



Figure 3: 30°3.292'N, 80°11.2742'W 249.1 m
Swallowtail bass (*Anthias woodsi*) and blackbelly rosefish (*Helicolenus dactylopterus*) on scattered rock habitat north of the coral mound. Rocks encrusted with primnoid gorgonaceae (*Plumerella* sp.), sabellid worm tubes, cup corals, and hydroids.



Figure 4: 30°3.6086'N, 80°11.3631'W 246.3 m
Golden crab (*Chaceon fenneri*) were observed on both soft and hard bottom habitats during the dive.

Dive Number: ARC ROV 11-154A **Location:** USA, Florida, Jacksonville, 200 m Lophelia Site, Peak 1

Dive Notes:

Objectives, Site Description, Habitat, Fauna:

Objective: Survey apparent *Lophelia* coral mound discovered last year on NOAA DSC cruise (Jason II-547, 11/18/2010) and ground truth *Pisces* sonar survey of site. Target site- *Lophelia* mound (from *Pisces* multibeam): 30° 1.506'N, 80° 11.8'N; 208-246 m.

Dive Events: Surface current 2-3 kn; unable to station keep ROV due to current; so continued transect northerly over the target reef and then northeast, skirting several mounds; then north across apparent ledges. [Note- Depth recorded on video and WinFrog displays are now correct. The Arc ROV's top parallel lasers are calibrated at 20cm, bottom lasers 40 cm. The fiber optic cable to the ROV became twisted and broke again. The Arc ROV was taken out of service after this dive.]

Site Description/Habitat/Fauna: *Pisces* shipboard multibeam shows three high-relief mounds, shaped like typical *Lophelia* bioherms; conical, ~250 m diameter (color sonar, Fig. 1). Several smaller mounds and ledges are evident along the eastern survey area. ROV transect crossed the target *Lophelia* coral mound from S to N: south base- 246 m, peak- 208 m, north base- 244 m; maximum relief- 37 m; diameter at base ~250 m. South face (10-30o slope), with nearly 70-100% cover coral rubble and scattered 10-40 cm diameter (up to 1 m) live *Lophelia pertusa* colonies. Peak with 100% coral rubble cover, and scattered 10-30 cm live *Lophelia*. North slope 100% coral rubble and mud with sparse standing dead coral. North of mound, relatively flat mud with coral rubble. Dominant fauna in coral habitat: Fish- black belly rosefish, *Laemonema* (codling), anthiids; Sponges- Hexactinellida; Cnidaria- *Lophelia pertusa*, Plexauridae, Primnoidae; Echinodermata- *Centrostephanus*; Crustacea- *Eumunida*, *Rochinia*, *Cancer*, *Chaceon fenneri* (golden crab).

Skirted the western bases of three other mounds to the NE within the *Pisces* multibeam; these are coral rubble with sparse live and dead standing *Lophelia*. ROV transect continued along double ridge apparent in the Navy side-scan (black and white, Fig. 1); however, the ridges are not apparent in the ROV video; mostly soft sediment with 20-40% cover coral and rock rubble, small boulders to 20 cm; depth 239-242 m.

Percent Cover of Benthic Macro-Biota and Substrate:

ARC ROV 11-154A surveyed a *Lophelia* coral mound and hard-bottom rock habitat to the north of it. With a surface current of 2-3 knots, the ROV and ship were unable to station keep, resulting in a poor survey of the site. We basically had one quick transect over the mound, then northerly, skirting several other mounds, and then some hard-bottom ledges. The photo transects were divided into 3 hard-bottom habitats: *Lophelia* coral mound, base of the mound (hard bottom immediately north of the mound), and north ridge (hard-bottom habitat consisting of rock ledges ~2 nmi north of the *Lophelia* mound). Point count (CPCe[®]) was used to determine percent cover (see methods for details). Figure 1 shows the percent cover of hard bottom and soft bottom substrate for the entire dive; points on biota were scored as the underlying substrate type. Soft bottom substrate is defined as unconsolidated mud or sand. The dive had 27.2% cover of hard bottom which consisted of standing live *Lophelia pertusa* coral, coral rubble, rock pavement, small boulders and ledges. Benthic macro-biota covered 8.3% of the bottom and consisted of coral framework (0.4% cover), non-scleractinian corals (1.5%), and other organisms (6.3%) (Fig. 2, Table 1; see Table 2 for complete species list). The bottom was predominately bare (67.2% bare soft substrate, and 24.4% bare hard bottom). Figure 3 shows the percent cover substrate type for each habitat region of the dive site; the *Lophelia* coral mound was predominately coral rubble (67.3% cover) and standing coral framework (3.3%). The north base of the mound had 18.7% cover of coral rubble but no live coral. The *Lophelia* coral mound had 8.6% cover of biota, including 3.3% coral framework, 0.96% non-scleractinian corals, and 4.3% other organisms (Fig. 4). The north ridge had no framework coral, but more non-scleractinian coral (2.1%) and other organisms (10.2%). Overall sponges were uncommon with <0.1% cover.

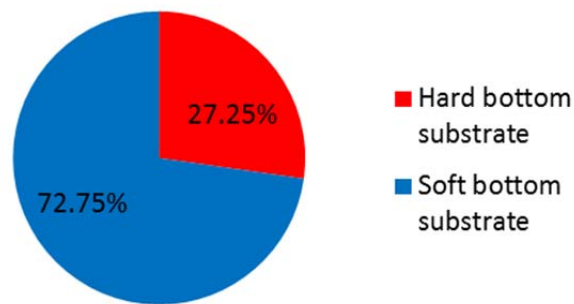


Figure 1. Percent cover of hard and soft bottom substrate at dive site 11-154A. CPCe[®] points on organisms were scored as the underlying substrate (hard or soft).

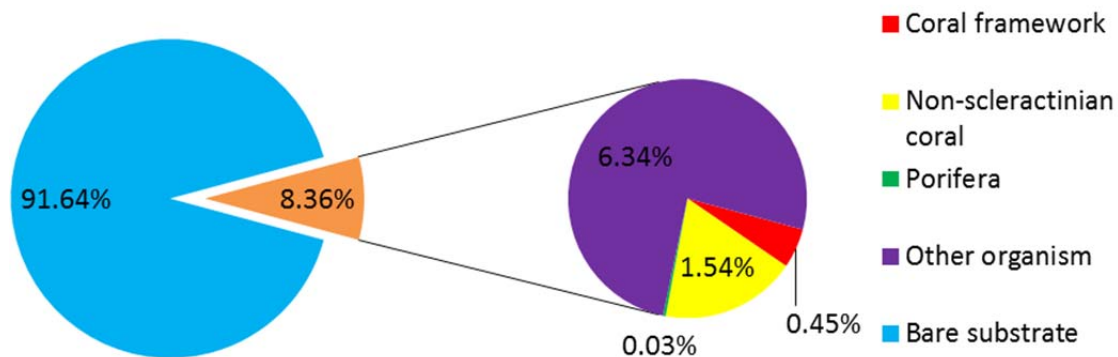


Figure 2. Percent cover of bare substrate and benthic macro-biota at dive site 11-154A. Coral framework is standing, colonial hard coral. Non-scleractinian corals are defined as Gorgonacea, other Alcyonacea, and Antipatharia.

Table 1. Percent cover of benthic macro-biota and substrate types at dive site 11-154A.

Benthic macro-biota and substrate types	% Cover
Coral framework	0.45%
Lophelia pertusa	0.45%
Non-scleractinian coral	1.54%
Gorgonacea, Unid	1.54%
Porifera	0.03%
Porifera- Hexactinellida, Calcarea, or Demospongiae	0.03%
Other organism	6.34%
Bare substrate	91.64%
Bare Soft Bottom substrate	67.21%
Coral rubble	16.39%
Rock- pavement, boulder, ledge	6.66%
Rubble	1.38%
Grand Total	100.00%

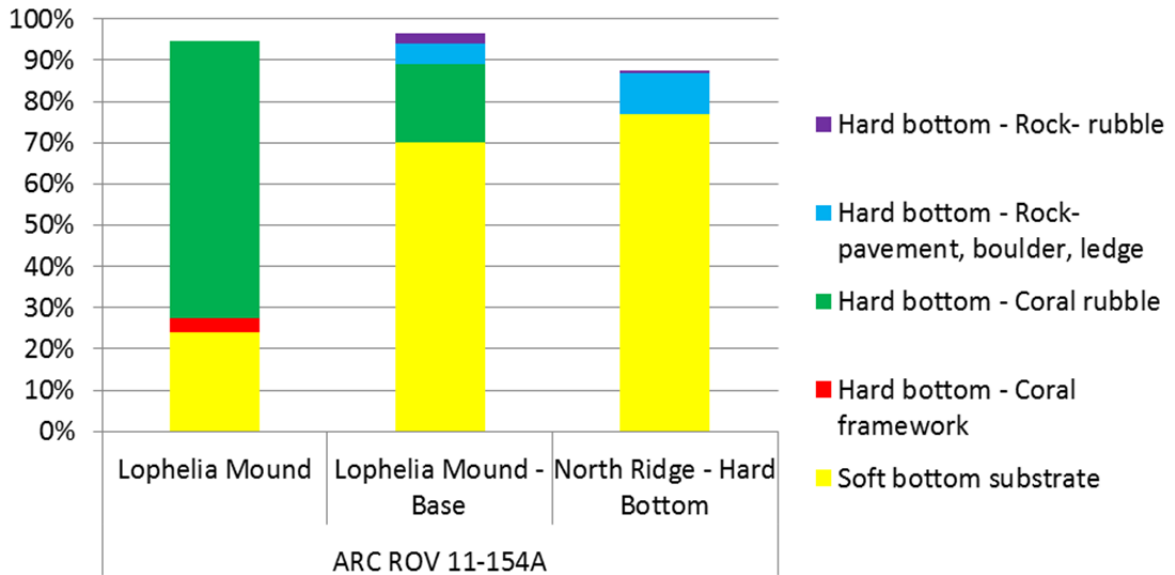


Figure 3. Percent cover of substrate types for each habitat zone at dive site 11-154A.

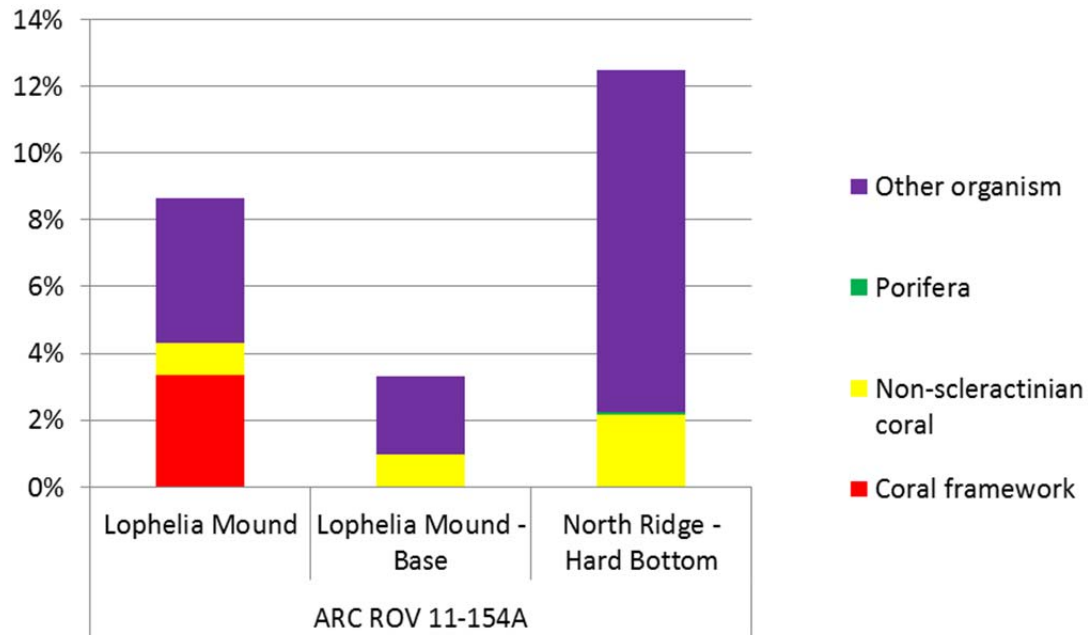


Figure 4. Percent cover of benthic macro-biota for each habitat zone at dive site 11-154A.

Density of Benthic Macro-Biota:

As discussed in the Methods, some common taxa could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phylum. Sponges, gorgonians, and black coral are especially difficult to identify without a specimen in hand. In these cases a general descriptive taxa was used, e.g., “brown lobate sponge” or “unidentified Demospongiae”, which could consist of numerous species. These designations should not be considered equivalent to species level and should not be used for diversity (H') indices calculations. Many deepwater species in this region look nearly identical, such as fan sponges which are polyphyletic and actually include different classes.

Dive site 11-154A had a total of 21 benthic macro-fauna taxa, consisting of 12 Cnidaria and 1 Porifera (Table 2). Overall density of all benthic macro-fauna was 6.6 organisms/m². Cnidaria contributed to 74.3% of the total density at this site, and Porifera 2.0%. Cnidaria dominated with densities of 4.9 organisms/m²; including 0.4 colonies of *Lophelia*/m² and 1.6 Gorgonacea, primarily Primnoidae (*Plumeralla* sp.).

Table 2. Density of benthic macro-biota at site 11-154A (# organisms, number/m², percent of total density).

Phylum/Class/Order/Scientific Name	# Organisms	#/m ²	% of Site
Porifera	5	0.13	2.01%
Demospongiae	5	0.13	2.01%
Cnidaria	185	4.91	74.30%
Anthozoa	181	4.80	72.69%
Actiniaria	66	1.75	26.51%
Actiniaria	41	1.09	16.47%
Sagartiidae	25	0.66	10.04%
Alcyonacea	61	1.62	24.50%

Dive Number: ARC ROV 11-154A **Location:** USA, Florida, Jacksonville, 200 m Lophelia Site, Peak 1

Ellisellidae	4	0.11	1.61%
Gorgonacea (accepted as Alcyonacea)	2	0.05	0.80%
Primnoidae	55	1.46	22.09%
Antipatharia	1	0.03	0.40%
Antipathidae	1	0.03	0.40%
Ceriantharia	1	0.03	0.40%
Cerianthidae	1	0.03	0.40%
Corallimorpharia	4	0.11	1.61%
Corallimorpharia	4	0.11	1.61%
Scleractinia	47	1.25	18.88%
Lophelia pertusa	16	0.42	6.43%
Scleractinia- unid cup	31	0.82	12.45%
Zoanthidea	1	0.03	0.40%
Zoanthidae	1	0.03	0.40%
Hydrozoa	4	0.11	1.61%
Hydrozoa	4	0.11	1.61%
Hydroidolina	4	0.11	1.61%
Annelida	16	0.42	6.43%
Polychaeta	16	0.42	6.43%
Mollusca	20	0.53	8.03%
Cephalopoda	2	0.05	0.80%
Octopoda	2	0.05	0.80%
Octopoda	2	0.05	0.80%
Gastropoda	18	0.48	7.23%
Arthropoda	17	0.45	6.83%
Malacostraca	17	0.45	6.83%
Decapoda	17	0.45	6.83%
Cancer sp.	2	0.05	0.80%
Chaceon fenneri	1	0.03	0.40%
Eumunida sp.	7	0.19	2.81%
Paguroidea	7	0.19	2.81%
Echinodermata	6	0.16	2.41%
Echinoidea	4	0.11	1.61%
Cidaroida	4	0.11	1.61%
Ophiuroidea	2	0.05	0.80%
Grand Total	249	6.61	100.00%

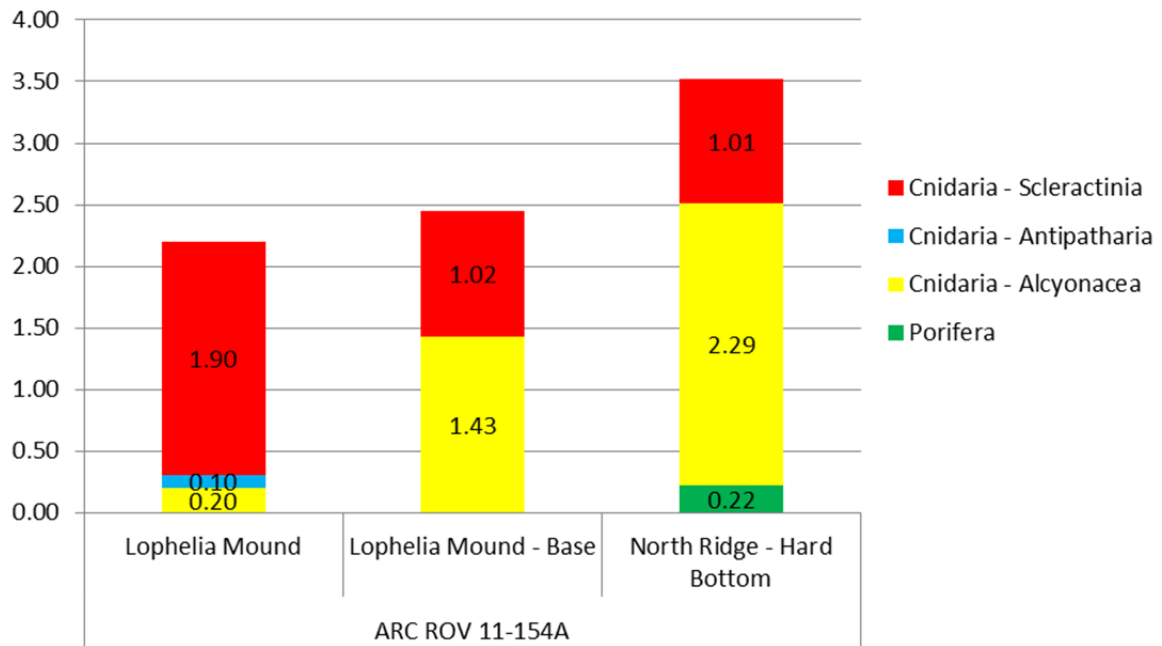


Figure 5. Density (number colonies/m²) of Porifera, hard coral (Stylasteridae, Scleractinia), Antipatharia, and Alcyonacea (Gorgonacea) for each habitat zone of dive site 11-154A.

Figure 5 shows the density of coral for each of the habitat zones at dive site 11-154A. Coral is defined as hard coral (Stylasteridae and Scleractinia), Antipatharia, and Gorgonacea. The *Lophelia* mound had an overall coral density of 2.2 colonies/m², which included 1.9 Scleractinia. The hard-bottom rock ridge had greater overall density of 3.5 organisms/m²; the density of Gorgonacea was greater (2.3 colonies/m²) than at the other habitats, and the Scleractinia were all cup corals.

Fish Data Analysis:

Video transects were used to analyze the fish populations and densities. Protocol for the fish analyses was to divide the continuous video into 5 minute segments, or whenever there was a change in habitat type, whichever came first, so each video segment only contained one habitat type (see Methods for details). These were also correlated with the habitat types used for the benthic analyses. All fish were identified for each ROV dive to species level and counted. The total distance (km) of each dive was used to calculate the density (# individuals/km) of each fish species. The average field of view was about 10-15 m. A total of 10 taxa of fish were identified from dive site 11-154A for a total density of 62 individuals/km (Table 3). These were dominated by *Laemonema* spp. (41 individuals/km), black belly rosefish (15), and anthiids (2.4).

Table 3. Density of fish for all transects at dive site 11-154A (number individuals/km).

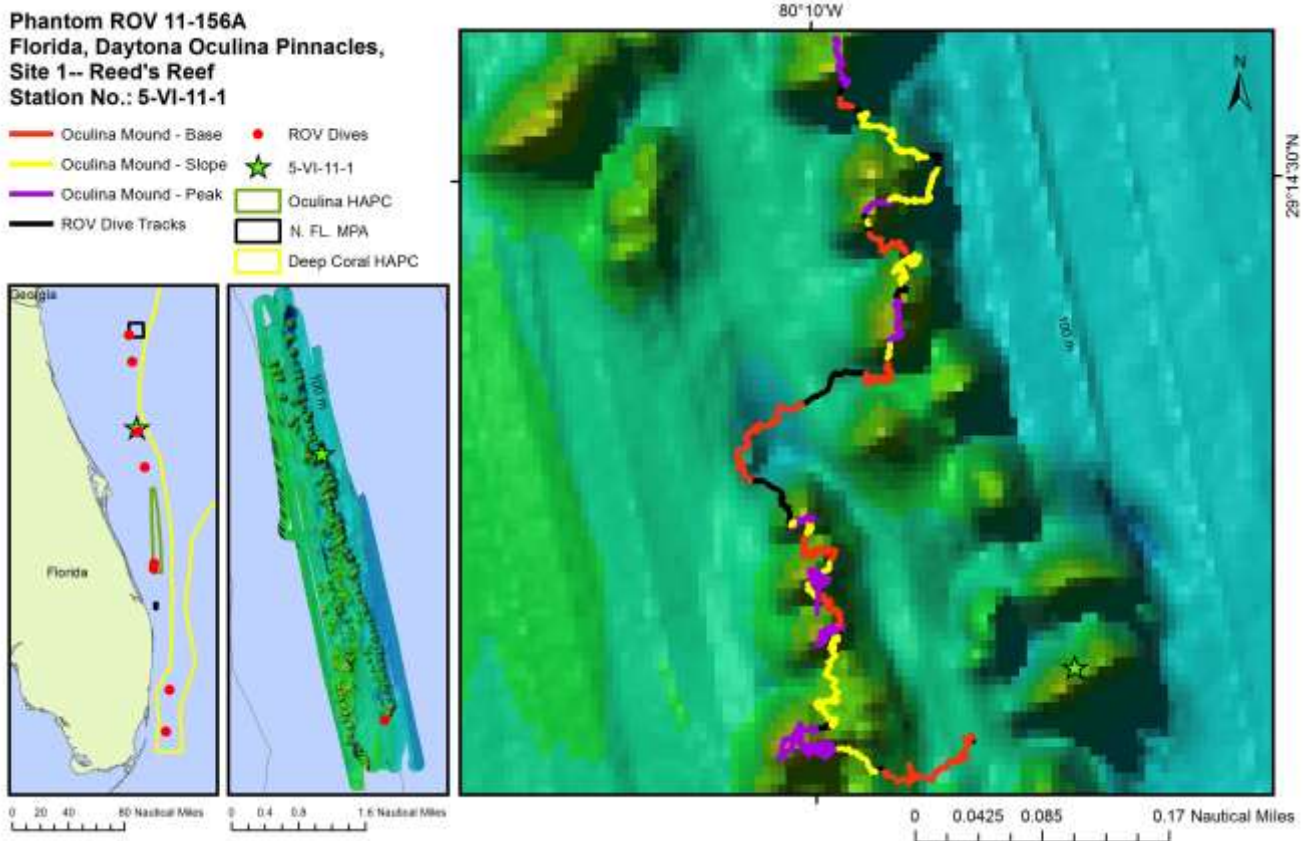
Common Name	Species Name	Density (#/km)
mora	<i>Laemonema</i> sp.	33.3
blackbelly rosefish	<i>Helicolenus dactylopterus</i>	15.8
shortbeard codling	<i>Laemonema barbatulum</i>	8.1
anthiids	Anthiinae	1.6
hake	Gadiformes	1.3
deepwater flounder	<i>Monolene sessilicauda</i>	0.5

Dive Number: ARC ROV 11-154A **Location:** USA, Florida, Jacksonville, 200 m Lophelia Site, Peak 1

swallowtail bass	<i>Anthias woodsi</i>	0.5
spotted hake	<i>Urophycis regius</i>	0.3
anthiids	<i>Anthias sp.</i>	0.2
chain catshark	<i>Scyliorhinus retifer</i>	0.2

Dive Number: Phantom ROV 11- 156A **Location:** USA, Florida, Daytona Oculina Pinnacles, Site 1-- Reed's Reef

General Location and Dive Track:



Site Overview:

Project: 2011 Extreme Corals, NOAA DSCP

Principal Investigator: Andrew W. David

PI Contact Info: 3500 Delwood Beach Rd. Panama City FL 32408

Website: <http://coralreef.noaa.gov/deepseacorals>

Scientific Observers: Andrew W. David, Charles Messing, Diego Figueroa, Jana Thoma, John Reed, Stephanie Farrington

Data Management: Access Database, Excel Spreadsheet, WinFrog

ROV Navigation Data: WinFrog

Ship Position System: DGPS

Report Analyst: John Reed, Stephanie Farrington

Dive Overview:

Vessel: NOAA Ship *Pisces*

Sonar Data: Daytona Oculina Pinnacles: 3_Daytona8.tif

Purpose: Map and characterize DSCE off SE USA

ROV: NOAA SW Fisheries Super Phantom ROV

Sensors Used: Temperature (°C), Dissolved Oxygen (ml/l), Salinity (PSU), Conductivity

Date of Dive: 6/5/2011

Specimens: 3

Digital Photos: 574

DVD: 5

Hard Drive: 2

Date Compiled: 2/20/2013

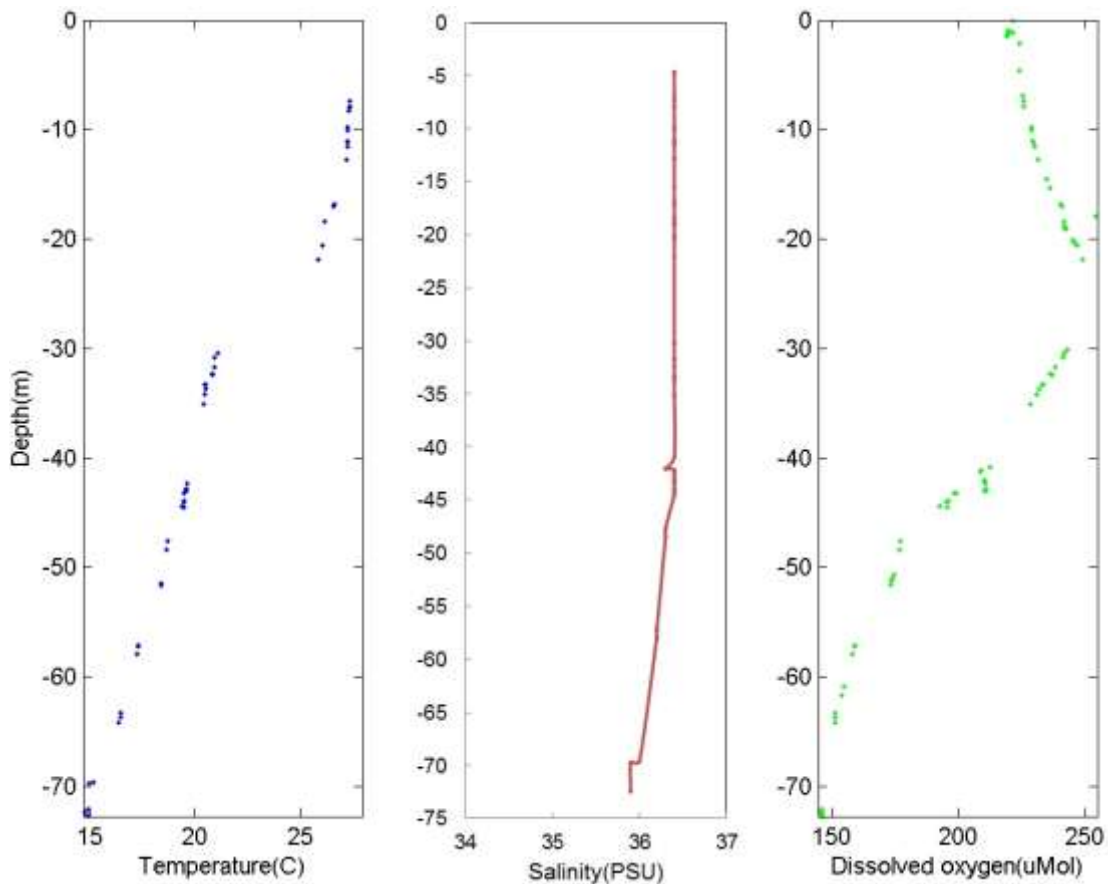
Dive Number: Phantom ROV 11- 156A **Location:** USA, Florida, Daytona Oculina Pinnacles, Site 1-- Reed's Reef

Dive Data:

Minimum Bottom Depth (m): 70	Total Transect Length (km): 2.524
Maximum Bottom Depth (m): 90	Surface Current (kn): 0
On Bottom (Time- GMT): 13:34	On Bottom (Lat/Long): 29°14.1116'N; 80°09.8650'W
Off Bottom (Time- GMT): 17:53	Off Bottom (Lat/Long): 29°14.5875'N; 80°09.9818'W
Physical (bottom); Temp (°C): 14.10	Salinity: 35.80 Visibility (ft): 60 Current (kn): 0

Physical Environment:

CTD Number 11-156A_CTDU



All CTD data were collected with the Super Phantom ROV which recorded depth, temperature (°C), conductivity (salinity, PSU), pressure (mbar), sound velocity (m/sec), oxygen concentration (uMol), and oxygen saturation. These data were used both to support multibeam surveys (sound velocity) and to characterize hydrographic conditions at the dive sites.

The following values were recorded at the maximum depth of this CTD cast (-72.7 m): temperature- 14.9, salinity- 35.9 (taken at 69.7 m), and dissolved oxygen- 146. Surface temperature was 26.7 and there was a thermocline near 20-30 m depth; salinity peaked between 5 and 40 m, dissolved oxygen peaked at 22-30 m. Visibility was estimated at 18-21 m from the ROV video.

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Daytona Oculina Pinnacles, Site 1--
156A Reed's Reef

Dive Imagery:



Figure 1: 29°14.23'N, 80°9.9951'W 71.4 m
Seven deepwater *Oculina* coral mounds (20-35 m relief) were crossed during this ROV dive. The slopes of the mounds are mostly coral rubble and standing dead coral framework which still provides habitat for many benthic species. Corals (*Telesto* sp.- purple gorgonian, *Epizoanthus* sp.- white zoanths, *Callipodium rubens*- pink Alcyonacea), sponges (Poecilosclerida- orange lobate, Spirastrellidae- orange encrusting), sea urchins (*Eucidaris tribuloides*). Bank butterflyfish (*Prognathodes aya*) and yellowtail reef fish (*Chromis enchrysurus*).



Figure 2: 29°14.5833'N, 80°9.9801'W 77.1 m
Small live *Oculina varicosa* colonies are scattered over the coral rubble bottom on these 20-35 m tall coral mounds which are thousands of years old. These individual coral colonies are new growth, less than 10-20 years old, and only grow about 10 mm or less a year. The coral provides habitat for hundreds of species of small invertebrates and in turn for juvenile fish and breeding populations of grouper.



Figure 3: 29°14.3688'N, 80°9.9606'W 85.4 m
Scamp (*Mycteroperca phenax*) takes shelter in ledges of the deepwater *Oculina* coral reef. Corals (Ivory tree coral- *Oculina varicosa*, solitary cup Scleractinia), anemones (*Corallimorphus* sp.), various encrusting sponges, serpulid worms and hydroids.



Figure 4: 29°14.3654'N, 80°9.9467'W 78.1 m
Snowy grouper (*Epinephelus niveatus*) are common on the *Oculina* reefs.

Dive Number: Phantom ROV 11- 156A **Location:** USA, Florida, Daytona Oculina Pinnacles, Site 1-- Reed's Reef

Dive Notes:

Objectives, Site Description, Habitat, Fauna:

Objective: Survey *Oculina* coral mounds and ground truth sonar survey in area outside *Oculina* HAPC and never surveyed previously. Target site- *Oculina* mound (from *Pisces* multibeam): 29° 14.17'N, 80° 9.802'W; 70-90 m.

Dive Events: Surveyed seven *Oculina* mounds at the northern end of the *Pisces* Daytona sonar survey area. [Note- Prior to this dive, the *Arc* ROV was replaced with the *Phantom* ROV for the remainder of the dives. The *Phantom* had standard definition video. The *Phantom's* top parallel lasers are calibrated at 20 cm, bottom lasers 61 cm. Depth recorded in WinFrog is correct; video overlay display is incorrect.]

Site Description/Habitat/Fauna: *Pisces* shipboard multibeam surveyed for first time an area of deep-sea *Oculina* coral mounds along the shelf-edge break, ~40 nmi north of the *Oculina* HAPC. The sonar survey off Daytona covered 5.7 x 0.8 nmi, discovering >100 mounds, 15-35 m relief, forming a very dense linear pattern oriented NNW-SSE. Individual mounds are conical to E-W oriented ridges, 100-500 m wide at the base, and with base depths of 90-95 m, and peaks 60-70 m. Mounds are *Oculina* bioherms; 70-90% coral rubble and mud on slopes (10-45°) and peaks, with scattered live and dead standing colonies of *Oculina varicosa* (white, azooxanthellate); most live colonies are ~10-30 cm diameter. The peaks are generally E-W ridges covered with coral rubble and patches of abundant standing dead coral. Near the base of some mounds is exposed rock pavement and 1-2 m ledges. Valleys between the mounds is mostly soft sediment, sandy mud, and shell hash. Dominant fauna: Fish- scamp (common), few gag and snowy grouper, red porgy, amberjack, tilefish burrow, black seabass, bank butterfly, blue angel, moray, roughtongue bass, bigeye, scorpionfish, batfish, wrasses, Ogcocephalidae; Sponges- Demospongiae, barrel sponge; Cnidaria- *Oculina varicosa* (Ivory tree coral), *Telesto*, Plexauridae, *Titanideum*, *Condylactis gigantea*, Cerianthidae, Antipatharia; Polychaeta- Sabellidae; Echinoderms- *Eucidaris tribuloides*, *Centrostephanus*, *Narcissia trigonaria*, *Astroporpa annulata*.

Dive Number: Phantom ROV 11-156A

Location: USA, Florida, Daytona Oculina Pinnacles, Site 1--Reed's Reef

Percent Cover of Benthic Macro-Biota and Substrate:

Phantom ROV 11-156A surveyed seven newly discovered *Oculina* mounds at the northern end of the new Pisces Daytona sonar survey area. The entire sonar survey covered 4.5 nmi² and had >100 high-relief coral mounds. The dive transects were divided into three habitat types: *Oculina* mound peak, mound slope, and base (area between the mounds). Point count (CPCe[®]) was used to determine percent cover (see methods for details). Figure 1 shows the percent cover of hard bottom and soft bottom substrate; points on biota were scored as the underlying substrate type. Soft bottom substrate is defined as unconsolidated mud or sand. Hard bottom in this region may consist of coral framework which is defined as standing colonial hard coral (either live or dead), coral rubble, rock pavement, or rock ledges. Site 11-156A was predominately hard bottom substrate (94.3% cover), consisting primarily of coral framework (5.1%), coral rubble (53.9%), and rock pavement and ledges (11.2%) (Fig. 2, Table 1). Benthic macro-biota covered 24% of the bottom and consisted of 5.1% coral framework (0.34% live *Oculina*, 4.2% standing dead *Oculina*), 1.5% Porifera, 0.8% non-scleractinian coral, and 16.5% other organisms (Fig. 2, Table 1; see Table 2 for complete species list). Figure 3 shows the percent cover of substrate type for each habitat zone of the dive site. Both the *Oculina* peaks and slopes had >80% cover of coral substrate, consisting of standing coral framework (7.4% and 5.4%, respectively) and coral rubble (66.8% and 64.9%, respectively). Exposed rock ledges and pavement was the predominate substrate at the mound base (35.9% cover). Dead coral is typically described as standing dead or coral rubble, however, it is recognized to be an important component of the habitat. Live coral, coral rubble, and standing dead coral all provide habitat for hundreds of species of invertebrates and juvenile fish (e.g., Reed et al., 1982, 1987, 2002; Ross and Quattrini, 2007), in addition to commercially valuable species (e.g., Reed and Farrington, 2010).

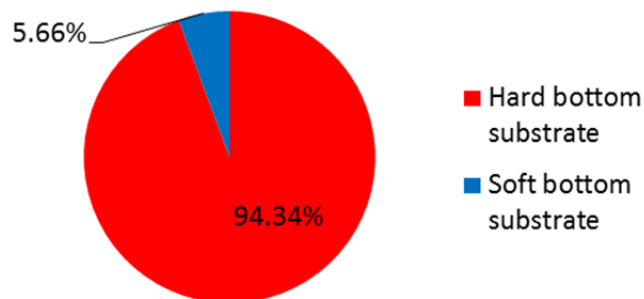


Figure 1. Percent cover of hard and soft bottom substrate at dive site 11-156A. CPCe[®] points on organisms were scored as the underlying substrate (hard or soft).

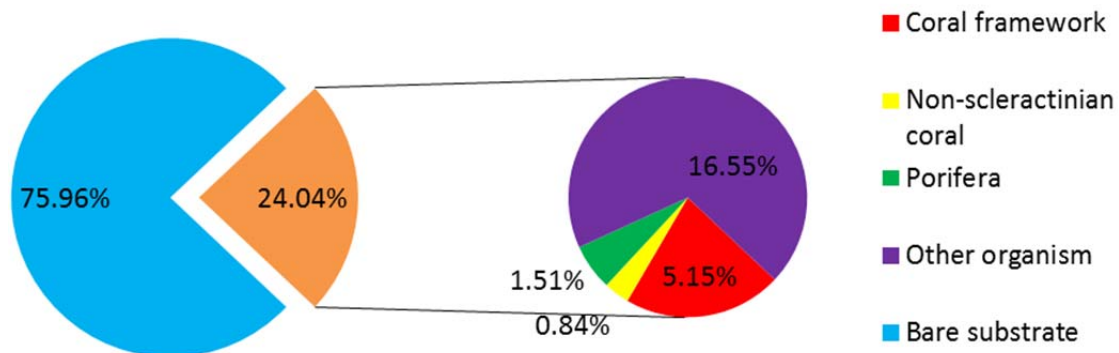


Figure 2. Percent cover of bare substrate and benthic macro-biota at dive site 11-156A. Coral framework is standing, colonial hard coral. Non-scleractinian corals are defined as Gorgonacea, other Alcyonacea, and Antipatharia.

Dive Number: Phantom ROV 11-156A

Location: USA, Florida, Daytona Oculina Pinnacles, Site 1--Reed's Reef

Table 1. Percent cover of benthic macro-biota and substrate types at dive site 11-154A.

Benthic macro-biota and substrate types	% Cover
Coral framework	5.15%
Oculina varicosa	0.34%
Scleractinia, unid	0.60%
Standing Dead Coral	4.21%
Non-scleractinian coral	0.84%
Alcyonacea	0.60%
Antipatharia	0.21%
Gorgonacea, Unid	0.03%
Porifera	1.51%
Porifera- Hexactinellida, Calcarea, or Demospongiae	1.51%
Other organism	16.54%
Bare substrate	75.95%
Bare Soft Bottom substrate	4.88%
Coral rubble	53.94%
Rock- pavement, boulder, ledge	11.22%
Rubble	5.90%
Human debris	0.02%
Fishing line/long line	0.02%
Grand Total	100.00%

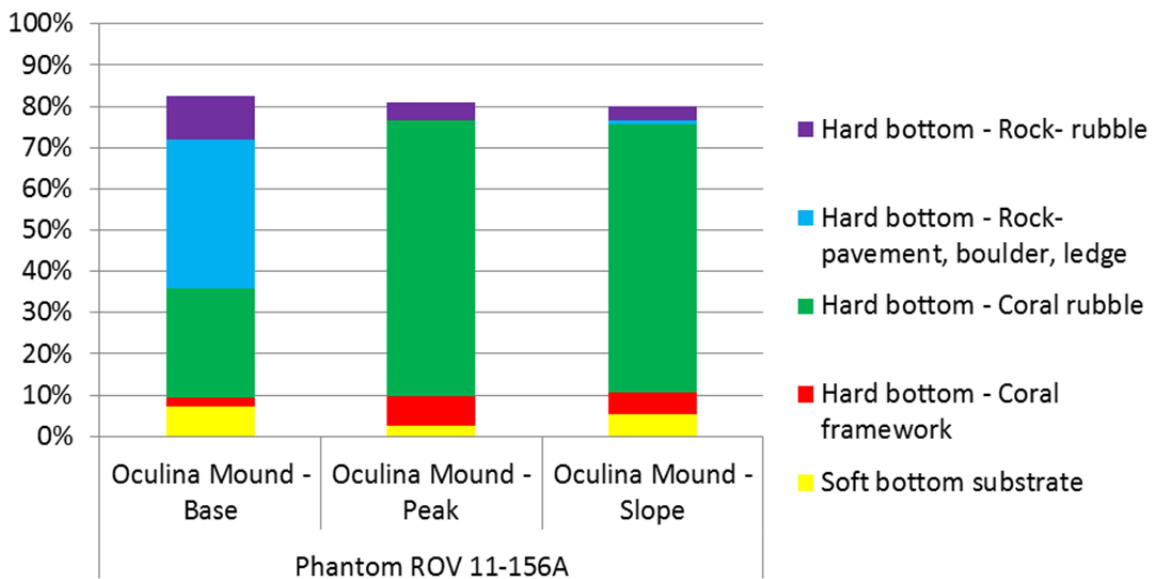


Figure 3. Percent cover of substrate types for each habitat zone at dive site 11-156A.

Dive Number: Phantom ROV 11-156A

Location: USA, Florida, Daytona Oculina Pinnacles, Site 1--Reed's Reef

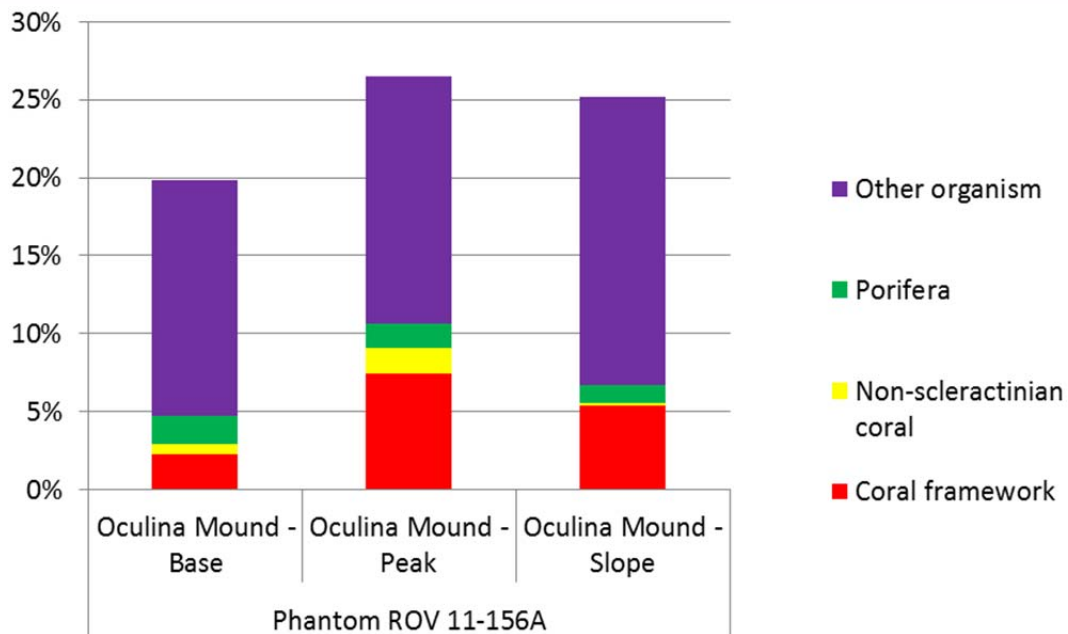


Figure 4. Percent cover of benthic macro-biota for each habitat zone at dive site 11-156A.

The percent cover of biota by habitat type shows the greatest cover of biota was on the *Oculina* mound peaks and slopes (26.% and 25.2%, respectively). Coral framework was greatest on the mounds (7.4% cover on the peaks) although 2.3% cover was also the flat areas between the mounds. Non-scleractinian coral cover on the peaks was 1.6% and sponge cover was also 1.6%.

Density of Benthic Macro-Biota:

As discussed in the Methods, some common taxa could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phylum. Sponges, gorgonians, and black coral are especially difficult to identify without a specimen in hand. In these cases a general descriptive taxa was used, e.g., “brown lobate sponge” or “unidentified Demospongiae”, which could consist of numerous species. These designations should not be considered equivalent to species level and should not be used for diversity (H') indices calculations. Many deepwater species in this region look nearly identical, such as fan sponges which are polyphyletic and actually include different Classes.

Dive site 11-156A had a total of 52 benthic macro-fauna taxa, consisting of 19 Cnidaria and 4 Porifera (Table 2). Overall density of all benthic macro-fauna was 24.9 organisms/m². Cnidaria contributed to 42.1% of the total density at this site, and Porifera 9.3%. Demosponges and Cnidaria dominated with densities of 2.3 and 10.5 colonies/m², respectively. Alcyonacea, primarily Gorgonacea, contributed to 2.4 colonies/m². Scleractinia overall was 2.7 colonies/m², with standing *Oculina* colonies at 0.86.

Table 2. Density of benthic macro-biota at site 11-156A (# organisms, number/m², percent of total density).

Phylum/Class/Order/Scientific Name	# Organisms	#/m ²	% of Site
Porifera	169	2.31	9.27%
Demospongiae	169	2.31	9.27%

Dive Number: Phantom ROV 11-156A

Location: USA, Florida, Daytona Oculina Pinnacles, Site 1--Reed's Reef

Dictyoceratida	2	0.03	0.11%
Ircinia campana	1	0.01	0.05%
Ircinia felix	1	0.01	0.05%
Hadromerida	90	1.23	4.94%
Spirastrellidae	90	1.23	4.94%
Demospongiae	77	1.05	4.22%
Demospongiae	77	1.05	4.22%
Cnidaria	767	10.47	42.07%
Anthozoa	656	8.96	35.98%
Actiniaria	27	0.37	1.48%
Actiniaria	27	0.37	1.48%
Alcyonacea	173	2.36	9.49%
Alcyonacea	15	0.20	0.82%
Diodogorgia sp.	1	0.01	0.05%
Gorgonacea (accepted as Alcyonacea)	1	0.01	0.05%
Nidalia occidentalis	7	0.10	0.38%
Telesto sp.	149	2.03	8.17%
Antipatharia	8	0.11	0.44%
Antipathidae	1	0.01	0.05%
Stichopathes lutkeni	4	0.05	0.22%
Tanacetipathes hirta	3	0.04	0.16%
Ceriantharia	13	0.18	0.71%
Cerianthidae	13	0.18	0.71%
Corallimorpharia	6	0.08	0.33%
Corallimorphus sp.	6	0.08	0.33%
Scleractinia	196	2.68	10.75%
Cladocora sp.	86	1.17	4.72%
Oculina varicosa	10	0.14	0.55%
Oculina varicosa- dead standing	53	0.72	2.91%
Phyllangia americana	29	0.40	1.59%
Scleractinia- unid cup	18	0.25	0.99%
Zoanthidea	233	3.18	12.78%
Palythoa sp.	4	0.05	0.22%
Zoanthidae	229	3.13	12.56%
Hydrozoa	111	1.52	6.09%
Hydrozoa	111	1.52	6.09%
Hydroidolina	102	1.39	5.60%
Hydroidolina- long pine	9	0.12	0.49%
Annelida	385	5.26	21.12%
Polychaeta	385	5.26	21.12%
Amphinomida	1	0.01	0.05%
Amphinomida	1	0.01	0.05%
Sabellida	117	1.60	6.42%

Dive Number: Phantom ROV 11-156A

Location: USA, Florida, Daytona Oculina Pinnacles, Site 1--Reed's Reef

Sabellidae	66	0.90	3.62%
Serpulidae	51	0.70	2.80%
Polychaeta	267	3.65	14.65%
Polychaeta	267	3.65	14.65%
Mollusca	15	0.20	0.82%
Gastropoda	15	0.20	0.82%
Caenogastropoda	8	0.11	0.44%
Vermicularia knorrii	8	0.11	0.44%
Neogastropoda	2	0.03	0.11%
Murex sp.	2	0.03	0.11%
Gastropoda	5	0.07	0.27%
Calliostoma sp.	1	0.01	0.05%
Gastropoda	4	0.05	0.22%
Arthropoda	93	1.27	5.10%
Malacostraca	85	1.16	4.66%
Amphipoda	73	1.00	4.00%
Corophiidea	73	1.00	4.00%
Decapoda	12	0.16	0.66%
Decapoda	1	0.01	0.05%
Majidae	1	0.01	0.05%
Paguroidea	4	0.05	0.22%
Parthenope sp.	1	0.01	0.05%
Stenocionops sp.	1	0.01	0.05%
Stenorhynchus seticornis	4	0.05	0.22%
Pycnogonida	8	0.11	0.44%
Pantopoda	8	0.11	0.44%
Anoplodactylus lentus	8	0.11	0.44%
Bryozoa	4	0.05	0.22%
Gymnolaemata	4	0.05	0.22%
Cheilostomatida	4	0.05	0.22%
Hippoporidra	4	0.05	0.22%
Echinodermata	387	5.28	21.23%
Asteroidea	16	0.22	0.88%
Forcipulatida	1	0.01	0.05%
Coscinasterias tenuispina	1	0.01	0.05%
Valvatida	13	0.18	0.71%
Goniasteridae	12	0.16	0.66%
Narcissia trigonaria	1	0.01	0.05%
Asteroidea	2	0.03	0.11%
Asteroidea	1	0.01	0.05%
Asteroidea- red spotted	1	0.01	0.05%
Echinoidea	368	5.02	20.19%

Dive Number: Phantom ROV 11-156A

Location: USA, Florida, Daytona Oculina Pinnacles, Site 1--Reed's Reef

Arbacioda	96	1.31	5.27%
Arbacia punctulata	96	1.31	5.27%
Cidaroida	264	3.60	14.48%
Eucidaris tribuloides	264	3.60	14.48%
Diadematoida	6	0.08	0.33%
Centrostephanus longispinus	6	0.08	0.33%
Echinoidea	2	0.03	0.11%
Ophiuroidea	3	0.04	0.16%
Euryalida	2	0.03	0.11%
Asteroporpa annulata	2	0.03	0.11%
Ophiuroidea	1	0.01	0.05%
Chordata	2	0.03	0.11%
Ascidiacea	2	0.03	0.11%
Human debris	1	0.01	0.05%
Human debris	1	0.01	0.05%
Human debris	1	0.01	0.05%
Human debris- cans/bottles	1	0.01	0.05%
Grand Total	1823	24.89	100.00%

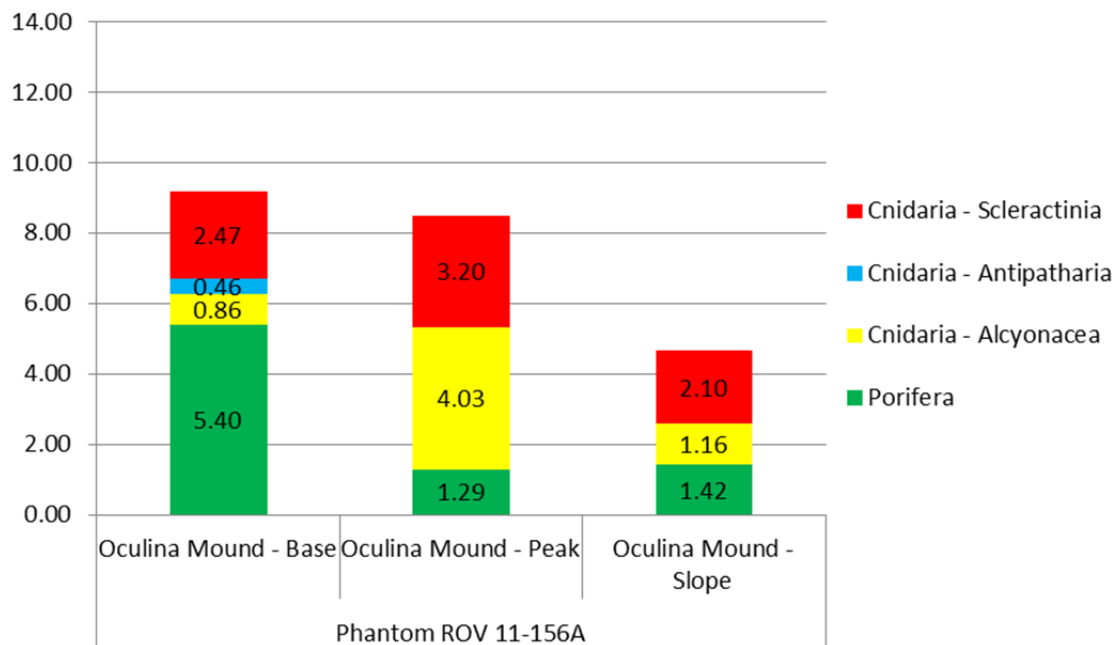


Figure 5. Density (number colonies/m²) of Porifera, hard coral (Scleractinia), Antipatharia, and Alcyonacea (Gorgonacea) for each habitat zone of dive site 11-156A.

Figure 5 shows the density of Porifera and coral for each of the habitats at dive site 11-156A. Coral is defined as hard coral (Scleractinia), Antipatharia, and Gorgonacea. The *Oculina* peaks had the greatest density of scleractinian corals (3.2 colonies/m²), but they were also common on the slopes (2.3) and base (2.5). Alcyonacea cover was also greatest on the peaks (4.0) and sponges had the greatest density at the mound bases (5.4 colonies/m²). In addition to these analyses of the digital still photo transects, a total count of live standing

Dive Number: Phantom ROV 11-156A

Location: USA, Florida, Daytona Oculina Pinnacles, Site 1--Reed's Reef

Oculina coral colonies was made from the forward-looking video camera for the entire dive. For this dive, 33 colonies were counted in the video and ranged in size from ~15 to 30 cm, which is equivalent to possibly 10-20 years old. Since the actual video field-of-view is just a small portion of the total mound area, we calculated the estimated field-of-view area for the dive [field-of-view width (~10 m) x transect length = area of the video transect]. From this we estimated the total number of live *Oculina* corals that may occur over the entire mound area at that dive site. In ArcGis we calculated the total planar surface area of the coral mounds that were transected during the dive which was 160,610 m². We then multiplied the density of coral in the video and by the total mound surface area. We estimate a total of 217 live coral colonies may occur on these 7 *Oculina* mounds.

Fish Data Analysis:

Video transects were used to analyze the fish populations and densities. Protocol for the fish analyses was to divide the continuous video into 5 minute segments, or whenever there was a change in habitat type, whichever came first, so each video segment only contained one habitat type (see Methods for details). These were also correlated with the habitat types used for the benthic analyses. All fish were identified for each ROV dive to species level and counted. The total distance (km) of each dive was used to calculate the density (# individuals/km) of each fish species. The average field of view was about 10-15 m. A total of 25 taxa of fish were identified from dive site 11-156A for a total density of 485 individuals/km (Table 3). These were dominated by *Centropristes* sp. (328 individuals/km; either black sea bass and/or bank sea bass but were too far away to distinguish), bank sea bass (41), roughtongue bass (30) and unidentified anthiids (25; either roughtongue bass or red barbier). Managed species included scamp (6.3/km), black sea bass (5.2), amberjack (1.6), red porgy (1.6), and snowy grouper (0.8).

Table 3. Density of fish for all transects at dive site 11-156A (number individuals/km).

Common Name	Species Name	Density (#/km)
sea bass	<i>Centropristes</i> sp.	327.7
bank sea bass	<i>Centropristes ocyurus</i>	40.8
roughtongue bass	<i>Pronotogrammus martinicensis</i>	29.7
anthiids	Anthiinae	24.6
tattler	<i>Serranus phoebe</i>	11.1
bank butterflyfish	<i>Prognathodes aya</i>	8.3
short bigeye	<i>Pristigenys alta</i>	7.1
scamp	<i>Mycteroperca phenax</i>	6.3
black sea bass	<i>Centropristes striata</i>	5.2
yellowtail reefish	<i>Chromis enchrysurus</i>	4.4
red barbier	<i>Hemanthias vivanus</i>	4.0
wrasse	<i>Halichoeres</i> sp.	2.8
saddle bass	<i>Serranus notospilus</i>	2.0
scorpionfish	Scorpaenidae	2.0
amberjack	<i>Seriola</i> sp.	1.6
red porgy	<i>Pagrus pagrus</i>	1.6
blue angelfish	<i>Holacanthus bermudensis</i>	1.2
apricot bass	<i>Plectranthias garrupellus</i>	0.8
longnose batfish	<i>Ogcocephalus corniger</i>	0.8
snowy grouper	<i>Epinephelus niveatus</i>	0.8

Dive Number: Phantom ROV 11-156A

Location: USA, Florida, Daytona Oculina Pinnacles, Site 1--Reed's Reef

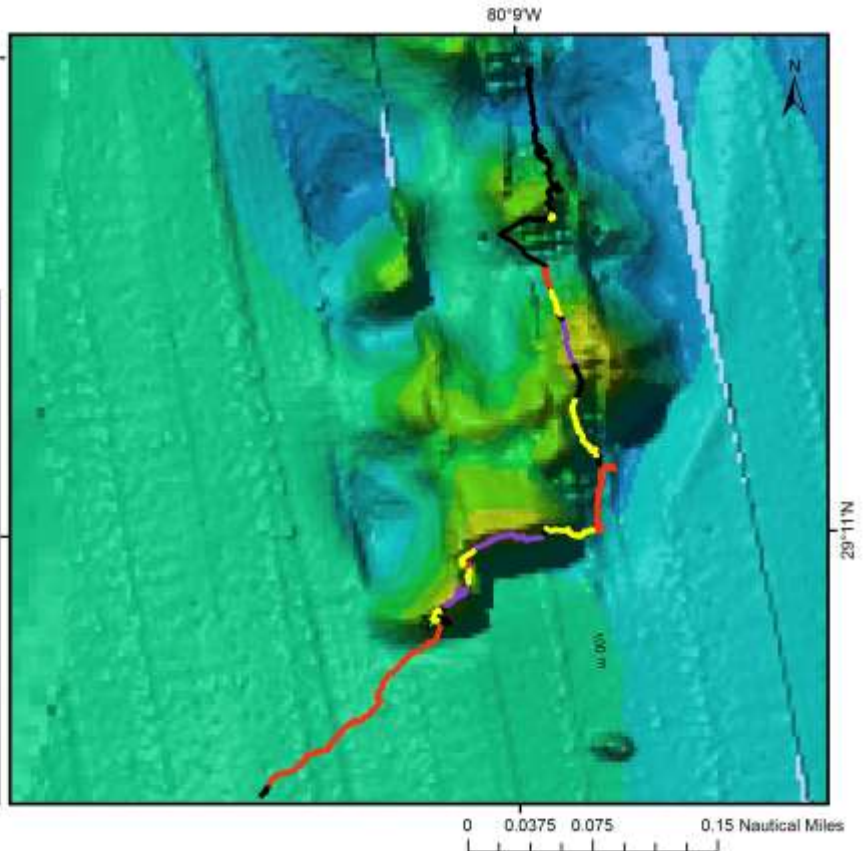
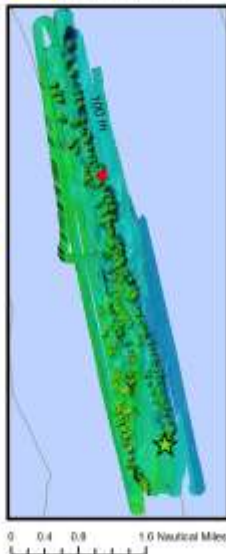
wrasse bass	<i>Liopropoma eukrines</i>	0.8
moray eel	Muraenidae	0.4
sand diver	<i>Synodus intermedius</i>	0.4
sea bass	Serranidae	0.4
sea bass	<i>Serranus sp.</i>	0.4

Dive Number: Phantom ROV 11- 156B **Location:** USA, Florida, Daytona Oculina Pinnacles, Site 2-- Reed's Reef Southern End Eastern Ridge

General Location and Dive Track:

Phantom ROV 11-156B
Florida, Daytona Oculina Pinnacles, Site 2--
Reed's Reef Southern End Eastern Ridge
Station No.: 5-VI-11-2

- Oculina Mound - Base
- Oculina Mound - Slope
- Oculina Mound - Peak
- ROV Dive Tracks
- ROV Dives
- ★ 5-VI-11-2
- Oculina HAPC
- N. FL MPA
- Deep Coral HAPC



Site Overview:

Project: 2011 Extreme Corals, NOAA DSCP
Principal Investigator: Andrew W. David
PI Contact Info: 3500 Delwood Beach Rd. Panama City FL 32408
Website: <http://coralreef.noaa.gov/deepseacorals>
Scientific Observers: Andrew W. David, Charles Messing, Diego Figueroa, Jana Thoma, John Reed, Stephanie Farrington
Data Management: Access Database, Excel Spreadsheet, WinFrog
ROV Navigation Data: WinFrog
Ship Position System: DGPS
Report Analyst: John Reed, Stephanie Farrington

Dive Overview:

Vessel: NOAA Ship *Pisces*
Sonar Data: Daytona Oculina Pinnacles: 3_Daytona8.tif
Purpose: Map and characterize DSCE off SE USA
ROV: NOAA SW Fisheries Super Phantom ROV
Sensors Used: Temperature (°C), Dissolved Oxygen (ml/l), Salinity (PSU), Conductivity
Date of Dive: 6/5/2011
Specimens: 0
Digital Photos: 270
DVD: 3
Hard Drive: 1
Date Compiled: 2/20/2013

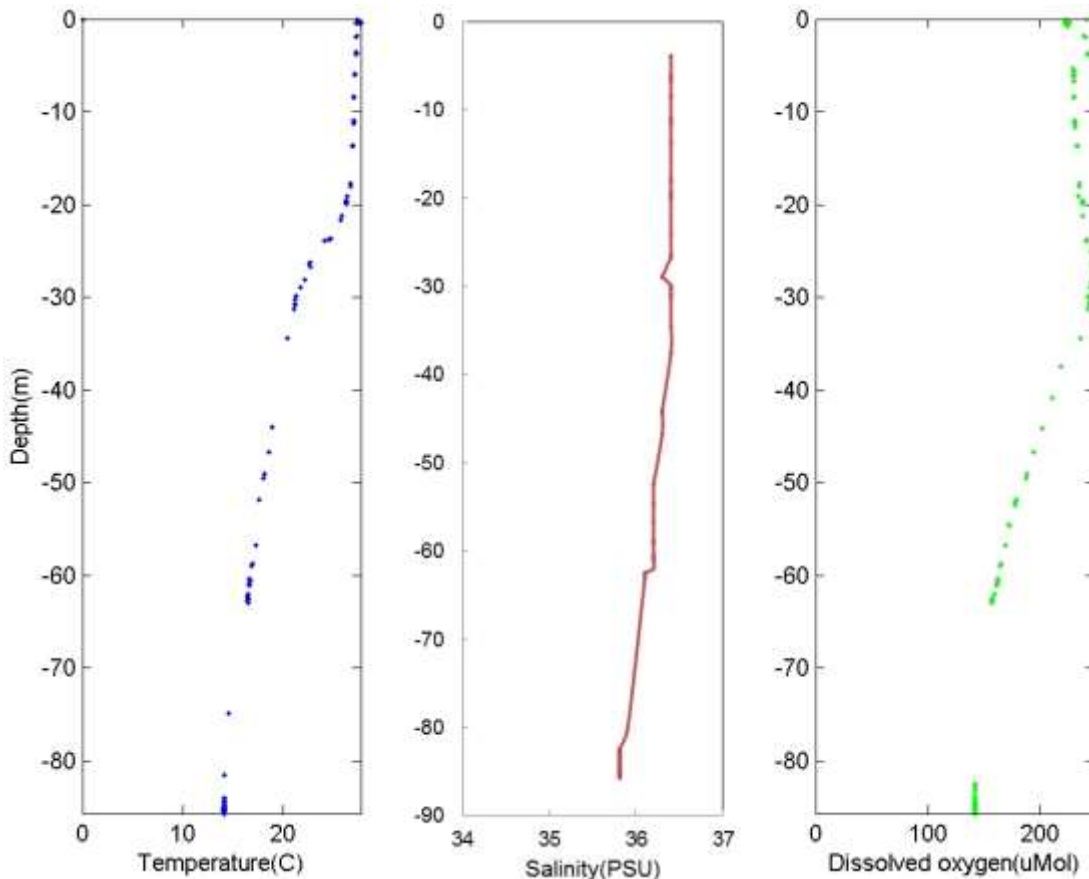
Dive Number: Phantom ROV 11- 156B **Location:** USA, Florida, Daytona Oculina Pinnacles, Site 2-- Reed's Reef Southern End Eastern Ridge

Dive Data:

Minimum Bottom Depth (m): 70	Total Transect Length (km): 1.338
Maximum Bottom Depth (m): 92	Surface Current (kn): 0
On Bottom (Time- GMT): 19:45	On Bottom (Lat/Long): 29°10.8294'N; 80°09.1835'W
Off Bottom (Time- GMT): 21:47	Off Bottom (Lat/Long): 29°11.2592'N; 80°08.9894'W
Physical (bottom); Temp (°C): 14.10	Salinity: 35.81 Visibility (ft): 40 Current (kn): 0

Physical Environment:

CTD Number 11-156B_CTDD



All CTD data were collected with the Super Phantom ROV which recorded depth, temperature (°C), conductivity (salinity, PSU), pressure (mbar), sound velocity (m/sec), oxygen concentration (uMol), and oxygen saturation. These data were used both to support multibeam surveys (sound velocity) and to characterize hydrographic conditions at the dive sites.

The following values were recorded at the maximum depth of this CTD cast (85.7 m): temperature- 14.2, salinity- 35.8, and dissolved oxygen- 142.2. Surface temperature was 27.3 and there was a thermocline near 20 m depth; salinity peaked between 0 and 28 m, dissolved oxygen peaked at 30 m. Visibility was estimated at 12-15 m from the ROV video.

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Daytona Oculina Pinnacles, Site 2--
156B Reed's Reef Southern End Eastern Ridge

Dive Imagery:



Figure 1: 29°10.9816'N, 80°9.0396'W 71.4 m
Small live *Oculina varicosa* colonies are scattered over the coral rubble bottom on these 20-35 m tall coral mounds which are thousands of years old. These individual coral colonies are new growth, less than 10-20 years old, and only grow about 10 mm or less a year. Coral (Ivory tree coral- *Oculina varicosa*, solitary cup Scleractinia), *Epizoanthus* sp. zoanths, sea urchins (*Arbacia punctulata*, *Eucidaris tribuloides*), various demosponges, hydroids. Bank sea bass (*Centropristis ocyurus*), juvenile black sea bass (*Centropristis striata*) and apricot bass (*Plectranthias garrupellis*).



Figure 2: 29°10.9745'N, 80°9.0355'W 78.4 m
Four deepwater *Oculina* coral mounds (20-35 m relief) were crossed during this ROV dive. The slopes of the mounds are mostly coral rubble and standing dead coral framework which still provides habitat for many benthic species. This species of giant red brittlestar (*Ophioderma devanyi*) was first discovered and described from the deepwater *Oculina* coral reefs. (Parallel red lasers - 20 cm).



Figure 3: 29°11.0638'N, 80°8.9599'W 80.5 m
This snowy grouper (*Epinephelus niveatus*; ~50 cm) takes shelter in a small cave on the deepwater *Oculina* reef.



Figure 4: 29°11.0015'N, 80°8.9499'W 86.3 m
Ocellated moray eel (*Gymnothorax saxicola*) in a burrow of coral rubble. Coral (*Cladocora* sp.- pink cluster coral, Scleractinia cup corals), anemone (*Corallimorphus* sp.), sabellid polychaetes, and hydroids.

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Daytona Oculina Pinnacles, Site 2--
156B Reed's Reef Southern End Eastern Ridge

Dive Notes:

Objectives, Site Description, Habitat, Fauna:

Objective: Survey *Oculina* coral mounds and ground truth sonar survey in area outside *Oculina* HAPC and never surveyed previously. Target site- *Oculina* mound (from *Pisces* multibeam): 29° 10.948'N, 80° 9.0585'W; 70-90 m.

Dive Events: ROV transect surveyed four *Oculina* mounds at the southern end of the *Pisces* Daytona sonar survey area. One colony (15 cm) of *Oculina varicosa* was collected with a by-catch of two crabs. [Note- The *Phantom* ROV's top parallel lasers are calibrated at 20 cm, bottom lasers 61 cm. Depth recorded in WinFrog is correct; video overlay display is incorrect.]

Site Description/Habitat/Fauna: ROV ground-truthed that the mounds are *Oculina* bioherms; ~70-95% coral rubble and mud on slopes (10-45°) and peaks, with scattered live and dead standing colonies of *Oculina varicosa* (white, azooxanthellate); most colonies are ~10-30 cm diameter. Individual mounds are E-W oriented ridges with base depths of 85-95 m, peaks ~70 m, and 125-340 m wide at the base. The peaks are covered with coral rubble and patches of abundant standing dead coral. Near the base of some mounds is exposed rock pavement and 1-2 m ledges. Valleys between the mounds is mostly soft sediment, sandy mud, and shell hash. Dominant fauna: Fish- snowy grouper, dozens of greater amberjack, black seabass, bank butterfly, bigeye, rough-tongue bass; Cnidaria- *Oculina varicosa* (Ivory tree coral), dense burrowing anemones Cerianthidae, *Virgularia*, *Stichopathes*, hydroids; Echinoderms- *Ophioderma devaneyi*, dense congregations of black long-spined urchins *Centrostephanus*, *Arbacia punctulata*, *Eucidaris tribuloides*.

Dive Number: Phantom ROV 11-156B

Location: USA, Florida, Daytona Oculina Pinnacles, Site 2--Reed's Reef Southern End Eastern Ridge

Percent Cover of Benthic Macro-Biota and Substrate:

Phantom ROV 11-156B surveyed four newly discovered *Oculina* mounds at the southern end of the new *Pisces* Daytona sonar survey area. The entire sonar survey covered 4.5 nmi² and had >100 high-relief coral mounds. The dive transects were divided into three habitat types: *Oculina* mound peak, mound slope, and base (area between the mounds). Point count (CPCe[®]) was used to determine percent cover (see methods for details). Figure 1 shows the percent cover of hard bottom and soft bottom substrate; points on biota were scored as the underlying substrate type. Soft bottom substrate is defined as unconsolidated mud or sand. Hard bottom in this region may consist of coral framework which is defined as standing colonial hard coral (either live or dead), coral rubble, rock pavement, or rock ledges. Site 11-156B was predominately hard bottom substrate (93.1% cover), consisting primarily of coral framework (4.3%), coral rubble (68.8%), and rock pavement and ledges (2.55%) (Fig. 2, Table 1). Benthic macro-biota covered 21.7% of the bottom and consisted of 4.3% coral framework (0.9% live *Oculina*, 2.9% standing dead *Oculina*), 3.9% Porifera, 0.3% non-scleractinian coral, and 13.2% other organisms (Fig. 2, Table 1; see Table 2 for complete species list). Figure 3 shows the percent cover of substrate type for each habitat zone of the dive site. Both the *Oculina* peaks and slopes have >80% cover of coral substrate, consisting of standing coral framework (3.5% and 6.3%, respectively) and coral rubble (74.3% and 64.9%, respectively). Exposed rock ledges and pavement also occurred on the flat areas of the mound base (8.5% cover). Dead coral is typically described as standing dead or coral rubble, however, it is recognized to be an important component of the habitat. Live coral, coral rubble, and standing dead coral provide habitat for hundreds of species of invertebrates and juvenile fish (e.g., Reed et al., 1982, 1987, 2002; Ross and Quattrini, 2007), in addition to commercially valuable species (e.g., Reed and Farrington, 2010).

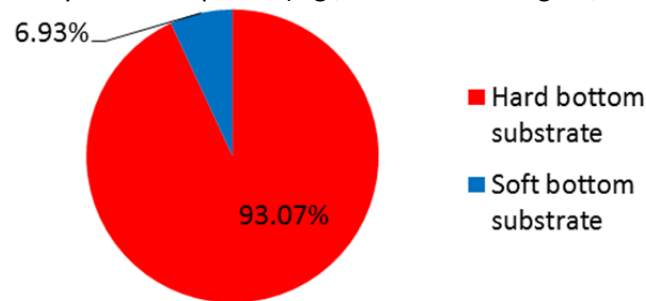


Figure 1. Percent cover of hard and soft bottom substrate at dive site 11-156B. CPCe[®] points on organisms were scored as the underlying substrate (hard or soft).

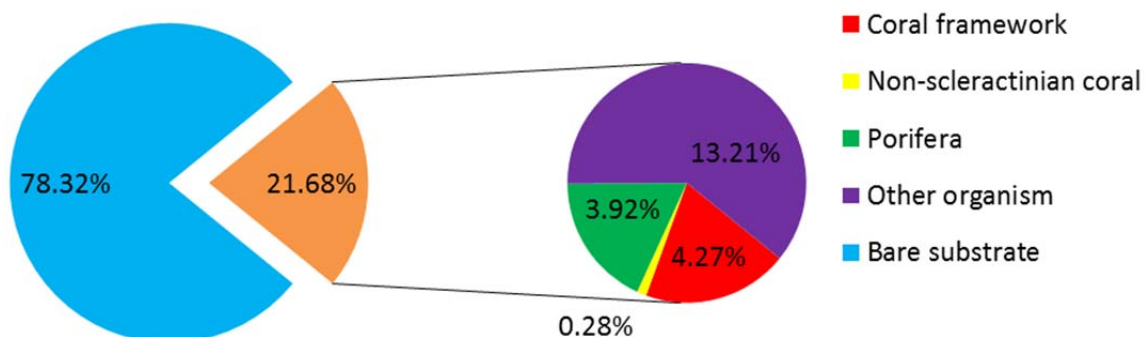


Figure 2. Percent cover of bare substrate and benthic macro-biota at dive site 11-156B. Coral framework is standing, colonial hard coral. Non-scleractinian corals are defined as Gorgonacea, other Alcyonacea, and Antipatharia.

Dive Number: Phantom ROV 11-156B

Location: USA, Florida, Daytona Oculina Pinnacles, Site 2--Reed's Reef Southern End Eastern Ridge

Table 1. Percent cover of benthic macro-biota and substrate types at dive site 11-156B.

Benthic macro-biota and substrate types	% Cover
Coral framework	4.27%
Oculina varicosa	0.92%
Scleractinia, unid	0.47%
Standing Dead Coral	2.89%
Non-scleractinian coral	0.28%
Alcyonacea	0.11%
Antipatharia	0.17%
Porifera	3.92%
Porifera- Hexactinellida, Calcarea, or Demospongiae	3.92%
Other organism	13.21%
Bare substrate	78.32%
Bare Soft Bottom substrate	6.90%
Coral rubble	68.82%
Rock- pavement, boulder, ledge	2.55%
Rubble	0.06%
Grand Total	100.00%

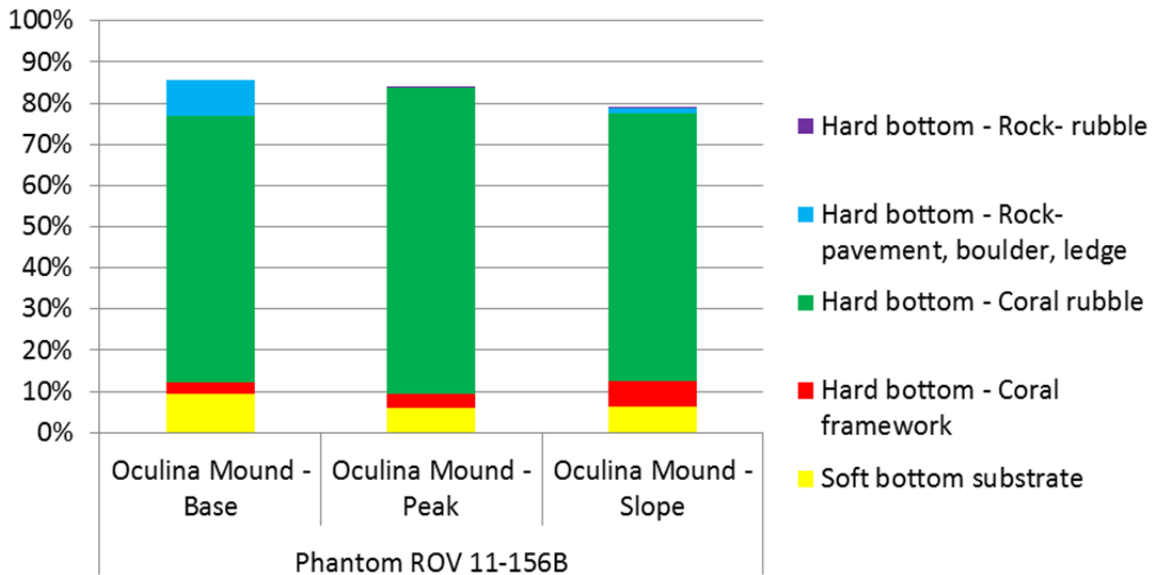


Figure 3. Percent cover of substrate types and biota for each habitat zone at dive site 11-156B.

Dive Number: Phantom ROV 11-156B

Location: USA, Florida, Daytona Oculina Pinnacles, Site 2-- Reed's Reef Southern End Eastern Ridge

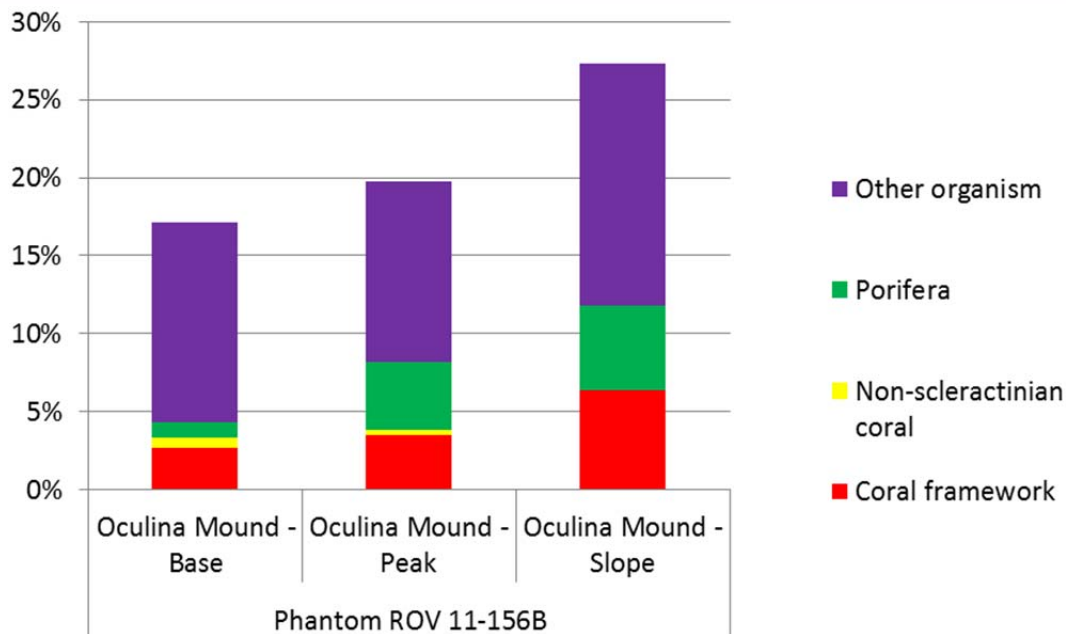


Figure 4. Percent cover of benthic macro-biota for each habitat zone at dive site 11-156B.

The percent cover of biota by habitat type shows the greatest cover of biota was on the *Oculina* mound peaks and slopes (14.7% and 27.3%, respectively). Coral framework was greatest on the mounds (6.3% cover on the slopes and 3.5% cover on the peaks) although 2.7% cover also was on the flat areas between the mounds. Sponge cover ranged from 5.5% cover on the mound slopes to 1.0% at the base.

Density of Benthic Macro-Biota:

As discussed in the Methods, some common taxa could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phylum. Sponges, gorgonians, and black coral are especially difficult to identify without a specimen in hand. In these cases a general descriptive taxa was used, e.g., “brown lobate sponge” or “unidentified Demospongiae”, which could consist of numerous species. These designations should not be considered equivalent to species level and should not be used for diversity (H') indices calculations. Many deepwater species in this region look nearly identical, such as fan sponges which are polyphyletic and actually include different Classes.

Dive site 11-156B had a total of 44 benthic macro-fauna taxa, consisting of 16 Cnidaria and 4 Porifera (Table 2). Overall density of all benthic macro-fauna was 21.2 organisms/m². Cnidaria contributed to 38.2% of the total density at this site, and Porifera 9.7%. Cnidaria and demosponges dominated with densities of 8.1 and 2.1 colonies/m², respectively. Antipatharia had a density of 0.37 colonies/m². Scleractinia overall were 3.4 colonies/m², with standing *Oculina* colonies at 2.1. Of the sponges an unidentified *Chondosia?* sp. had a density of 0.7 colonies/m².

Table 2. Density of benthic macro-biota at site 11-156B (# organisms, number/m², percent of total density).

Phylum/Class/Order/Scientific Name	# Organisms	#/m ²	% of Site
Porifera	107	2.07	9.73%

Dive Number: Phantom ROV 11-156B

Location: USA, Florida, Daytona Oculina Pinnacles, Site 2--Reed's Reef Southern End Eastern Ridge

Demospongiae	107	2.07	9.73%
Chondrosida	38	0.73	3.45%
Chondrosia sp.	38	0.73	3.45%
Dictyoceratida	1	0.02	0.09%
Ircinia sp.	1	0.02	0.09%
Hadromerida	6	0.12	0.55%
Spirastrellidae	6	0.12	0.55%
Demospongiae	62	1.20	5.64%
Cnidaria	420	8.11	38.18%
Anthozoa	341	6.58	31.00%
Actiniaria	12	0.23	1.09%
Actiniaria	12	0.23	1.09%
Alcyonacea	28	0.54	2.55%
Alcyonacea	1	0.02	0.09%
Gorgonacea (accepted as Alcyonacea)	4	0.08	0.36%
Nidalia occidentalis	4	0.08	0.36%
Telesto sp.	19	0.37	1.73%
Antipatharia	8	0.15	0.73%
Antipathidae	3	0.06	0.27%
Stichopathes lutkeni	2	0.04	0.18%
Tanacetipathes hirta	3	0.06	0.27%
Ceriantharia	39	0.75	3.55%
Cerianthidae	39	0.75	3.55%
Corallimorpharia	15	0.29	1.36%
Corallimorphus sp.	15	0.29	1.36%
Scleractinia	174	3.36	15.82%
Cladocora sp.	54	1.04	4.91%
Oculina varicosa	13	0.25	1.18%
Oculina varicosa- dead standing	95	1.83	8.64%
Phyllangia americana	1	0.02	0.09%
Scleractinia- unid cup	11	0.21	1.00%
Zoanthidea	65	1.26	5.91%
Zoanthidae	65	1.26	5.91%
Hydrozoa	79	1.53	7.18%
Hydrozoa	79	1.53	7.18%
Hydroidolina	79	1.53	7.18%
Annelida	192	3.71	17.45%
Polychaeta	192	3.71	17.45%
Sabellida	92	1.78	8.36%
Sabellidae	57	1.10	5.18%
Serpulidae	35	0.68	3.18%
Polychaeta	100	1.93	9.09%

Dive Number: Phantom ROV 11-156B

Location: USA, Florida, Daytona Oculina Pinnacles, Site 2--Reed's Reef Southern End Eastern Ridge

Mollusca	12	0.23	1.09%
Bivalvia	3	0.06	0.27%
Pectinoida	1	0.02	0.09%
Plicatula gibbosa	1	0.02	0.09%
Bivalvia	2	0.04	0.18%
Bivalvia	2	0.04	0.18%
Gastropoda	9	0.17	0.82%
Umbraculida	2	0.04	0.18%
Umbraculum sp.	2	0.04	0.18%
Gastropoda	7	0.14	0.64%
Gastropoda	7	0.14	0.64%
Arthropoda	89	1.72	8.09%
Malacostraca	70	1.35	6.36%
Amphipoda	48	0.93	4.36%
Corophiidea	48	0.93	4.36%
Decapoda	22	0.42	2.00%
Brachyura	2	0.04	0.18%
Decapoda	1	0.02	0.09%
Majidae	1	0.02	0.09%
Paguroidea	17	0.33	1.55%
Stenorhynchus seticornis	1	0.02	0.09%
Pycnogonida	19	0.37	1.73%
Pantopoda	19	0.37	1.73%
Anoplodactylus lentus	19	0.37	1.73%
Echinodermata	279	5.39	25.36%
Asteroidea	23	0.44	2.09%
Valvatida	14	0.27	1.27%
Goniasteridae	14	0.27	1.27%
Asteroidea	9	0.17	0.82%
Asteroidea	9	0.17	0.82%
Echinoidea	238	4.60	21.64%
Arbacioida	96	1.85	8.73%
Arbacia punctulata	96	1.85	8.73%
Arbacioida	1	0.02	0.09%
Coelopleurus floridanus	1	0.02	0.09%
Cidaroida	136	2.63	12.36%
Cidaroida	7	0.14	0.64%
Eucidaris tribuloides	129	2.49	11.73%
Diadematoida	4	0.08	0.36%
Centrostephanus longispinus	4	0.08	0.36%
Echinoidea	1	0.02	0.09%
Ophiuroidea	18	0.35	1.64%

Dive Number: Phantom ROV 11-156B **Location:** USA, Florida, Daytona Oculina Pinnacles, Site 2-- Reed's Reef Southern End Eastern Ridge

Euryalida	1	0.02	0.09%
Asteroporpa annulata	1	0.02	0.09%
Ophiurida	15	0.29	1.36%
Ophioderma devaneyi	15	0.29	1.36%
Ophiuroidea	2	0.04	0.18%
Human debris	1	0.02	0.09%
Human debris	1	0.02	0.09%
Human debris	1	0.02	0.09%
Human debris- fish line/gear	1	0.02	0.09%
Grand Total	1100	21.24	100.00%

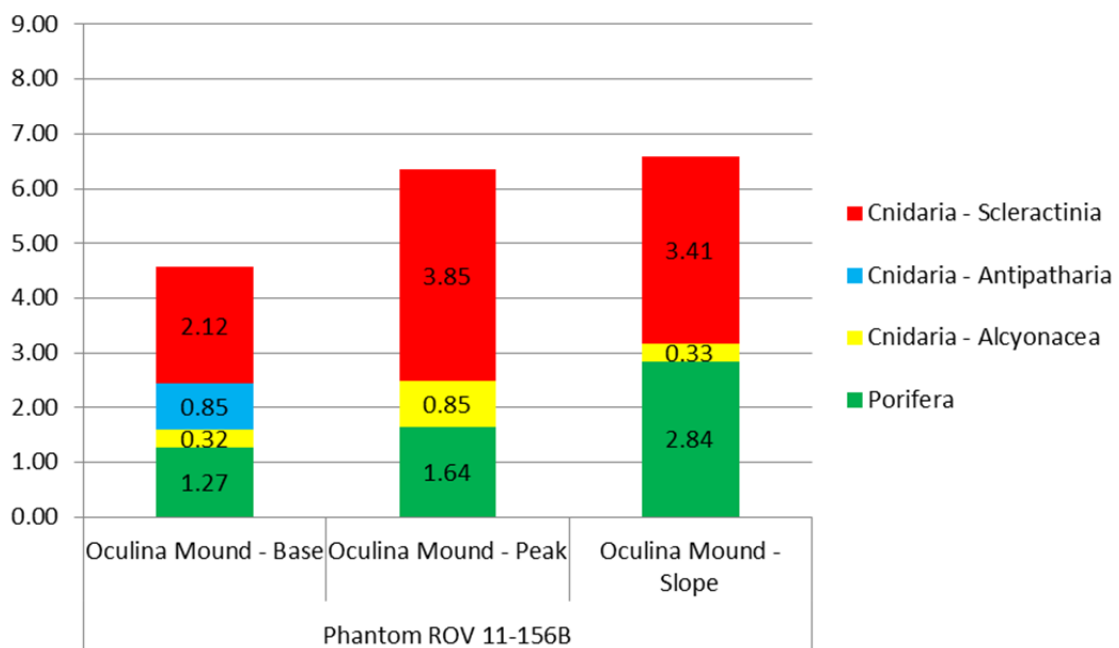


Figure 5. Density (number colonies/m²) of Porifera, hard coral (Stylasteridae, Scleractinia), Antipatharia, and Alcyonacea (Gorgonacea) for each habitat zone at dive site 11-156B.

Figure 5 shows the density of Porifera and coral for each of the habitats at dive site 11-156B. Coral is defined as hard coral (Scleractinia), Antipatharia, and Gorgonacea. The *Oculina* peaks and slopes had the greatest density of Scleractinia coral (3.8 and 3.4 colonies/m², respectively), and Alcyonacea cover was greatest on the peaks (0.8). Coral density was 2.1 colonies/m² in the flat areas between the mounds (base), and sponge cover ranged from 2.8 colonies/m² on the slopes to 1.6 on the peaks and 1.3 at the base. In addition to these analyses of the digital still photo transects, a total count of live standing *Oculina* coral colonies was made from the forward-looking video camera for the entire dive. For this dive, 16 colonies were counted in the video and ranged in size from ~15 to 30 cm, which is equivalent to possibly 10-20 years old. Since the actual video field-of-view is just a small portion of the total mound area, we calculated the estimated field-of-view area for the dive [field-of-view width (~10 m) x transect length = area of the video transect]. From this we estimated the total number of live *Oculina* corals that may occur over the entire mound area at that dive site. In ArcGis we calculated the total planar surface area of the coral mounds that were transected during the dive which was 88,143 m². We then multiplied the density of coral in the video by the total mound surface area. We estimate a total of 107 live coral colonies may occur on these four *Oculina* mounds.

Dive Number: Phantom ROV 11-156B

Location: USA, Florida, Daytona Oculina Pinnacles, Site 2--Reed's Reef Southern End Eastern Ridge

Fish Data Analysis:

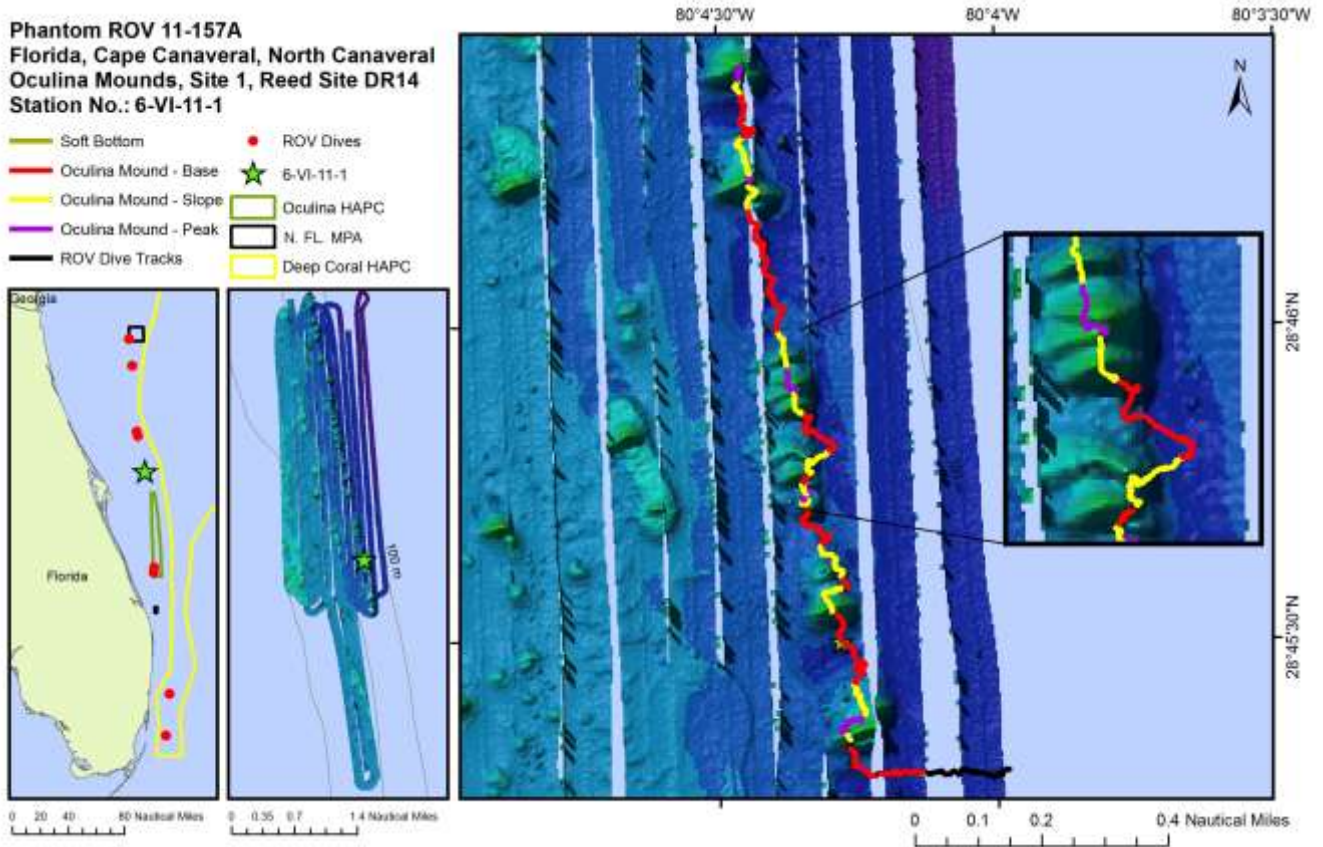
Video transects were used to analyze the fish populations and densities. Protocol for the fish analyses was to divide the continuous video into 5 minute segments, or whenever there was a change in habitat type, whichever came first, so each video segment only contained one habitat type (see Methods for details). These were also correlated with the habitat types used for the benthic analyses. All fish were identified for each ROV dive to species level and counted. The total distance (km) of each dive was used to calculate the density (# individuals/km) of each fish species. A total of 15 taxa of fish were identified from dive site 11-156B for a total density of 223 individuals/km (Table 3). These were dominated by *Centropristes* sp. (114 individuals/km; either black sea bass and/or bank sea bass but were too far away to distinguish), bank sea bass (38.9), roughtongue bass (27) and tatlars (18). Managed and fished species included almaco jack (0.7) and snowy grouper (0.7).

Table 3. Density of fish for all transects at dive site 11-156B (number individuals/km).

Common Name	Species Name	Density (#/km)
sea bass	<i>Centropristes</i> sp.	114.3
bank sea bass	<i>Centropristes ocyurus</i>	38.9
roughtongue bass	<i>Pronotogrammus martinicensis</i>	26.9
tattler	<i>Serranus phoebe</i>	17.9
bank butterflyfish	<i>Prognathodes aya</i>	12.0
yellowtail reeffish	<i>Chromis enchrysurus</i>	5.2
batfish	<i>Ogcocephalus</i> sp.	1.5
short bigeye	<i>Pristigenys alta</i>	1.5
almaco jack	<i>Seriola rivoliana</i>	0.7
blue angelfish	<i>Holacanthus bermudensis</i>	0.7
ocellated moray	<i>Gymnothorax saxicola</i>	0.7
saddle bass	<i>Serranus notospilus</i>	0.7
scorpionfish	Scorpaenidae	0.7
snowy grouper	<i>Epinephelus niveatus</i>	0.7
wrasse bass	<i>Liopropoma eukrines</i>	0.7

Dive Number: Phantom ROV 11-157A **Location:** USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

General Location and Dive Track:



Site Overview:

Project: 2011 Extreme Corals, NOAA DSCP

Principal Investigator: Andrew W. David

PI Contact Info: 3500 Delwood Beach Rd. Panama City FL 32408

Website: <http://coralreef.noaa.gov/deepseacorals>

Scientific Observers: Andrew W. David, Charles Messing, Diego Figueroa, Jana Thoma, John Reed, Stephanie Farrington

Data Management: Access Database, Excel Spreadsheet, WinFrog

ROV Navigation Data: WinFrog

Ship Position System: DGPS

Report Analyst: John Reed, Stephanie Farrington

Dive Overview:

Vessel: NOAA Ship *Pisces*

Sonar Data: Titusville Oculina Pinnacles

Purpose: Map and characterize DSCE off SE USA

ROV: NOAA SW Fisheries Super Phantom ROV

Sensors Used: Temperature (°C), Dissolved Oxygen (ml/l), Salinity (PSU), Conductivity

Date of Dive: 6/6/2011

Specimens: 7

Digital Photos: 1070

DVD: 6

Hard Drive: 2

Date Compiled: 2/20/2013

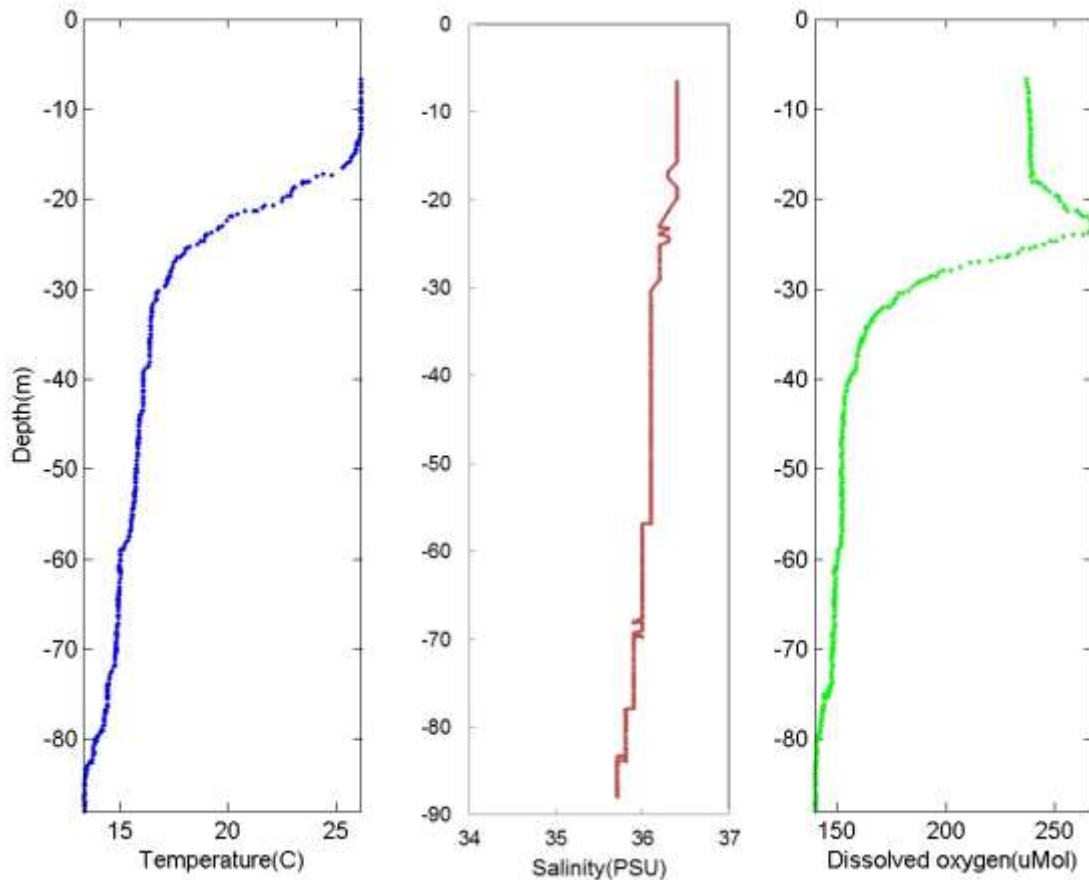
Dive Number: Phantom ROV 11- 157A **Location:** USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

Dive Data:

Minimum Bottom Depth (m): 64	Total Transect Length (km): 3.747
Maximum Bottom Depth (m): 88	Surface Current (kn): .3-.6 kt
On Bottom (Time- GMT): 16:11	On Bottom (Lat/Long): 28°45.2923'N; 80°03.9855'W
Off Bottom (Time- GMT): 21:41	Off Bottom (Lat/Long): 28°46.4133'N; 80°04.4582'W
Physical (bottom); Temp (°C): 13.30	Salinity: 35.70 Visibility (ft): 50+ Current (kn):

Physical Environment:

CTD Number 11-157A_CTDD



All CTD data were collected with the Super Phantom ROV which recorded depth, temperature (°C), conductivity (salinity, PSU), pressure (mbar), sound velocity (m/sec), oxygen concentration (uMol), and oxygen saturation. These data were used both to support multibeam surveys (sound velocity) and to characterize hydrographic conditions at the dive sites.

The following values were recorded at the maximum depth of this CTD cast (87.9 m): temperature- 13.3, salinity- 35.7, and dissolved oxygen- 140. Surface temperature was 27.1 and there was a thermocline near 20-30 m depth; salinity peaked between 0 and 18, dissolved oxygen peaked at 24 m. Visibility was estimated at 15-18 m from the ROV video.

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Cape Canaveral, North Canaveral
157A Oculina Mounds, Site 1, Reed Site DR14

Dive Imagery:



Figure 1: 28°45.6596'N, 80°4.3089'W 82.3 m
Nine deepwater *Oculina* coral mounds (5-20 m relief) were crossed during this ROV dive. The slopes of the mounds are mostly coral rubble and standing dead coral framework which still provides habitat for many benthic species. Small live *Oculina varicosa* colonies like this one (~20 cm diameter) are relatively new growth, less than 10-20 years old, and only grow about 10 mm or less a year.



Figure 2: 28°45.5978'N, 80°4.2814'W 77.2 m
The coral rubble slope of this deepwater *Oculina* mound provides habitat for these black corals (*Tanacetipathes hirta*- 20 cm bushes, *Stichopathes lutkeni*- spiral whip coral), red ball coral (*Nicella occidentalis*), and hydroids. Bank sea bass (*Centropristis ocyurus*) and juvenile black sea bass (*Centropristis striata*).



Figure 3: 28°46.0496'N, 80°4.4023'W 83.9 m
Pair of snowy grouper (*Epinephelus niveatus*; ~50 cm) on the slope of the deepwater *Oculina* coral reef.



Figure 4: 28°45.8933'N, 80°4.3641'W 66.7 m
Adult and juvenile black sea bass (*Centropristis striata*) are becoming more abundant once again after being overfished from the deepwater *Oculina* reefs during the 1980s and 1990s.

Dive Number: Phantom ROV 11- 157A **Location:** USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

Dive Notes:

Objectives, Site Description, Habitat, Fauna:

Objective: Survey *Oculina* coral mounds and ground truth sonar survey in area outside *Oculina* HAPC. Target site- *Oculina* mound (from *Pisces* multibeam): 28° 45.497'N, 80° 04.283'W, 64-88 m. Only one submersible dive has been made in this area in 1982 on Reed Peak DR-14 (JSL I-1209).

Dive Events: ROV transect crossed nine *Oculina* coral mounds on a northerly heading. One colony of black coral (15 cm) was collected: *Tanacetipathes* sp. with six associated animals. [Note- The *Phantom* ROV's top parallel lasers are calibrated at 20 cm, bottom lasers 61 cm. Depth recorded in WinFrog is correct; video overlay display is off by 0.5-1 m.]

Site Description/Habitat/Fauna: *Pisces* shipboard multibeam surveyed for first time an area of deep-sea *Oculina* coral mounds along the shelf edge break, ~15 nmi north of the *Oculina* HAPC. The sonar survey off Titusville covered ~3.2 x 1.0 nmi, discovering ~35 mounds, 5 to 20 m-tall, and oriented in a linear pattern parallel to the shoreline NNW-SSE. Individual mounds are oval, ranging from 50-235 m in diameter at the base, with an E-W oriented ridge at the peak; the peaks range from 65-80 m depth and the bases 75-85 m. Individual mound slopes and peaks are nearly 100% coral, mostly coral rubble, with sparse standing coral framework, and sparse small (10-40 cm) live *Oculina varicosa* coral colonies; the peaks appear hummocky with 20-cm tall patches of standing dead coral. The bases of the mounds have exposed rock boulders and 1 m ledges. Some of the dead coral appears to be coated with black fuzz, possibly cyanobacteria(?). Dominant fauna: Fish- snowy grouper, scamp, gag grouper, red porgy (common), black seabass (abundant), bigeye, bank butterfly, scorpaenids, roughtongue bass, cubbyu, red hogfish, tattler, leopard toadfish, toadfish, greater amberjack; Cnidaria- *Oculina varicosa* (Ivory tree coral), *Stichopathes*, Plexauridae, *Nidalia*, hydroids, Cerianthidae, Antipatharia; Echinoderms- *Centrostephanus*, *Eucidaris tribuloides*, *Ophioderma devanyi*, *Astroporpa annulata*. Video of trawl door.

Dive Number: Phantom ROV 11-157A

Location: USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

Percent Cover of Benthic Macro-Biota and Substrate:

Phantom ROV 11-157A surveyed nine newly discovered *Oculina* mounds within the new *Pisces* Titusville multibeam sonar survey area. The entire sonar survey covered 3.2 nmi² and had ~35 high-relief coral mounds. The dive transects were divided into three habitat types: *Oculina* mound peak, mound slope, and base (area between the mounds). Point count (CPCe[®]) was used to determine percent cover (see methods for details). Figure 1 shows the percent cover of hard bottom and soft bottom substrate; points on biota were scored as the underlying substrate type. Soft bottom substrate is defined as unconsolidated mud or sand. Hard bottom in this region may consist of coral framework which is defined as standing colonial hard coral (either live or dead), coral rubble, rock pavement, or rock ledges. Site 11-157A was predominately hard bottom substrate (91.8% cover), consisting primarily of coral framework (4.7%), coral rubble (51.6%), and rock pavement and ledges (4.5%) (Fig. 2, Table 1). Benthic macro-biota covered 25.6% of the bottom and consisted of 4.7% coral framework (0.7% live *Oculina*, 3.6% standing dead *Oculina*), 3.7% Porifera, 0.4% non-scleractinian coral, and 16.7% other organisms (Fig. 2, Table 1; see Table 2 for complete species list). Figure 3 shows the percent cover of substrate type for each habitat zone of the dive site. Both the *Oculina* peaks and slopes have >65% cover of coral substrate, consisting of standing coral framework (13.9% and 4.7%, respectively) and coral rubble (51.4% and 70.5%, respectively). Exposed rock ledges and pavement also occurred on the flat areas of the mound base (6.9% cover). Dead coral is typically described as standing dead or coral rubble, however, it is recognized as live-bottom habitat, and is an important component of the habitat. Live coral, coral rubble, and standing dead coral provide habitat for hundreds of species of invertebrates and juvenile fish (e.g., Reed et al., 1982, 1987, 2002; Ross and Quattrini, 2007), in addition to commercially valuable species (e.g., Reed and Farrington, 2010).

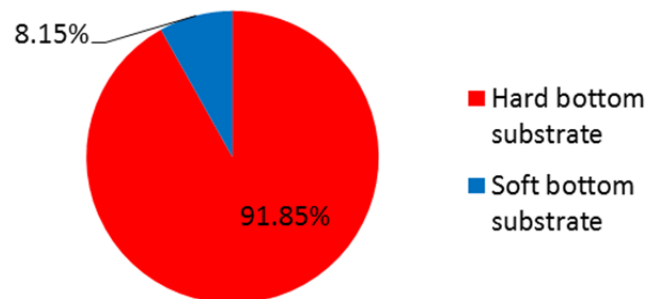


Figure 1. Percent cover of hard and soft bottom substrate at dive site 11-157A. CPCe[®] points on organisms were scored as the underlying substrate (hard or soft).

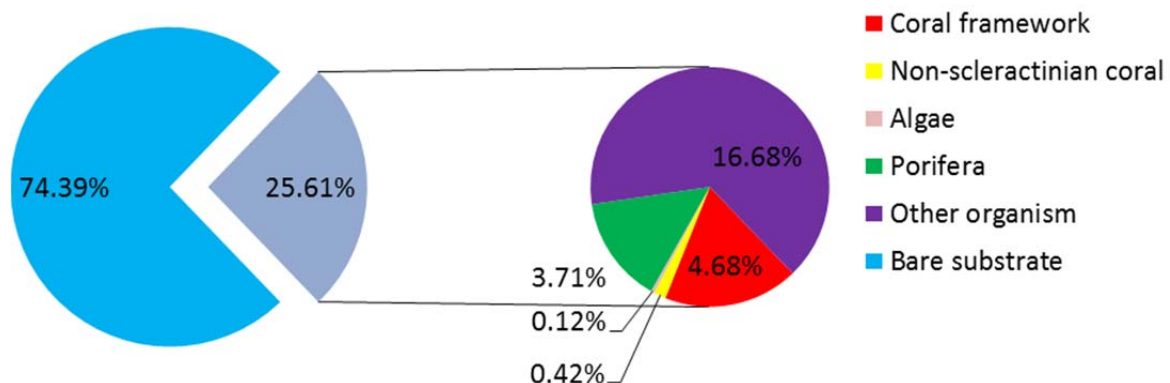


Figure 2. Percent cover of bare substrate and benthic macro-biota at dive site 11-157A. Coral framework is standing, colonial hard coral. Non-scleractinian corals are defined as Gorgonacea, other Alcyonacea, and Antipatharia.

Dive Number: Phantom ROV 11-157A

Location: USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

Table 1. Percent cover of benthic macro-biota and substrate types at dive site 11-157A.

Benthic macro-biota and substrate types	% Cover
Coral framework	4.67%
Oculina varicosa	0.66%
Scleractinia, unid	0.45%
Standing Dead Coral	3.56%
Non-scleractinian coral	0.42%
Alcyonacea	0.10%
Antipatharia	0.26%
Gorgonacea, Unid	0.05%
Porifera	3.70%
Porifera- Hexactinellida, Calcarea, or Demospongiae	3.70%
Other organism	16.64%
Algae	0.12%
Algae- green, brown, red, or cyanobacteria	0.12%
Bare substrate	74.22%
Bare Soft Bottom substrate	7.66%
Coral rubble	51.52%
Rock- pavement, boulder, ledge	4.50%
Rubble	10.54%
Human debris	0.23%
Human debris- Other	0.23%
Grand Total	100.00%

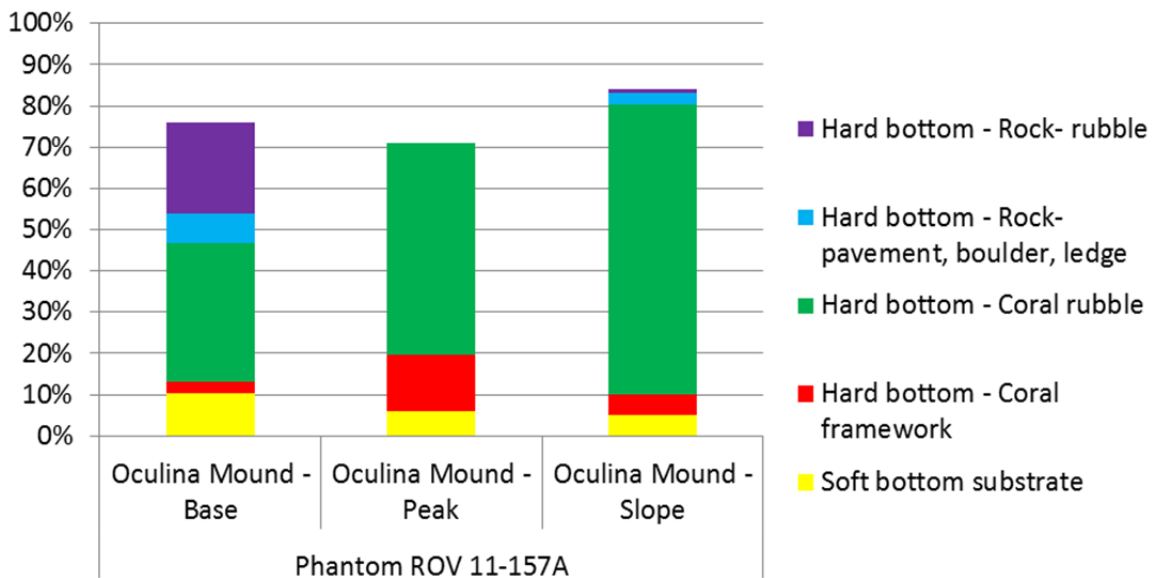


Figure 3. Percent cover of substrate types and biota for each habitat zone at dive site 11-157A.

Dive Number: Phantom ROV 11-157A

Location: USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

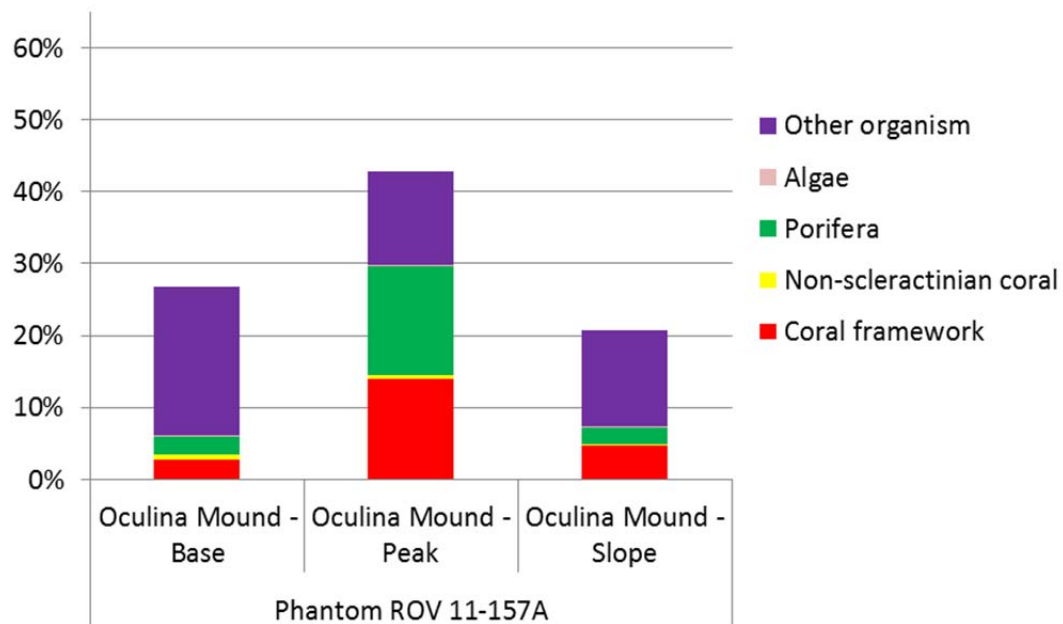


Figure 4. Percent cover of benthic macro-biota for each habitat zone at dive site 11-157A.

The percent cover of biota by habitat type shows the greatest cover of biota was on the *Oculina* mound peaks (42.87% cover). Coral framework was greatest on the peaks (13.89% cover) although 2.7% cover also was on the flat areas between the mounds. Sponge cover ranged from 15.2% cover on the mound peaks to 2.5% on the slopes and base.

Density of Benthic Macro-Biota:

As discussed in the Methods, some common taxa could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phylum. Sponges, gorgonians, and black coral are especially difficult to identify without a specimen in hand. In these cases a general descriptive taxa was used, e.g., “brown lobate sponge” or “unidentified Demospongiae”, which could consist of numerous species. These designations should not be considered equivalent to species level and should not be used for diversity (H') indices calculations. Many deepwater species in this region look nearly identical, such as fan sponges which are polyphyletic and actually include different Classes.

Dive site 11-157A had a total of 43 benthic macro-fauna taxa, consisting of 18 Cnidaria and 3 Porifera (Table 2). Overall density of all benthic macro-fauna was 26.4 organisms/m². Cnidaria contributed to 33.5% of the total density at this site and Porifera 6.6%. Cnidaria and demosponges dominated with densities of 8.8 and 1.7 colonies/m², respectively. Antipatharia had 0.3 colonies/m² and Alcyonacea had 0.97. Scleractinia overall had 1.2 colonies/m², with standing *Oculina* colonies at 0.8. Of the sponges an unidentified *Chondosia?* sp. had a density of 0.2 colonies/m².

Table 2. Density of benthic macro-biota at site 11-157A (# organisms, number/m², percent of total density).

Phylum/Class/Order/Scientific Name	# Organisms	#/m ²	% of Site
Porifera	125	1.73	6.58%
Demospongiae	125	1.73	6.58%

Dive Number: Phantom ROV 11-157A **Location:** USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

Chondrosida	17	0.24	0.89%
Chondrosia sp.	17	0.24	0.89%
Demospongiae	108	1.50	5.68%
Demospongiae	102	1.42	5.37%
Demospongiae- orange sphere	6	0.08	0.32%
Cnidaria	638	8.85	33.56%
Anthozoa	431	5.98	22.67%
Actiniaria	72	1.00	3.79%
Actiniaria	72	1.00	3.79%
Alcyonacea	70	0.97	3.68%
Alcyonacea	1	0.01	0.05%
Ellisellidae	20	0.28	1.05%
Eunicella sp.	6	0.08	0.32%
Gorgonacea (accepted as Alcyonacea)	7	0.10	0.37%
Nidalia occidentalis	23	0.32	1.21%
Telesto sp.	13	0.18	0.68%
Antipatharia	21	0.29	1.10%
Antipathidae	8	0.11	0.42%
Stichopathes lutkeni	7	0.10	0.37%
Tanacetipathes hirta	6	0.08	0.32%
Ceriantharia	49	0.68	2.58%
Cerianthidae	49	0.68	2.58%
Corallimorpharia	3	0.04	0.16%
Corallimorphus sp.	3	0.04	0.16%
Scleractinia	86	1.19	4.52%
Cladocora sp.	16	0.22	0.84%
Oculina varicosa	10	0.14	0.53%
Oculina varicosa- dead standing	49	0.68	2.58%
Scleractinia- unid cup	11	0.15	0.58%
Zoanthidea	130	1.80	6.84%
Zoanthidae	130	1.80	6.84%
Hydrozoa	207	2.87	10.89%
Leptothecata	43	0.60	2.26%
Aglaophenia trifida	43	0.60	2.26%
Hydrozoa	164	2.28	8.63%
Hydroidolina	164	2.28	8.63%
Annelida	454	6.30	23.88%
Polychaeta	454	6.30	23.88%
Amphinomida	1	0.01	0.05%
Hermodice carunculata	1	0.01	0.05%
Sabellida	225	3.12	11.84%
Sabellidae	214	2.97	11.26%
Serpulidae	11	0.15	0.58%

Dive Number: Phantom ROV 11-157A

Location: USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

Polychaeta	228	3.16	11.99%
Mollusca	4	0.06	0.21%
Gastropoda	4	0.06	0.21%
Gastropoda	4	0.06	0.21%
Gastropoda	4	0.06	0.21%
Arthropoda	234	3.25	12.31%
Malacostraca	215	2.98	11.31%
Amphipoda	200	2.78	10.52%
Corophiidea	200	2.78	10.52%
Decapoda	15	0.21	0.79%
Majidae	1	0.01	0.05%
Paguroidea	12	0.17	0.63%
Stenorhynchus seticornis	2	0.03	0.11%
Maxillopoda	6	0.08	0.32%
Maxillopoda	6	0.08	0.32%
Cirripedia	6	0.08	0.32%
Pycnogonida	13	0.18	0.68%
Pantopoda	13	0.18	0.68%
Anoplodactylus lentus	13	0.18	0.68%
Echinodermata	402	5.58	21.15%
Asteroidea	16	0.22	0.84%
Valvatida	9	0.12	0.47%
Goniasteridae	9	0.12	0.47%
Asteroidea	7	0.10	0.37%
Asteroidea	7	0.10	0.37%
Crinoidea	1	0.01	0.05%
Comatulida	1	0.01	0.05%
Comatulida	1	0.01	0.05%
Echinoidea	365	5.07	19.20%
Arbacioda	205	2.85	10.78%
Arbacia punctulata	205	2.85	10.78%
Cidaroida	154	2.14	8.10%
Cidaroida	9	0.12	0.47%
Eucidaris tribuloides	145	2.01	7.63%
Diadematoida	6	0.08	0.32%
Centrostephanus longispinus	6	0.08	0.32%
Ophiuroidea	20	0.28	1.05%
Euryalida	4	0.06	0.21%
Asteroporpa annulata	4	0.06	0.21%
Ophiurida	16	0.22	0.84%
Ophioderma devaneyi	16	0.22	0.84%
Chordata	16	0.22	0.84%

Dive Number: Phantom ROV 11-157A

Location: USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

Ascidacea	16	0.22	0.84%
Aplousobranchia	14	0.19	0.74%
Didemnidae	10	0.14	0.53%
Trididemnum sp.	4	0.06	0.21%
Ascidacea	2	0.03	0.11%
Ascidacea	2	0.03	0.11%
Rhodophyta	26	0.36	1.37%
Florideophyceae	1	0.01	0.05%
Rhodymeniales	1	0.01	0.05%
Rhodymenia sp.	1	0.01	0.05%
Rhodophyta	25	0.35	1.32%
Rhodophyta	25	0.35	1.32%
Corallinales or Peyssonneliaceae	25	0.35	1.32%
Human debris	2	0.03	0.11%
Human debris	2	0.03	0.11%
Human debris	2	0.03	0.11%
Human debris- fish line/gear	1	0.01	0.05%
Human debris- unid.	1	0.01	0.05%
Grand Total	1901	26.38	100.00%

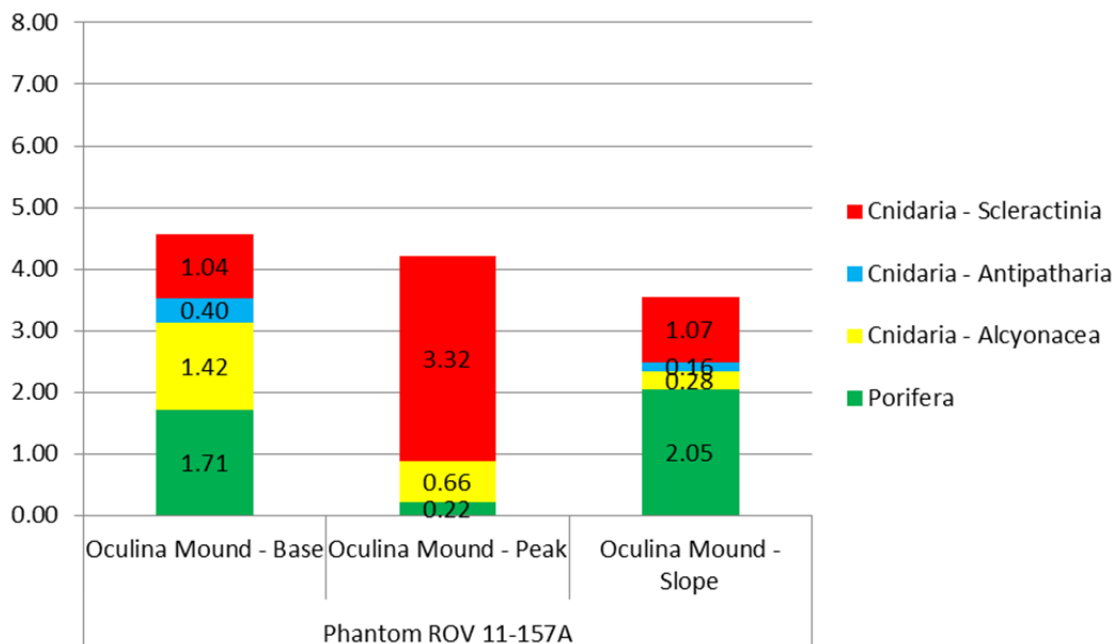


Figure 5. Density (number colonies/m²) of Porifera, hard coral (Stylasteridae, Scleractinia), Antipatharia, and Alcyonacea (Gorgonacea) for each habitat zone at dive site 11-157A.

Figure 5 shows the density of Porifera and coral for each of the habitats at dive site 11-157A. Coral is defined as hard coral (Scleractinia), Antipatharia, and Gorgonacea. The *Oculina* peaks had the greatest density of Scleractinia coral (3.3 colonies/m²) and Alcyonacea density was 0.7. Coral density was 1.0 colonies/m² in the flat areas between the mounds (base) and Alcyonacea were denser at the base. Sponge cover was 2.0

Dive Number: Phantom ROV 11-157A

Location: USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

colonies/m² on the slopes, 1.7 at the base, and 0.2 on the peaks. In addition to these analyses of the digital still photo transects, a total count of live standing *Oculina* coral colonies was made from the forward-looking video camera for the entire dive. For this dive, 34 colonies were counted in the video and ranged in size from ~10 to 40 cm, which is equivalent to possibly 10-25 years old. Since the actual video field-of-view is just a small portion of the total mound area, we calculated the estimated field-of-view area for the dive [field-of-view width (~10 m) x transect length = area of the video transect]. From this we estimated the total number of live *Oculina* corals that may occur over the entire mound area at the dive site. In ArcGis we calculated the total planar surface area of the coral mounds that were transected during the dive which was 123,895 m². We then multiplied the density of coral in the video by the total mound surface area. We estimate a total of 114 live coral colonies may occur on these nine *Oculina* mounds.

Fish Data Analysis:

Video transects were used to analyze the fish populations and densities. Protocol for the fish analyses was to divide the continuous video into 5 minute segments, or whenever there was a change in habitat type, whichever came first, so each video segment only contained one habitat type (see Methods for details). These were also correlated with the habitat types used for the benthic analyses. All fish were identified for each ROV dive to species level and counted. The total distance (km) of each dive was used to calculate the density (# individuals/km) of each fish species. A total of 26 taxa of fish were identified from dive site 11-157A for a total density of 812 individuals/km (Table 3). These were dominated by *Centropristes* spp (499 individuals/km; either black sea bass and/or bank sea bass but were too far away to distinguish), black sea bass (165), rough-tongue bass (45) and bank sea bass (43). Managed and fished species included black sea bass (165 individuals/km), amberjack (5), red porgy (5), snowy grouper (3), and scamp (0.8).

Table 3. Density of fish for all transects at dive site 11-157A (number individuals/km).

Common Name	Species Name	Density (#/km)
sea bass	<i>Centropristes</i> sp.	499.3
black sea bass	<i>Centropristes striata</i>	164.9
rough-tongue bass	<i>Pronotogrammus martinicensis</i>	45.1
bank sea bass	<i>Centropristes aya</i>	43.5
tattler	<i>Serranus phoebe</i>	17.3
bank butterflyfish	<i>Prognathodes aya</i>	8.3
amberjack	<i>Seriola</i> sp.	4.8
red porgy	<i>Pagrus pagrus</i>	4.8
yellowtail reeffish	<i>Chromis enchrysurus</i>	4.5
snowy grouper	<i>Epinephelus niveatus</i>	2.9
short bigeye	<i>Pristigenys alta</i>	2.4
batfish	<i>Ogcocephalus</i> sp.	2.1
scorpionfish	Scorpaenidae	2.1
wrasse	<i>Halichoeres</i> sp.	2.1
wrasse bass	<i>Liopropoma eukrines</i>	1.9
flounder	Bothidae	1.1
red hogfish	<i>Decodon puellaris</i>	0.8
scamp	<i>Mycteroperca phenax</i>	0.8
toadfish	<i>Opsanus</i> sp.	0.8
anthiid	Anthiinae	0.5

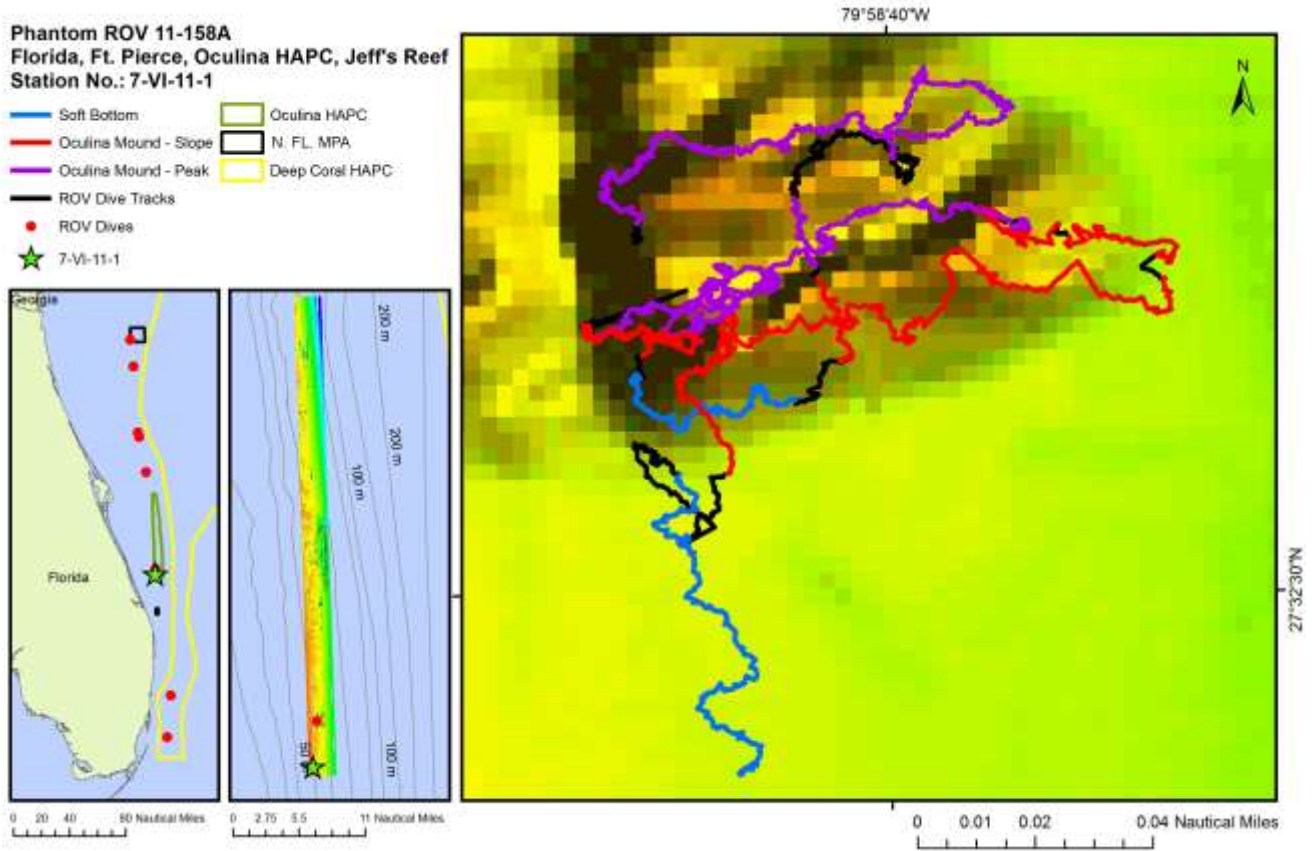
Dive Number: Phantom ROV 11-157A

Location: USA, Florida, Cape Canaveral, North Canaveral Oculina Mounds, Site 1, Reed Site DR14

blackbar drum	<i>Paraques iwamotoi</i>	0.3
blue angelfish	<i>Holacanthus bermudensis</i>	0.3
conger eel	Congridae	0.3
cusck eel	Ophidiidae	0.3
moray eel	Muraenidae	0.3
snake eel	Ophichthidae	0.3

Dive Number: Phantom ROV 11- Location: USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef 158A

General Location and Dive Track:



Site Overview:

Project: 2011 Extreme Corals, NOAA DSCP

Principal Investigator: Andrew W. David

PI Contact Info: 3500 Delwood Beach Rd. Panama City FL 32408

Website: <http://coralreef.noaa.gov/deepseacorals>

Scientific Observers: Andrew W. David, Charles Messing, Diego Figueroa, Jana Thoma, John Reed, Stephanie Farrington

Data Management: Access Database, Excel Spreadsheet, WinFrog

ROV Navigation Data: WinFrog

Ship Position System: DGPS

Report Analyst: John Reed, Stephanie Farrington

Dive Overview:

Vessel: NOAA Ship *Pisces*

Sonar Data:

Purpose: Map and characterize DSCE off SE USA

ROV: NOAA SW Fisheries Super Phantom ROV

Sensors Used: Temperature (°C), Dissolved Oxygen (ml/l), Salinity (PSU), Conductivity

Date of Dive: 6/7/2011

Specimens: 0

Digital Photos: 743

DVD: 4

Hard Drive: 2

Date Compiled: 2/20/2013

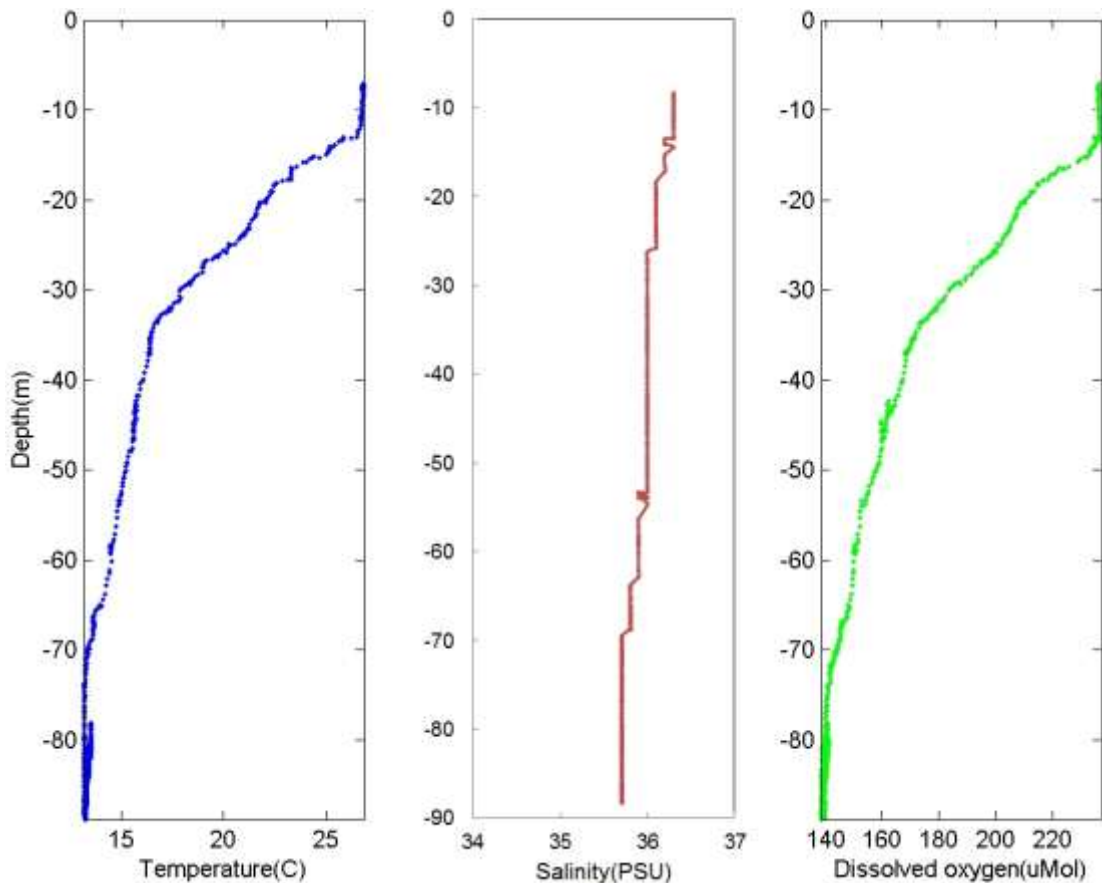
Dive Number: Phantom ROV 11- **Location:** USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef 158A

Dive Data:

Minimum Bottom Depth (m): 68	Total Transect Length (km): 1.733
Maximum Bottom Depth (m): 88	Surface Current (kn): 0.5
On Bottom (Time- GMT): 13:22	On Bottom (Lat/Long): 27°31.0853'N; 79°58.1966'W
Off Bottom (Time- GMT): 17:02	Off Bottom (Lat/Long): 27°32.5617'N; 79°58.7164'W
Physical (bottom); Temp (°C): 13.20	Salinity: 35.70 Visibility (ft): 30 Current (kn): 0.5

Physical Environment:

CTD Number 11-158A_CTDD



All CTD data were collected with the Super Phantom ROV which recorded depth, temperature (°C), conductivity (salinity, PSU), pressure (mbar), sound velocity (m/sec), oxygen concentration (uMol), and oxygen saturation. These data were used both to support multibeam surveys (sound velocity) and to characterize hydrographic conditions at the dive sites.

The following values were recorded at the maximum depth of this CTD cast (88.2 m): temperature- 13.2, salinity- 35.7, and dissolved oxygen- 138.8. Surface temperature was 27.1 and there was a thermocline near 12-30 m depth; salinity peaked between 0 and 12 m, dissolved oxygen peaked at 0-13 m. Visibility was estimated at 9-12 m from the ROV video.

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef 158A

Dive Imagery:



Figure 1: 27°32.565'N, 79°58.6729'W 70 m
Dense *Oculina varicosa* coral thickets on top ridge of deepwater *Oculina* reef within the OHAPC. Note that the coral is wrapped in fishing line. Lost fishing gear including long lines and trawl nets are not uncommon even within the closed OHAPC.



Figure 2: 27°32.5485'N, 79°58.7082'W 72.5 m
Standing coral framework (Ivory tree coral- *Oculina varicosa*), both living and dead provide habitat to hundreds of species of benthic invertebrates and fish. Sponges (*Geodia* several spp.- flat top sponges, *Erylus?* sp.- grey lobate, Spirastrellidae- red-orange encrusting, Poecilosclerida- orange flabellate), Gorgonacea, and Hydroida. Red barbier (*Hemanthias vivanus*).



Figure 3: 27°32.5496'N, 79°58.7016'W 70.2 m
Scamp (*Mycteroperca phenax*; ~50 cm) on live deepwater *Oculina* coral reef. Ivory tree coral (*Oculina varicosa*), yellow sponge (*Geodia* sp.), grey lobate sponges (*Erylus* sp.), orange encrusters (Spirastrellidae), and spider crab (*Stenorhynchus seticornis*).



Figure 4: 27°32.5561'N, 79°58.6148'W 82.6 m
Snowy grouper (*Epinephelus niveatus*; ~50 cm) with school of red barbier (*Hemanthias vivanus*) on deepwater *Oculina* coral reef within the OHAPC. Large colony of live Ivory tree coral (*Oculina varicosa*) and scattered dead coral framework. Wire coral (*Stichopathes lutkeni*), orange sponge (Poecilosclerida), purple gorgonian (*Diodogorgia* sp.) with spaghetti brittlestar (*Asteropora annulata*).

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef 158A

Dive Notes:

Objectives, Site Description, Habitat, Fauna:

Objective: Survey *Oculina* coral mound inside the original *Oculina* HAPC (designated 1984). Target site- Jeff's Reef *Oculina* mound: 27° 31'N, 79° 58'W; 68-88 m.

Dive Events: Conducted several video/photo transects over the reef including south slope, peak ridges, and north slope using the multibeam sonar from Reed et al. 2005 (DSC Symp.). [Note- The *Phantom* ROV's top parallel lasers are calibrated at 20 cm, bottom lasers 61 cm. Depth recorded in WinFrog is correct; video overlay display is incorrect.]

Site Description/Habitat/Fauna: Jeff's Reef is an *Oculina* coral bioherm, ~360 m x 165 m diameter at the base, with three ridge peaks oriented E-W; maximum depth at the eastern base is 88 m and minimum peak depth is 68. The southern flank (20-45° slope) and peaks, facing the Florida Current are up to 100% coral cover, with thickets of standing live *Oculina varicosa* coral (azooxanthellate), 30-150 cm tall, standing dead coral and coral rubble. The north slope is less steep and dominated by coral rubble and less live coral. Top south ridge has 80-90% coral cover. Dominant fauna include: Fish- scamp (common, one supermale coloration), gag, black seabass, 50-cm burrows (blueline tilefish in soft sediment off the reef), roughtongue bass, bank seabass, scorpion fish, black drum, blue angel, cubbyu, barbier, wrasse bass, cardinal squirrelfish, moray, bigeye; Sponges- Demospongiae, *Erylus* sp., Theonellidae, Spirastrellidae; Cnidaria- *Oculina varicosa* (Ivory tree coral), *Stichopathes lutkeni*, Plexauridae, *Nidalia occidentalis*, hydroids, Cerianthidae, Antipatharia- *Tanacetipathes*, *Titanideum frauenfeldii*, *Arthropodium* (*Callipodium*), Corallimorpharia, Actiniaria; Echinoderms- *Holothuria lentigenosa enodis*, *Centrostephanus*, *Isostichopus badionotus*, *Coscinasterias*. Video of cable and fishing line on south base, longline, ball of net, trawl line through the coral.

Dive Number: Phantom ROV 11-158A

Location: USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef

Percent Cover of Benthic Macro-Biota and Substrate:

Phantom ROV 11-158A surveyed Jeff's Reef inside of the *Oculina* HAPC. The dive transects were divided into two habitat types: *Oculina* mound peak and *Oculina* mound slope. Point count (CPCe[®]) was used to determine percent cover (see methods for details). Figure 1 shows the percent cover of hard bottom and soft bottom substrate; points on biota were scored as the underlying substrate type. Soft bottom substrate is defined as unconsolidated mud or sand. Hard bottom in this region may consist of coral framework which is defined as standing colonial hard coral (either live or dead), coral rubble, rock pavement, or rock ledges. Site 11-158A was predominately hard bottom substrate (89.8% cover), consisting primarily of coral framework (37.9%), coral rubble (13.8%), but essentially no exposed rock pavement or ledges (Fig. 2, Table 1). Benthic macro-biota covered 76.4% of the bottom and consisted of 37.9% coral framework (21.2% live *Oculina*, 16.5% standing dead *Oculina*), 24.9% Porifera, 1.8% non-scleractinian coral, and 10.8% other organisms (Fig. 2, Table 1; see Table 2 for complete species list). Figure 3 shows the percent cover of substrate type for each habitat zone of the dive site. Basically there was little difference between the habitat zones. The cover of *Oculina* coral framework ranged from 43.7% on the mound slope to 36.1% at the peak; coral rubble was 11.7% and 14.5%, respectively. Dead coral is typically described as standing dead or coral rubble, however, it is recognized as live-bottom habitat, and is an important component of the habitat. Live coral, coral rubble, and standing dead coral provide habitat for hundreds of species of invertebrates and juvenile fish (e.g., Reed et al., 1982, 1987, 2002; Ross and Quattrini, 2007), in addition to commercially valuable species (e.g., Reed and Farrington, 2010).

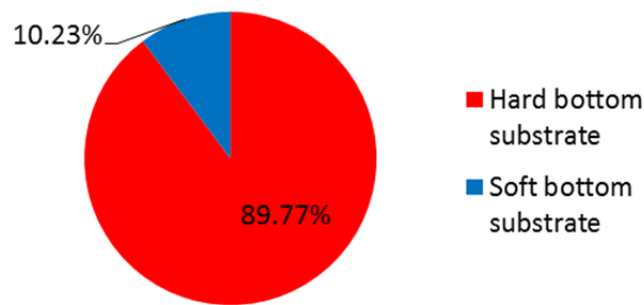


Figure 1. Percent cover of hard and soft bottom substrate at dive site 11-158A. CPCe[®] points on organisms were scored as the underlying substrate (hard or soft).

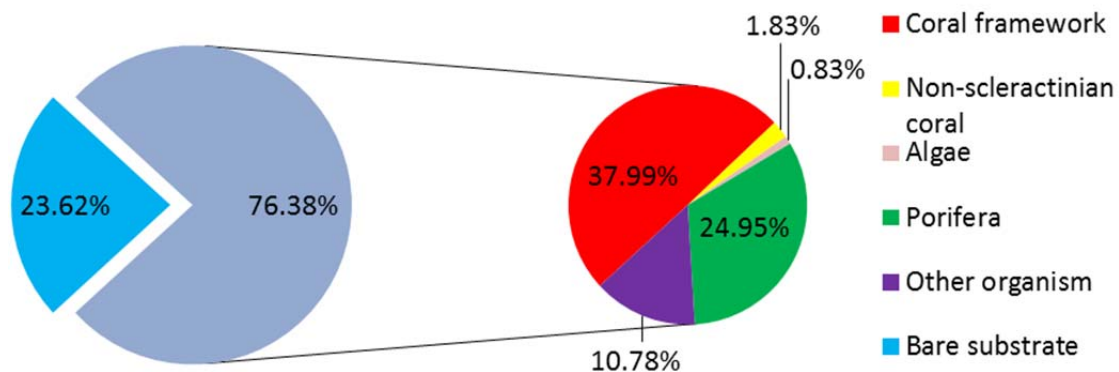


Figure 2. Percent cover of bare substrate and benthic macro-biota at dive site 11-158A. Coral framework is standing, colonial hard coral. Non-scleractinian corals are defined as Gorgonacea, other Alcyonacea, and Antipatharia.

Dive Number: Phantom ROV 11-158A

Location: USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef

Table 1. Percent cover of benthic macro-biota and substrate types at dive site 11-158A.

Benthic macro-biota and substrate types	% Cover
Coral framework	37.85%
Oculina varicosa	21.25%
Scleractinia, unid	0.10%
Standing Dead Coral	16.51%
Non-scleractinian coral	1.82%
Alcyonacea	0.10%
Antipatharia	0.19%
Gorgonacea, Unid	1.54%
Porifera	24.86%
Porifera- Hexactinellida, Calcarea, or Demospongiae	24.86%
Other organism	10.74%
Algae	0.82%
Algae- green, brown, red, or cyanobacteria	0.82%
Bare substrate	23.53%
Bare Soft Bottom substrate	9.68%
Coral rubble	13.80%
Rock- pavement, boulder, ledge	0.05%
Human debris	0.38%
Human debris- Other	0.38%
Grand Total	100.00%

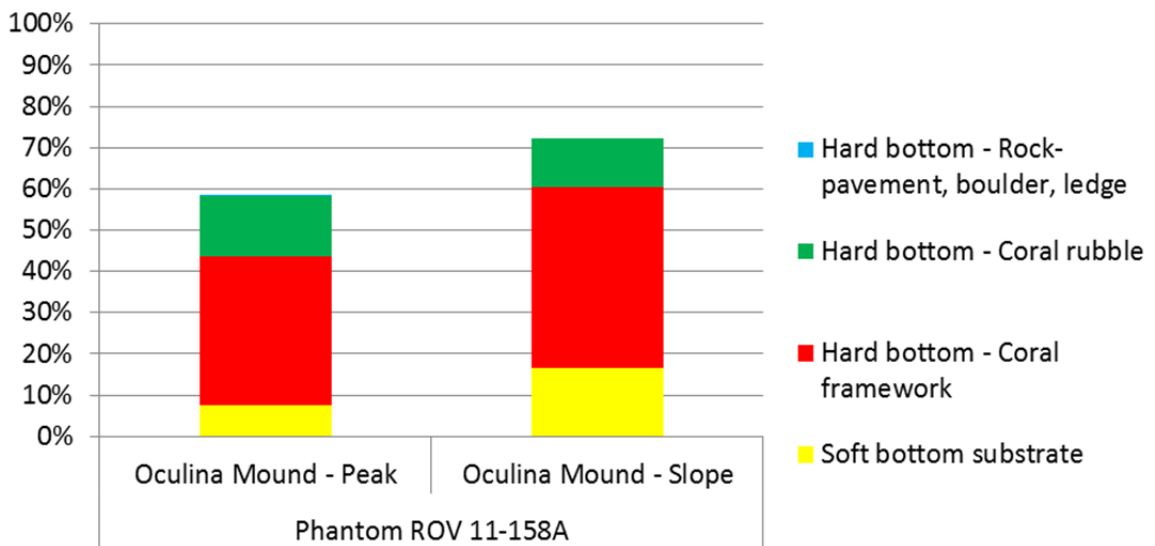


Figure 3. Percent cover of substrate types for each habitat zone at dive site 11-158A.

Dive Number: Phantom ROV 11-158A

Location: USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef

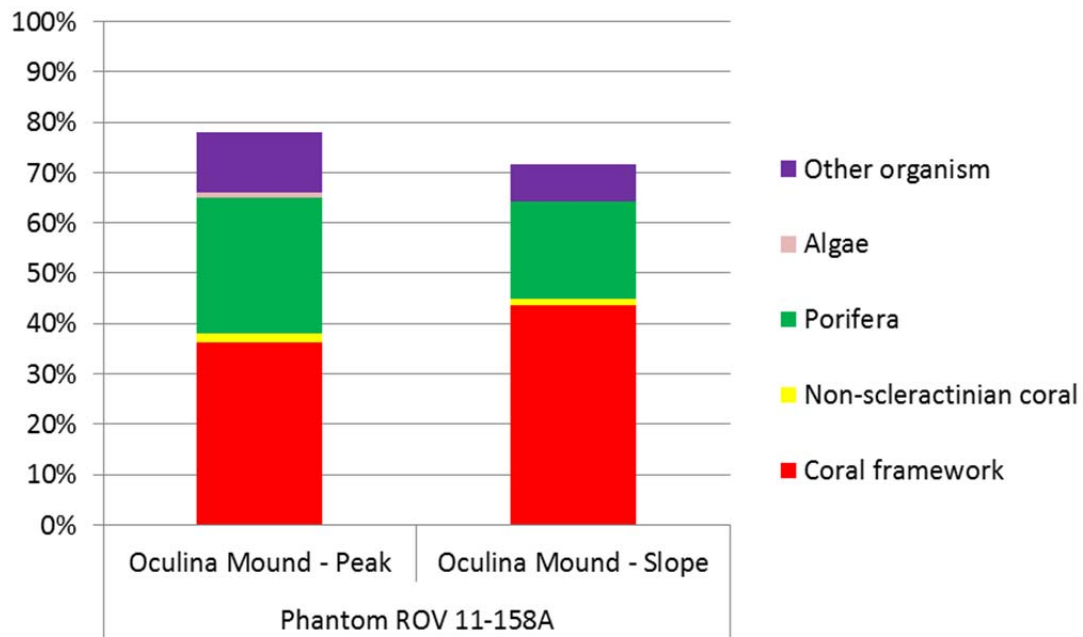


Figure 4. Percent cover of benthic macro-biota for each habitat zone at dive site 11-158A.

The percent cover of biota by habitat zone shows >70% cover for both habitats (Fig. 4). *Oculina* coral framework was the dominant biota on both the slope and peak (43.7 and 36.1 colonies/m², respectively), sponges ranged from 19.1 to 26.8, non-scleractinian corals were 1.3-2.0 colonies/m².

Density of Benthic Macro-Biota:

As discussed in the Methods, some common taxa could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phylum. Sponges, gorgonians, and black coral are especially difficult to identify without a specimen in hand. In these cases a general descriptive taxa was used, e.g., “brown lobate sponge” or “unidentified Demospongiae”, which could consist of numerous species. These designations should not be considered equivalent to species level and should not be used for diversity (H') indices calculations. Many deepwater species in this region look nearly identical, such as fan sponges which are polyphyletic and actually include different Classes.

Dive site 11-158A had a total of 50 benthic macro-fauna taxa, consisting of 20 Cnidaria and 13 Porifera (Table 2). Overall density of all benthic macro-fauna was 58.9 organisms/m². Cnidaria contributed to 37.6% of the total density at this site, and Porifera 58.0%. Cnidaria and demosponges dominated with densities of 22.1 and 34.2 colonies/m², respectively. Antipatharia had 0.34 colonies/m² and Alcyonacea (primarily Gorgonacea) had 10.7. Scleractinia overall had 7.3 colonies/m², with standing live *Oculina* colonies at 6.1. Sponges were dominated by *Erylus* sp. (26.7 colonies/m²), *Geodia* spp. (2.7), and *Spirastrellidae* (3.1).

Table 2. Density of benthic macro-biota at site 11-158A (# organisms, number/m², percent of total density).

Phylum/Class/Order/Scientific Name	# Organisms	#/m ²	% of Site
Porifera	3803	34.16	58.02%

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Location: USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef

Demospongiae	3803	34.16	58.02%
Astrophorida	3272	29.39	49.92%
Erylus sp.	2968	26.66	45.28%
Geodia- flat top	203	1.82	3.10%
Geodia- flat top red	26	0.23	0.40%
Geodia- flat top yellow	64	0.57	0.98%
Geodia sp.	3	0.03	0.05%
Geodia sp.- tan sp ap pore	8	0.07	0.12%
Chondrosida	3	0.03	0.05%
Chondrosia sp.	3	0.03	0.05%
Hadromerida	351	3.15	5.35%
Spirastrellidae	351	3.15	5.35%
Poecilosclerida	27	0.24	0.41%
Poecilosclerida	27	0.24	0.41%
Verongida	2	0.02	0.03%
Aplysina sp.	2	0.02	0.03%
Demospongiae	148	1.33	2.26%
Demospongiae	127	1.14	1.94%
Demospongiae- am white	6	0.05	0.09%
Demospongiae- ye lobate	15	0.13	0.23%
Cnidaria	2463	22.12	37.57%
Anthozoa	2298	20.64	35.06%
Actiniaria	144	1.29	2.20%
Actiniaria	85	0.76	1.30%
Actiniaria- mat anemone	59	0.53	0.90%
Alcyonacea	1194	10.72	18.22%
Alcyonacea	2	0.02	0.03%
Callipodium rubens (=Anthopodium rubens)	7	0.06	0.11%
Diodogorgia sp.	64	0.57	0.98%
Gorgonacea (accepted as Alcyonacea)	1087	9.76	16.58%
Leptogorgia sp.	1	0.01	0.02%
Nicella sp.	1	0.01	0.02%
Nidalia occidentalis	31	0.28	0.47%
Telesto sp.	1	0.01	0.02%
Antipatharia	38	0.34	0.58%
Antipathidae	3	0.03	0.05%
Stichopathes lutkeni	30	0.27	0.46%
Tanacetipathes hirta	5	0.04	0.08%
Ceriantharia	53	0.48	0.81%
Cerianthidae	53	0.48	0.81%
Corallimorpharia	10	0.09	0.15%
Corallimorphus sp.	10	0.09	0.15%
Scleractinia	814	7.31	12.42%

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Cladocora sp.	1	0.01	0.02%
Oculina varicosa	681	6.12	10.39%
Oculina varicosa- dead standing	131	1.18	2.00%
Phyllangia americana	1	0.01	0.02%
Zoanthidea	45	0.40	0.69%
Zoanthidae	45	0.40	0.69%
Hydrozoa	165	1.48	2.52%
Hydrozoa	165	1.48	2.52%
Hydroidolina	165	1.48	2.52%
Annelida	7	0.06	0.11%
Polychaeta	7	0.06	0.11%
Sabellida	7	0.06	0.11%
Mollusca	4	0.04	0.06%
Gastropoda	4	0.04	0.06%
Littorinimorpha	4	0.04	0.06%
Cypraea sp.	4	0.04	0.06%
Arthropoda	66	0.59	1.01%
Malacostraca	54	0.49	0.82%
Amphipoda	28	0.25	0.43%
Corophiidea	28	0.25	0.43%
Decapoda	26	0.23	0.40%
Decapoda	17	0.15	0.26%
Paguroidea	1	0.01	0.02%
Stenorhynchus seticornis	8	0.07	0.12%
Pycnogonida	12	0.11	0.18%
Pantopoda	12	0.11	0.18%
Anoplodactylus lentus	12	0.11	0.18%
Echinodermata	133	1.19	2.03%
Asteroidea	53	0.48	0.81%
Forcipulatida	53	0.48	0.81%
Coscinasterias tenuispina	53	0.48	0.81%
Echinoidea	7	0.06	0.11%
Arbacioda	5	0.04	0.08%
Arbacia punctulata	5	0.04	0.08%
Cidaroida	1	0.01	0.02%
Diadematoida	1	0.01	0.02%
Centrostephanus longispinus	1	0.01	0.02%
Holothuroidea	35	0.31	0.53%
Aspidochirotida	35	0.31	0.53%
Holothuria lengtiginosa	34	0.31	0.52%
Isostichopus badionotus	1	0.01	0.02%
Ophiuroidea	38	0.34	0.58%

Dive Number: Phantom ROV 11-158A

Location: USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef

Euryalida	22	0.20	0.34%
Asteroporpa annulata	22	0.20	0.34%
Ophiurida	1	0.01	0.02%
Ophiothrix sp.	1	0.01	0.02%
Ophiuroidea	15	0.13	0.23%
Chordata	17	0.15	0.26%
Ascidiacea	17	0.15	0.26%
Aplousobranchia	2	0.02	0.03%
Didemnidae	2	0.02	0.03%
Ascidiacea	15	0.13	0.23%
Ascidiacea	15	0.13	0.23%
Cyanophyta	57	0.51	0.87%
Cyanophyta	57	0.51	0.87%
Cyanophyta	57	0.51	0.87%
Cyanobacteria	57	0.51	0.87%
Human debris	5	0.04	0.08%
Human debris	5	0.04	0.08%
Human debris	5	0.04	0.08%
Human debris- fish line/gear	4	0.04	0.06%
Human debris- unid.	1	0.01	0.02%
Grand Total	6555	58.88	100.00%

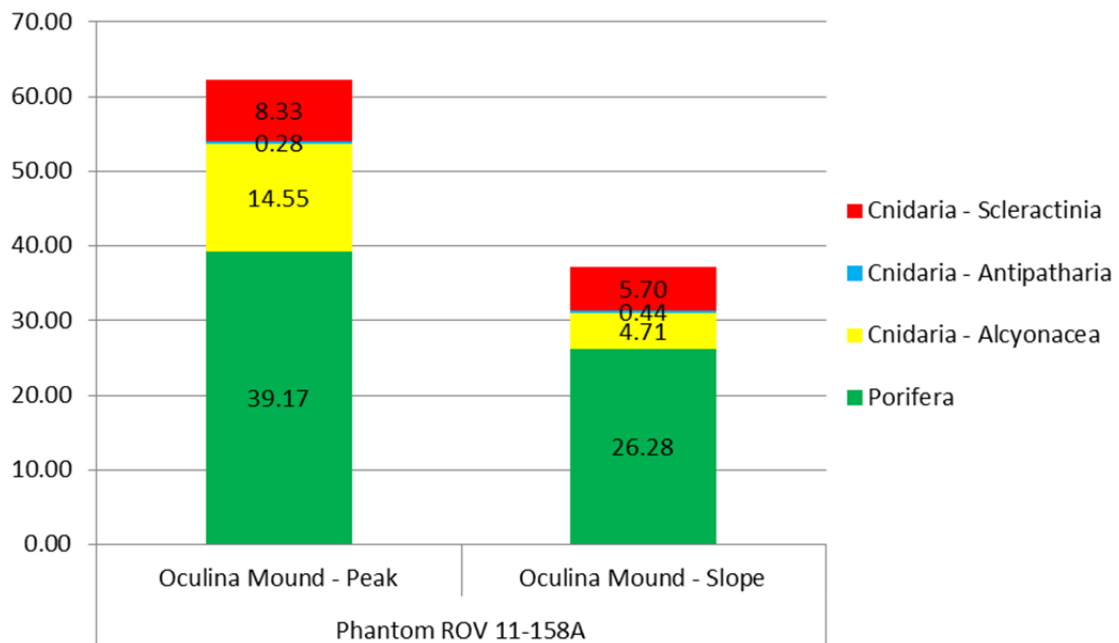


Figure 5. Density (number colonies/m²) of Porifera, hard coral (Stylasteridae, Scleractinia), Antipatharia, and Alcyonacea (Gorgonacea) for each habitat zone at dive site 11-158A.

Dive Number: Phantom ROV 11-158A **Location:** USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef

Figure 5 shows the density of Porifera and coral for each of the habitats at dive site 11-158A. Coral is defined as hard coral (Scleractinia), Antipatharia, and Gorgonacea. The *Oculina* mound peak had greater overall biota density (60.9 organisms/m²) than the mound slope (35.9); Scleractinian coral (all species) ranged from 8.3 to 5.7 on the peak and slope, respectively; and sponges were also very dense on the peak and slope (39.2 and 26.3 colonies/m², respectively) as were Alcyonacea (primarily Gorgonacea; 14.5 and 4.7, respectively).

Fish Data Analysis:

Video transects were used to analyze the fish populations and densities. Protocol for the fish analyses was to divide the continuous video into 5 minute segments, or whenever there was a change in habitat type, whichever came first, so each video segment only contained one habitat type (see Methods for details). These were also correlated with the habitat types used for the benthic analyses. All fish were identified for each ROV dive to species level and counted. The total distance (km) of each dive was used to calculate the density (# individuals/km) of each fish species. A total of 33 taxa of fish were identified from dive site 11-158A for a total density of 2738 individuals/km (Table 3). These were dominated by anthiids (unidentified Anthiinae, primarily rough-tongue bass and red bar-bier; 2565 individuals/km), rough-tongue bass (41), and bank butterflyfish (27). Managed and fished species included scamp (12.7), amberjack spp. (2.9), blue-line tilefish (1.2), snowy grouper (1.2), and gag grouper (0.6).

Table 3. Density of fish for all transects at dive site 11-158A (number individuals/km).

Common Name	Species Name	Density (#/km)
anthiids	Anthiinae	2565.5
rough-tongue bass	<i>Pronotogrammus martinicensis</i>	41.0
bank butterflyfish	<i>Prognathodes aya</i>	27.1
sea bass	<i>Centropristis</i> sp.	25.4
scamp	<i>Mycteroperca phenax</i>	12.7
bank sea bass	<i>Centropristis ocyurus</i>	12.1
cubby	<i>Equetus umbrus</i>	12.1
short bigeye	<i>Pristigenys alta</i>	7.5
tattler	<i>Serranus phoebe</i>	4.0
yellowtail reef-fish	<i>Chromis enchrysurus</i>	3.5
scorpionfish	Scorpaenidae	2.9
amberjack	<i>Seriola</i> sp.	2.3
red bar-bier	<i>Hemanthias vivanus</i>	2.3
searobin	Triglidae	2.3
wrasse bass	<i>Liopropoma eukrines</i>	2.3
blue angelfish	<i>Holacanthus bermudensis</i>	1.7
sea bass	<i>Serranus</i> sp.	1.7
batfish	<i>Ogcocephalus</i> sp.	1.2
tilefish	<i>Caulolatilus</i> sp.	1.2
purple reef-fish	<i>Chromis scotti</i>	1.2
reticulate moray eel	<i>Muraena retifera</i>	1.2
snowy grouper	<i>Epinephelus niveatus</i>	1.2
apricot bass	<i>Plectranthias garrupellus</i>	0.6
belted sand bass	<i>Serranus subligarius</i>	0.6

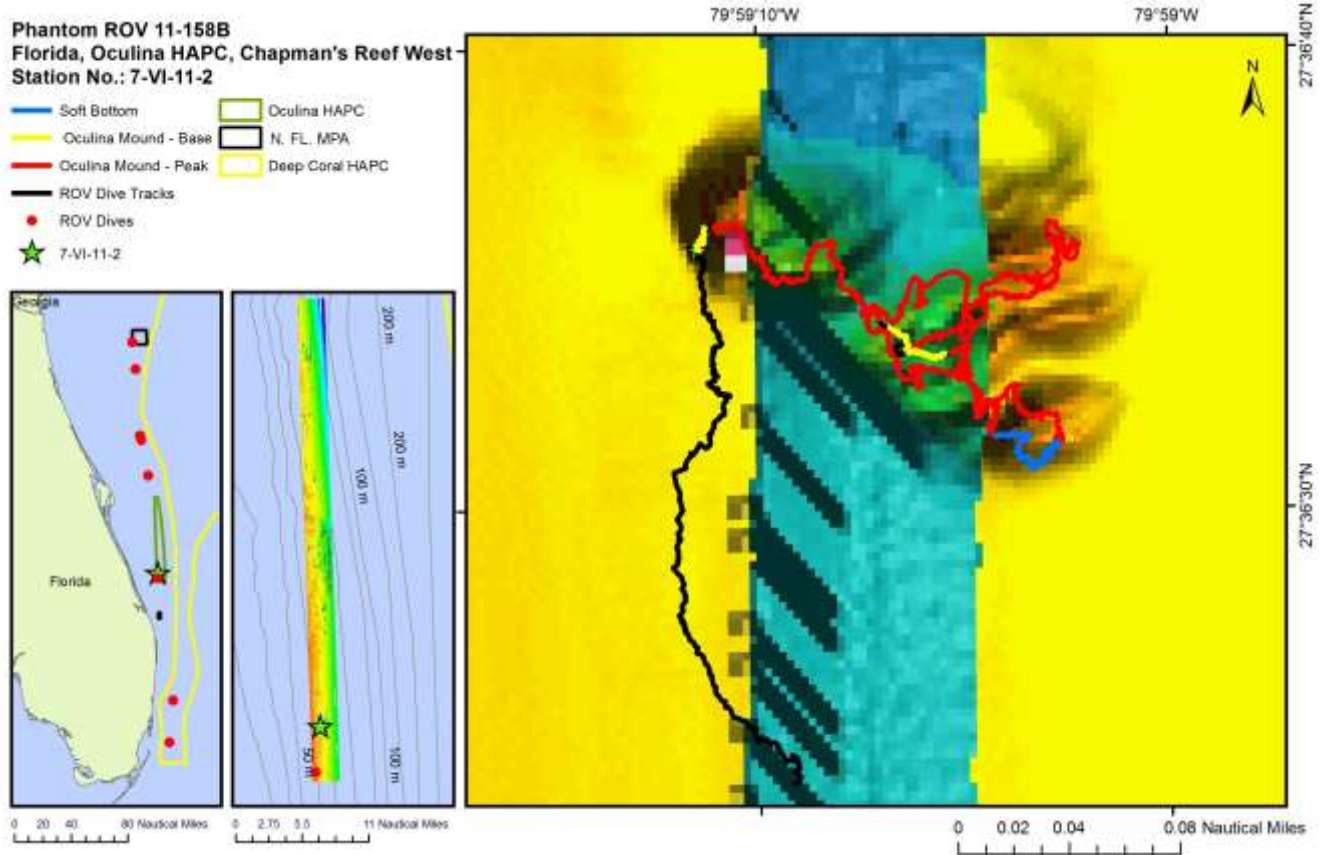
Dive Number: Phantom ROV 11-158A

Location: USA, Florida, Ft. Pierce, Oculina HAPC, Jeff's Reef

black sea bass	<i>Centropristis striata</i>	0.6
flounder	Bothidae	0.6
gag grouper	<i>Mycteroperca microlepis</i>	0.6
greater amberjack	<i>Seriola dumerili</i>	0.6
moray eel	Muraenidae	0.6
orangeback bass	<i>Serranus annularis</i>	0.6
red hogfish	<i>Decodon puellaris</i>	0.6
soldierfish	Holocentridae	0.6
wrasse	<i>Halichoeres sp.</i>	0.6

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Oculina HAPC, Chapman's Reef West 158B

General Location and Dive Track:



Site Overview: **Dive Overview:**

Project: 2011 Extreme Corals, NOAA DSCP

Principal Investigator: Andrew W. David

PI Contact Info: 3500 Delwood Beach Rd. Panama City FL 32408

Website: <http://coralreef.noaa.gov/deepseacorals>

Scientific Observers: Andrew W. David, Charles Messing, Diego Figueroa, Jana Thoma, John Reed, Stephanie Farrington

Data Management: Access Database, Excel Spreadsheet, WinFrog

ROV Navigation Data: WinFrog

Ship Position System: DGPS

Report Analyst: John Reed, Stephanie Farrington

Vessel: NOAA Ship *Pisces*

Sonar Data: Chapman test: chapman_S_N.tif

Purpose: Map and characterize DSCE off SE USA

ROV: NOAA SW Fisheries Super Phantom ROV

Sensors Used: Temperature (°C), Dissolved Oxygen (ml/l), Salinity (PSU), Conductivity

Date of Dive: 6/7/2011

Specimens: 0

Digital Photos: 541

DVD: 4

Hard Drive: 1

Date Compiled: 2/20/2013

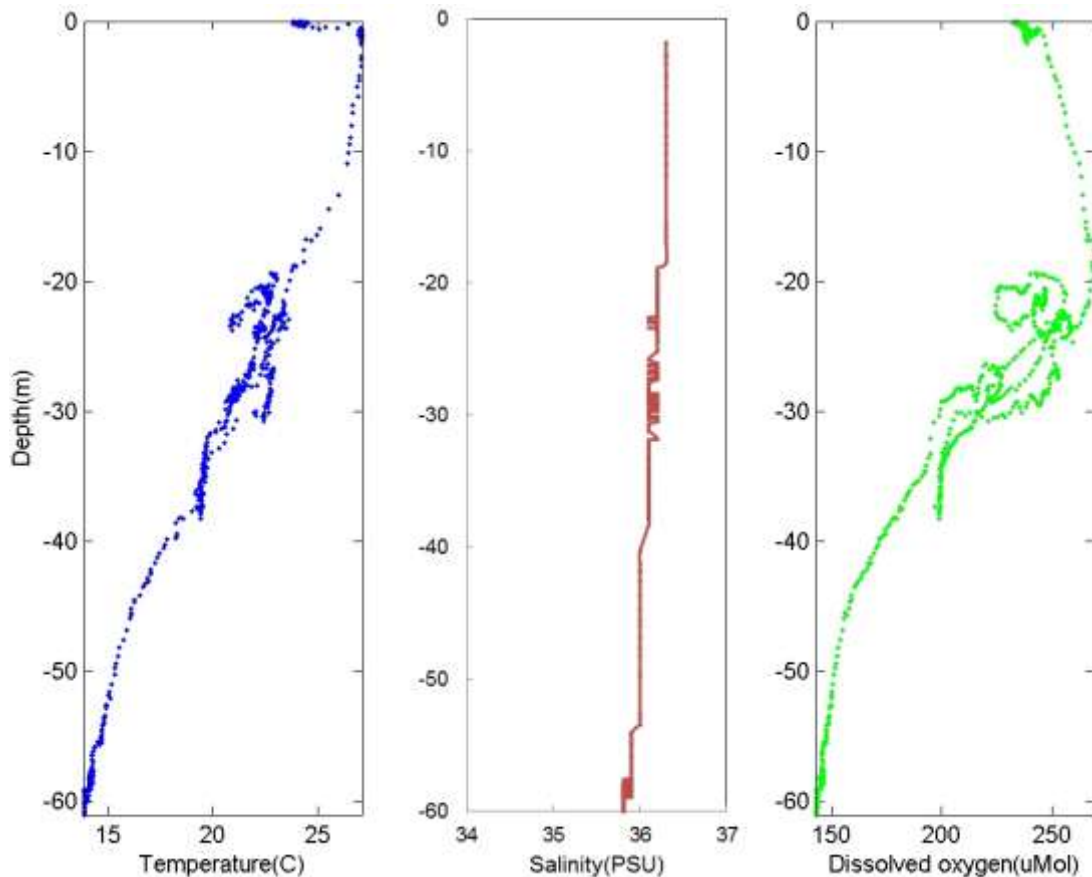
Dive Number: Phantom ROV 11- **Location:** USA, Florida, Oculina HAPC, Chapman's Reef West 158B

Dive Data:

Minimum Bottom Depth (m): 64	Total Transect Length (km): 1.926
Maximum Bottom Depth (m): 74	Surface Current (kn): .25
On Bottom (Time- GMT): 19:12	On Bottom (Lat/Long): 27°36.3984'N; 79°59.1549'W
Off Bottom (Time- GMT): 22:05	Off Bottom (Lat/Long): 27°36.5555'N; 79°59.1135'W
Physical (bottom); Temp (°C): 13.47	Salinity: 35.70 Visibility (ft): 60+ Current (kn): 0.25

Physical Environment:

CTD Number 11-158B_CTDU



All CTD data were collected with the Super Phantom ROV which recorded depth, temperature (°C), conductivity (salinity, PSU), pressure (mbar), sound velocity (m/sec), oxygen concentration (uMol), and oxygen saturation. These data were used both to support multibeam surveys (sound velocity) and to characterize hydrographic conditions at the dive sites.

The following values were recorded at the maximum depth of this CTD cast (61 m): temperature- 13.9, salinity- 35.8, and dissolved oxygen- 143.1. Surface temperature was 27.2 and there was no distinct thermocline; salinity peaked between 0 and 18 m, dissolved oxygen peaked at 20 m. Visibility was estimated at 18-21 m from the ROV video.

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Oculina HAPC, Chapman's Reef West 158B

Dive Imagery:



Figure 1: 27°36.571'N, 79°59.1255'W 67.4 m
Thickets of live Ivory tree coral (*Oculina varicosa*) growing on the ridges of the deepwater Oculina coral reef within the OHAPC. Encrusting the dead standing coral are sponges (*Geodia* spp.- flat top sponge, *Erylus* sp.- grey lobate, Spirastrellidae- red-orange), Gorgonacea, and Hydroida. Red barbier (*Hemanthias vivanus*).



Figure 2: 27°36.583'N, 79°59.1513'W 72.9 m
Trawl net wrapped around the Ivory tree coral (*Oculina varicosa*). Unfortunately although protected since 1984 as an OHAPC, lost fishing gear including fishing lines, long lines, and trawl nets are not uncommon on these deepwater reefs.



Figure 3: 27°36.5932'N, 79°59.047'W 68.3 m
The standing dead coral framework and coral rubble still provide habitat for many benthic species. Small live *Oculina varicosa* colonies like these (10-20 cm diameter) are relatively new growth, less than 10-20 years old. The coral rubble provides habitat for other species too, including purple gorgonians (*Diodogorgia* sp.), spaghetti brittlestars (*Asteroporpa annulata*), fire-ball corals (*Nidalia occidentalis*), and sponges (Spirastrellidae and Poecilosclerida).



Figure 4: 27°36.5413'N, 79°59.0642'W 67.1 m
Concrete reef blocks were placed within the OHAPC in the late 1990s and early 2000s as an experiment to attract coral settlement and fish, especially in dead rubble areas. This live Ivory tree coral, *Oculina varicosa*, has settled and grown on the block since 1997.

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Oculina HAPC, Chapman's Reef West 158B

Dive Notes:

Objectives, Site Description, Habitat, Fauna:

Objective: Survey *Oculina* coral mound inside the original *Oculina* HAPC (designated 1984). Target site- Chapman's Reef West *Oculina* mound: 27° 35'N, 79° 58'W; 64-74 m.

Dive Events: Conducted several video/photo transects including south slope and along the three peak ridges ground truthing the multibeam sonar from Reed et al. 2005 (DSC Symp.) and *Pisces* multibeam sonar. [Note- The *Phantom* ROV's top parallel lasers are calibrated at 20 cm, bottom lasers 61 cm. Depth recorded in WinFrog is correct; video overlay display is incorrect.]

Site Description/Habitat/Fauna: Chapman's Reef West is an *Oculina* coral bioherm, ~350 x 230 m, oriented NW-SE; maximum depth is 74 m and minimum depth is 64 m. Coral cover is greatest along the south face and along the edges of the three NW-SE ridges where live *Oculina varicosa* coral colonies (azooxanthellate) average 20-50 cm diameter but a few are up to 1 m. The coverage in these areas vary from 10-20% live coral up to 30-50% live along with coral rubble. The ridge tops tend to have greater percentage of coral rubble and few standing corals. At least six artificial reef blocks (~1 m x 1 m aggregates of concrete blocks; deployed in 1996-1998 by C. Koenig) were found; a few live colonies of *O. varicosa* are growing on some. On top of the reef are areas of thick deposits of a grey mud with pudding-like consistency which appears unnatural but similar to that seen on nearshore reefs which had been covered from coastal dredging projects. Dominant fauna include: Fish- scamp, black seabass, scorpaenids, puffer, wrasse bass, short bigeye, bank butterfly, spotted moray, black drum, anthiids, queen angelfish, damselfish; Sponges- demosponges; Cnidaria- *Oculina varicosa* (Ivory tree coral), *Stichopathes*, Plexauridae, Pennatulacea- *Virgularia*, *Anthomastus*, hydroids, Cerianthidae, Antipatharia- *Tanacetipathes*, *Arthropodium* (*Callipodium*), Corallimorpharia, Actiniaria; Echinoderms- *Holothuria lentigenosa*, *Centrostephanus*, *Astroporpa annulata*, *Ophioderma*, *Narcissia trigonaria*. Video of fish net on 1-m *Oculina* colony, trawl net, long lines, and a fish net by a dead coral.

Dive Number: Phantom ROV 11-158B **Location:** USA, Florida, Oculina HAPC, Chapman's Reef West

Percent Cover of Benthic Macro-Biota and Substrate:

Phantom ROV 11-158B surveyed Chapman’s Reef West inside of the *Oculina* HAPC. The dive transects were divided into two habitat types: *Oculina* mound peak (peak and slope were combined as the mound is fairly low relief), and *Oculina* mound base (valleys between the peaks). Point count (CPCe[®]) was used to determine percent cover (see methods for details). Figure 1 shows the percent cover of hard bottom and soft bottom substrate; points on biota were scored as the underlying substrate type. Soft bottom substrate is defined as unconsolidated mud or sand. Hard bottom in this region may consist of coral framework which is defined as standing colonial hard coral (either live or dead), coral rubble, rock pavement, or rock ledges. Site 11-158B was predominately hard bottom substrate (77.8% cover), consisting primarily of coral framework (29.2%), coral rubble (16.6%), but essentially no exposed rock pavement or ledges (Fig. 2, Table 1). Benthic macro-biota covered 62.3% of the bottom and consisted of 29% coral framework (12.5% live *Oculina*, 15.8% standing dead *Oculina*), 20.0% Porifera, 3.3% non-scleractinian coral, and 7.8% other organisms (Fig. 2, Table 1; see Table 2 for complete species list). Figure 3 shows the percent cover of substrate type for each habitat zone of the dive site. Basically there was little difference between the habitat zones. The cover of coral framework ranged from 29.5% on the mound to 26.3% in the valleys between the ridges (base); coral rubble was 16.6% and 16.8%, respectively. Dead coral is typically described as standing dead or coral rubble, however, it is recognized as live-bottom habitat, and is an important component of the habitat. Live coral, coral rubble, and standing dead coral provide habitat for hundreds of species of invertebrates and juvenile fish (e.g., Reed et al., 1982, 1987, 2002; Ross and Quattrini, 2007), in addition to commercially valuable species (e.g., Reed and Farrington, 2010).

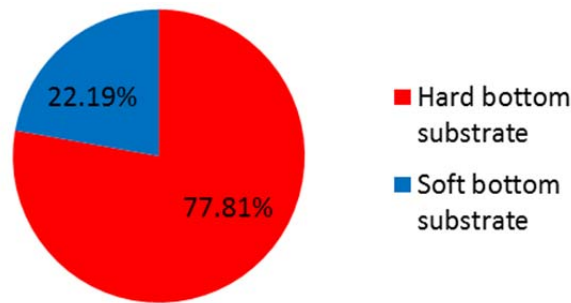


Figure 1. Percent cover of hard and soft bottom substrate at dive site 11-158B. CPCe[®] points on organisms were scored as the underlying substrate (hard or soft).

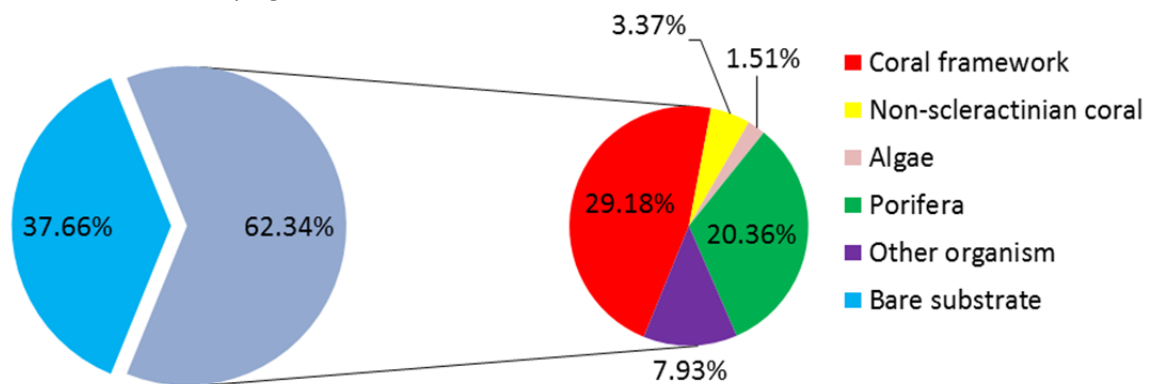


Figure 2. Percent cover of bare substrate and benthic macro-biota at dive site 11-158B. Coral framework is standing, colonial hard coral. Non-scleractinian corals are defined as Gorgonacea, other Alcyonacea, and Antipatharia.

Table 1. Percent cover of benthic macro-biota and substrate types at dive site 11-158B.

Benthic macro-biota and substrate types	% Cover
Coral framework	28.67%
Oculina varicosa	12.55%
Scleractinia, unid	0.27%
Standing Dead Coral	15.85%
Non-scleractinian coral	3.31%
Alcyonacea	0.64%
Antipatharia	1.11%
Gorgonacea, Unid	1.56%
Porifera	20.02%
Porifera- Hexactinellida, Calcarea, or Demospongiae	20.02%
Other organism	7.80%
Algae	1.48%
Algae- green, brown, red, or cyanobacteria	1.48%
Bare substrate	37.02%
Bare Soft Bottom substrate	20.46%
Coral rubble	16.34%
Rock- pavement, boulder, ledge	0.02%
Rubble	0.21%
Human debris	1.70%
Fish/crab trap	0.03%
Human debris- Other	1.45%
Trawl gear	0.22%
Grand Total	100.00%

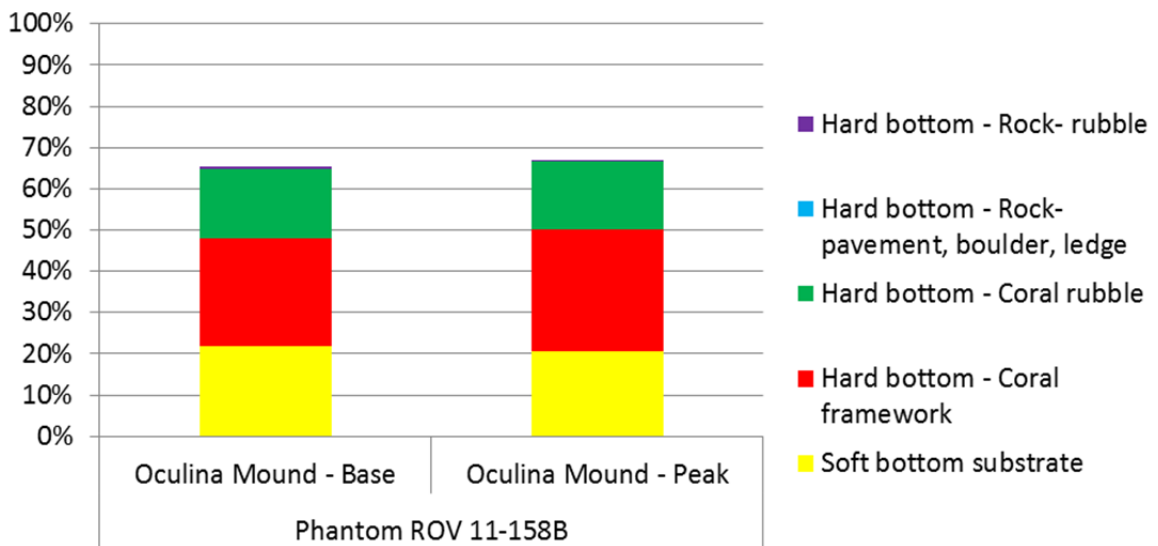


Figure 3. Percent cover of substrate types for each habitat zone at dive site 11-158B.

Dive Number: Phantom ROV 11-158B

Location: USA, Florida, Oculina HAPC, Chapman's Reef West

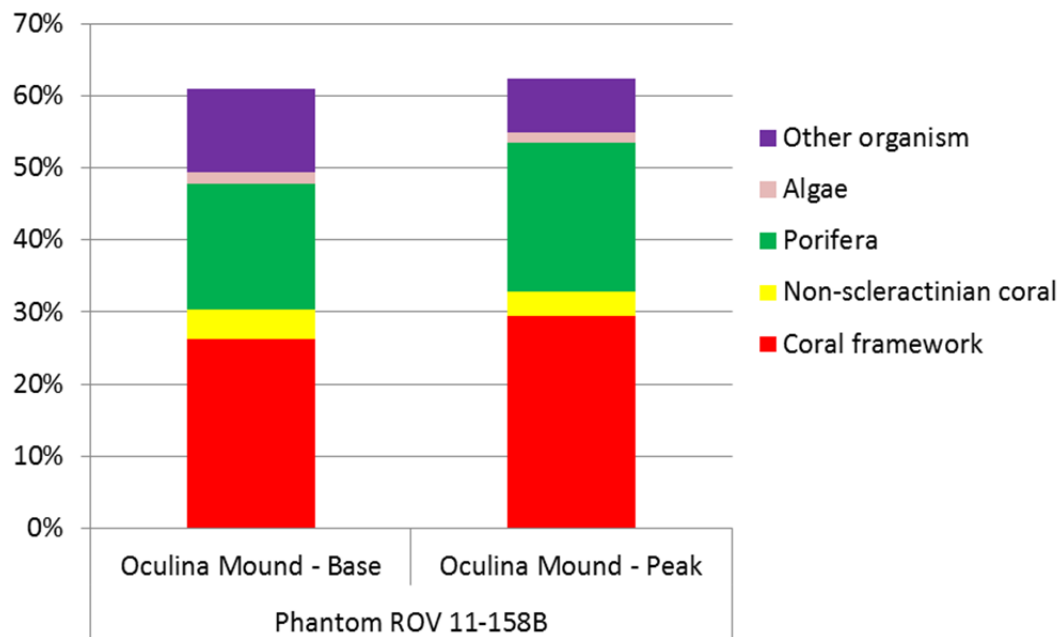


Figure 4. Percent cover of benthic macro-biota for each habitat zone at dive site 11-158B.

The percent cover of biota by habitat type shows >60% cover for both habitats (Fig. 4). *Oculina* coral framework was the dominant biota (26-29% cover), sponges ranged from 20.7% to 17.3%, and other biota were 11.5 to 7.5%.

Density of Benthic Macro-Biota:

As discussed in the Methods, some common taxa could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phylum. Sponges, gorgonians, and black coral are especially difficult to identify without a specimen in hand. In these cases a general descriptive taxa was used, e.g., “brown lobate sponge” or “unidentified Demospongiae”, which could consist of numerous species. These designations should not be considered equivalent to species level and should not be used for diversity (H') indices calculations. Many deepwater species in this region look nearly identical, such as fan sponges which are polyphyletic and actually include different Classes.

Dive site 11-158B had a total of 54 benthic macro-fauna taxa, consisting of 19 Cnidaria and 9 Porifera (Table 2). Overall density of all benthic macro-fauna was 30.4 organisms/m². Cnidaria contributed to 56.6% of the total density at this site, and Porifera 32.4%. Cnidaria and demosponges dominated with densities of 17.2 and 9.9 colonies/m², respectively. Antipatharia had a density of .68 colonies/m² and Alcyonacea had 9.1. Scleractinia overall had 5.5 colonies/m², with standing live *Oculina* colonies at 4.1. Sponges were dominated by *Erylus* sp. (5.57 colonies/m²), *Geodia* spp. (0.8), and *Spirastrellidae* (2.7).

Dive Number: Phantom ROV 11-158B **Location:** USA, Florida, Oculina HAPC, Chapman's Reef West

Table 2. Density of benthic macro-biota at site 11-158B (# organisms, number/m², percent of total density).

Phylum/Class/Order/Scientific Name	# Organisms	#/m ²	% of Site
Porifera	910	9.87	32.43%
Demospongiae	910	9.87	32.43%
Astrophorida	587	6.37	20.92%
Erylus sp.	513	5.57	18.28%
Geodia- flat top	34	0.37	1.21%
Geodia- flat top red	15	0.16	0.53%
Geodia- flat top yellow	24	0.26	0.86%
Geodia sp.	1	0.01	0.04%
Hadromerida	254	2.76	9.05%
Spirastrellidae	254	2.76	9.05%
Poecilosclerida	4	0.04	0.14%
Poecilosclerida	4	0.04	0.14%
Demospongiae	65	0.71	2.32%
Demospongiae	63	0.68	2.25%
Demospongiae- am white	2	0.02	0.07%
Cnidaria	1589	17.24	56.63%
Anthozoa	1508	16.36	53.74%
Actinaria	13	0.14	0.46%
Actinaria	13	0.14	0.46%
Alcyonacea	838	9.09	29.86%
Alcyonacea	1	0.01	0.04%
Callipodium rubens (=Anthopodium rubens)	8	0.09	0.29%
Diodogorgia sp.	28	0.30	1.00%
Ellisellidae	1	0.01	0.04%
Gorgonacea (accepted as Alcyonacea)	689	7.48	24.55%
Nicella sp.	1	0.01	0.04%
Nidalia occidentalis	110	1.19	3.92%
Antipatharia	63	0.68	2.25%
Antipathidae	20	0.22	0.71%
Stichopathes lutkeni	37	0.40	1.32%
Tanacetipathes hirta	6	0.07	0.21%
Ceriantharia	19	0.21	0.68%
Cerianthidae	19	0.21	0.68%
Corallimorpharia	21	0.23	0.75%
Corallimorphus sp.	21	0.23	0.75%
Scleractinia	504	5.47	17.96%
Oculina varicosa	381	4.13	13.58%
Oculina varicosa- dead standing	112	1.22	3.99%
Phyllangia americana	9	0.10	0.32%

Dive Number: Phantom ROV 11-158B **Location:** USA, Florida, Oculina HAPC, Chapman's Reef West

Scleractinia- unid colonial	1	0.01	0.04%
Scleractinia- unid cup	1	0.01	0.04%
Zoanthidea	50	0.54	1.78%
Zoanthidae	50	0.54	1.78%
Hydrozoa	81	0.88	2.89%
Hydrozoa	81	0.88	2.89%
Hydroidolina	81	0.88	2.89%
Annelida	67	0.73	2.39%
Polychaeta	67	0.73	2.39%
Amphinomida	1	0.01	0.04%
Hermodice carunculata	1	0.01	0.04%
Sabellida	25	0.27	0.89%
Sabellidae	25	0.27	0.89%
Polychaeta	41	0.44	1.46%
Mollusca	2	0.02	0.07%
Gastropoda	2	0.02	0.07%
Littorinimorpha	2	0.02	0.07%
Cypraea sp.	2	0.02	0.07%
Arthropoda	25	0.27	0.89%
Malacostraca	13	0.14	0.46%
Amphipoda	1	0.01	0.04%
Corophiidea	1	0.01	0.04%
Chelicerata	5	0.05	0.18%
Pycnogonida	5	0.05	0.18%
Decapoda	7	0.08	0.25%
Decapoda	2	0.02	0.07%
Stenorhynchus seticornis	5	0.05	0.18%
Pycnogonida	12	0.13	0.43%
Pantopoda	12	0.13	0.43%
Anoplodactylus lentus	12	0.13	0.43%
Echinodermata	158	1.71	5.63%
Asteroidea	121	1.31	4.31%
Forcipulatida	100	1.09	3.56%
Coscinasterias tenuispina	100	1.09	3.56%
Valvatida	1	0.01	0.04%
Goniasteridae	1	0.01	0.04%
Asteroidea	20	0.22	0.71%
Asteroidea	17	0.18	0.61%
Asteroidea- red spotted	3	0.03	0.11%
Echinoidea	17	0.18	0.61%
Arbacioda	4	0.04	0.14%
Arbacia punctulata	4	0.04	0.14%

Dive Number: Phantom ROV 11-158B **Location:** USA, Florida, Oculina HAPC, Chapman's Reef West

Cidaroida	1	0.01	0.04%
Eucidaris tribuloides	1	0.01	0.04%
Diadematoida	12	0.13	0.43%
Centrostephanus longispinus	12	0.13	0.43%
Holothuroidea	12	0.13	0.43%
Aspidochirotida	10	0.11	0.36%
Holothuria lengtiginosa	9	0.10	0.32%
Isostichopus badionotus	1	0.01	0.04%
Holothuroidea	2	0.02	0.07%
Holothuroidea	2	0.02	0.07%
Ophiuroidea	8	0.09	0.29%
Euryalida	5	0.05	0.18%
Asteroporpa annulata	5	0.05	0.18%
Ophiuroidea	3	0.03	0.11%
Chordata	13	0.14	0.46%
Asciacea	13	0.14	0.46%
Aplousobranchia	2	0.02	0.07%
Didemnidae	2	0.02	0.07%
Asciacea	11	0.12	0.39%
Asciacea	11	0.12	0.39%
Cyanophyta	25	0.27	0.89%
Cyanophyta	25	0.27	0.89%
Cyanophyta	25	0.27	0.89%
Cyanobacteria	25	0.27	0.89%
Rhodophyta	10	0.11	0.36%
Rhodophyta	10	0.11	0.36%
Rhodophyta	10	0.11	0.36%
Corallinales or Peyssonneliaceae	6	0.07	0.21%
Rhodophyta- flat oval	4	0.04	0.14%
Human debris	7	0.08	0.25%
Human debris	7	0.08	0.25%
Human debris	7	0.08	0.25%
Human debris- cans/bottles	2	0.02	0.07%
Human debris- net	4	0.04	0.14%
Human debris- unid.	1	0.01	0.04%
Grand Total	2806	30.45	100.00%

Dive Number: Phantom ROV 11-158B **Location:** USA, Florida, Oculina HAPC, Chapman's Reef West

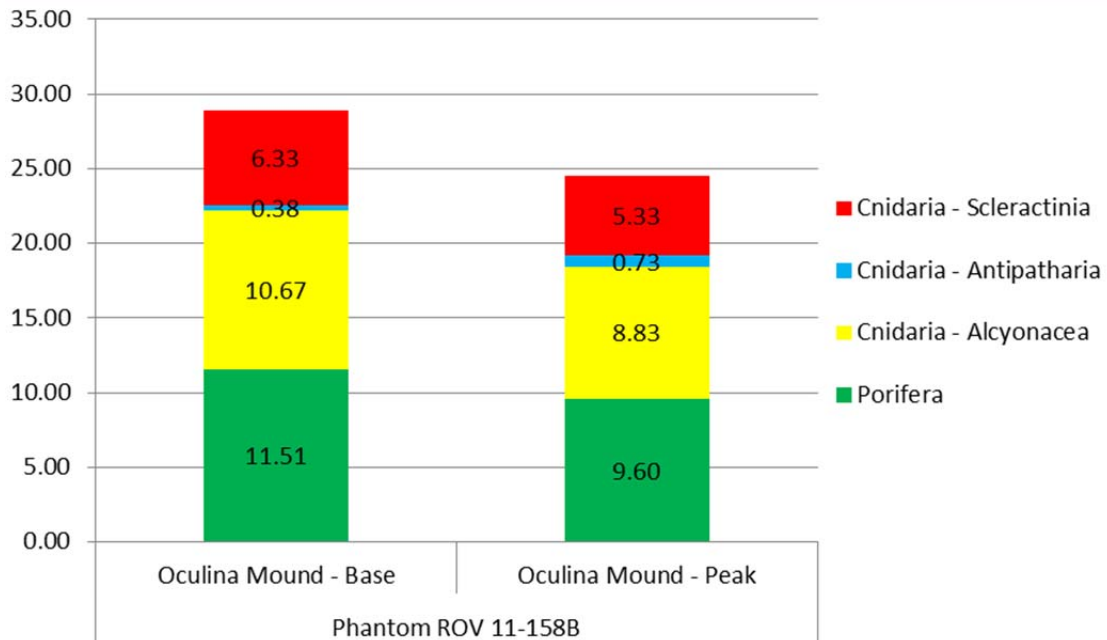


Figure 5. Density (number colonies/m²) of Porifera, hard coral (Stylasteridae, Scleractinia), Antipatharia, and Alcyonacea (Gorgonacea) for each habitat zone at dive site 11-158B.

Figure 5 shows the density of Porifera and coral for each of the habitats at dive site 11-158B. Coral is defined as hard coral (Scleractinia), Antipatharia, and Gorgonacea. The *Oculina* peaks and base had similar densities of scleractinian corals (5.3 and 6.3 colonies/m², respectively), sponges ranged from 9.6 to 11.5, respectively, and Alcyonacea were 8.8 to 10.7.

Fish Data Analysis:

Video transects were used to analyze the fish populations and densities. Protocol for the fish analyses was to divide the continuous video into 5 minute segments, or whenever there was a change in habitat type, whichever came first, so each video segment only contained one habitat type (see Methods for details). These were also correlated with the habitat types used for the benthic analyses. All fish were identified for each ROV dive to species level and counted. The total distance (km) of each dive was used to calculate the density (# individuals/km) of each fish species. A total of 24 taxa of fish were identified from dive site 11-158B for a total density of 1160 individuals/km (Table 3). These were dominated by anthiids (unidentified Anthiinae, primarily roughtongue bass and/or red barbier but were too far away to distinguish; 845 individuals/km), red barbier (103), and *Centropristes* sp. (41 individuals/km; either black sea bass and/or bank sea bass but were too far away to distinguish). Managed and fished species included black sea bass (11 individuals/km), scamp (1.6), amberjack and vermilion snapper (1.5/km each).

Table 3. Density of fish for all transects at dive site 11-158B (number individuals/km).

Common Name	Species Name	Density (#/km)
anthiids	Anthiinae	845.3
red barbier	<i>Hemanthias vivanus</i>	102.8
sea bass	<i>Centropristes</i> sp.	41.5
roughtongue bass	<i>Pronotogrammus marinicensis</i>	37.9
bank butterflyfish	<i>Prognathodes aya</i>	27.5

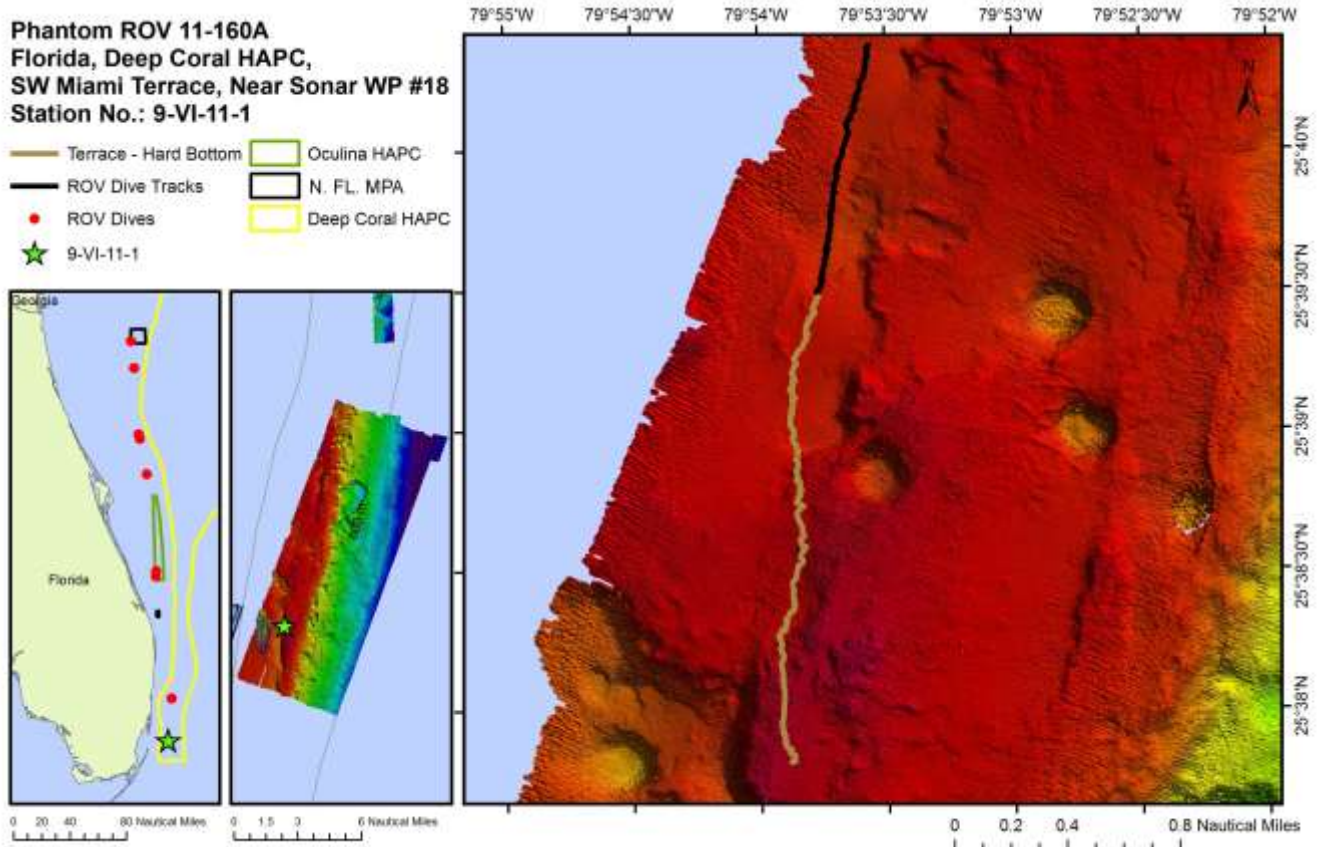
Dive Number: Phantom ROV 11-158B

Location: USA, Florida, Oculina HAPC, Chapman's Reef West

cubbyu	<i>Equetus umbrosus</i>	21.3
bank sea bass	<i>Centropristis ocyurus</i>	17.1
tattler	<i>Serranus phoebe</i>	16.6
black sea bass	<i>Centropristis striata</i>	11.4
scorpionfish	Scorpaenidae	8.3
short bigeye	<i>Pristigenys alta</i>	8.3
yellowtail reeffish	<i>Chromis enchrysurus</i>	6.7
wrasse bass	<i>Liopropoma eukrines</i>	4.2
reticulate moray		
eel	<i>Muraena retifera</i>	3.1
scamp	<i>Mycteroperca phenax</i>	1.6
blue angelfish	<i>Holacanthus bermudensis</i>	1.0
sea bass	<i>Serranus sp.</i>	1.0
wrasse	<i>Halichoeres sp.</i>	1.0
greater amberjack	<i>Seriola dumerili</i>	0.5
lizardfish	<i>Synodus sp.</i>	0.5
porcupinefish	<i>Diodon hystrix</i>	0.5
red hogfish	<i>Decodon puellaris</i>	0.5
sand diver	<i>Synodus intermedius</i>	0.5
vermilion snapper	<i>Rhomboplites aurorubens</i>	0.5

Dive Number: Phantom ROV 11-160A **Location:** USA, Florida, Deep Coral HAPC, SW Miami Terrace, Near Sonar WP #18

General Location and Dive Track:



Site Overview: **Dive Overview:**

Project: 2011 Extreme Corals, NOAA DSCP
Principal Investigator: Andrew W. David
PI Contact Info: 3500 Delwood Beach Rd. Panama City FL 32408
Website: <http://coralreef.noaa.gov/deepseacorals>
Scientific Observers: Andrew W. David, Charles Messing, Diego Figueroa, Jana Thoma, John Reed, Stephanie Farrington
Data Management: Access Database, Excel Spreadsheet, WinFrog
ROV Navigation Data: WinFrog
Ship Position System: DGPS
Report Analyst: John Reed, Stephanie Farrington

Vessel: NOAA Ship *Pisces*
Sonar Data: Miami Terrace: Miami_terrace_west.tif
Purpose: Map and characterize DSCE off SE USA
ROV: NOAA SW Fisheries Super Phantom ROV
Sensors Used: Temperature (°C), Dissolved Oxygen (ml/l), Salinity (PSU), Conductivity
Date of Dive: 6/9/2011
Specimens: 0
Digital Photos: 289
DVD: 6
Hard Drive: 1
Date Compiled: 2/20/2013

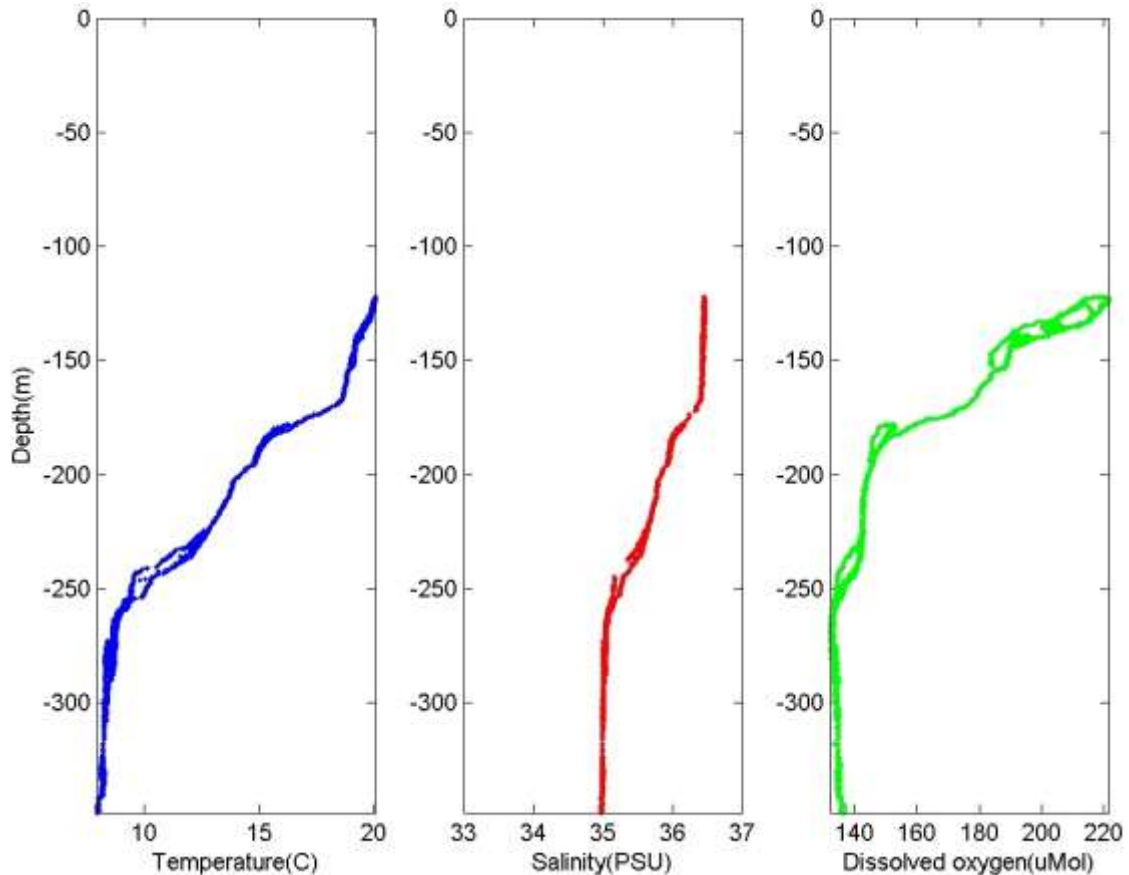
Dive Number: Phantom ROV 11- 160A **Location:** USA, Florida, Deep Coral HAPC, SW Miami Terrace, Near Sonar WP #18

Dive Data:

Minimum Bottom Depth (m): 340	Total Transect Length (km): 5.466
Maximum Bottom Depth (m): 375	Surface Current (kn): 1.2kts
On Bottom (Time- GMT): 18:53	On Bottom (Lat/Long): 25°37.7910'N; 79°53.8740'W
Off Bottom (Time- GMT): 21:31	Off Bottom (Lat/Long): 25°40.3702'N; 79°53.5650'W
Physical (bottom); Temp (°C): 7.90	Salinity: 34.97 Visibility (ft): 60 Current (kn):

Physical Environment:

CTD Number 11-160A_CTDD



All CTD data were collected with the Super Phantom ROV which recorded depth, temperature (°C), conductivity (salinity, PSU), pressure (mbar), sound velocity (m/sec), oxygen concentration (uMol), and oxygen saturation. These data were used both to support multibeam surveys (sound velocity) and to characterize hydrographic conditions at the dive sites.

The following values were recorded at the maximum depth of this CTD cast (348.1 m): temperature- 8.0, salinity- 35.0, and dissolved oxygen- 136.5. The CTD did not start recording until 122 m, at that depth temperature was 17.85 and there was a thermocline near 175 m depth; salinity peaked between 121 and 160 m, dissolved oxygen peaked at 121 m (the shallowest recorded). Visibility was estimated at 18-21 m from the ROV video.

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Deep Coral HAPC, SW Miami Terrace, 160A
Near Sonar WP #18

Dive Imagery:



Figure 1: 25°38.1903'N, 79°53.9135'W 345.7 m
Phosphoritic limestone rock slabs, boulders and cobble provide habitat for a variety of benthic species including these corals (*Lophelia pertusa*, unidentified cup Scleractinia, fire-ball coral- *Anthomastus* sp., gorgonacea- *Plumerella* sp.), sponges (Hexactinellida- various spp., *Geodia* sp.), and large anemone (Hormathiidae?).



Figure 2: 25°38.6752'N, 79°53.8467'W 354.2 m
Phosphoritic limestone rock slabs, boulders and cobble provide habitat for a variety of benthic species including these corals (solitary cup Scleractinia, gorgonacea- *Plumerella* sp.), sponges (Hexactinellida- various spp., *Geodia* sp.), and large anemone (Hormathiidae?).



Figure 3: 25°38.5515'N, 79°53.8412'W 354 m
Fragile glass goblet sponge (*Aphrocallistes beatrix*) is commonly found on the hard bottom habitat. This species is under research for its potent anti-pancreatic cancer properties.



Figure 4: 25°38.0979'N, 79°53.9145'W 343.3 m
These tube sponges (*Petrosia* sp.) are common on the phosphoritic rock slabs. Sponges (Lithistida,- thick wall cup, *Oceanapia* sp.- thin hollow tube).

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Deep Coral HAPC, SW Miami Terrace, 160A Near Sonar WP #18

Dive Notes:

Objectives, Site Description, Habitat, Fauna:

Objective: Survey portion of Miami Terrace within the Deep Coral Habitat Area of Particular Concern (CHAPC) that is also within the open Allowable Crab Fishing Area (ACFA) and to ground-truth NOAA regional bathymetric contour maps which show apparent high-relief features that are likely hard-bottom habitat. Target site- SW Miami Terrace: 25° 35.829'N, 79° 54.29'W; 350-410 m.

Dive Events: Difficulty with station keeping and ship's Dynamic Positioning in 2 kn surface current; launched and repositioned three times. ROV pulled off bottom numerous times during transect. Unable to stop ROV or maneuver in current. The ROV dive ended up 2.0 nmi northeast of the target site but within the CHAPC. [Note- The *Phantom* ROV's top parallel lasers are calibrated at 20 cm, bottom lasers 61 cm. Depth recorded in WinFrog is correct; video overlay display is incorrect.]

Site Description/Habitat/Fauna:

Mapped two sites with *Pisces* multibeam inside the ACFA and CHAPC (Miami Terrace south survey): 8 linear nmi and 5 nmi; the second site overlaps with Dave Naar's S. Miami sonar survey (2010). The sonar maps (Fig. 1) show definite high-relief hard bottom features, including individual mounds, steep ridge from 350-400 m with relief up to 60 m, and apparent deepwater sinkholes. The ROV dive site was 100% hard bottom consisting of rock pavement, rock slabs, boulders, cobble, rubble, gravel, sediment veneer over pavement, and low to moderate relief ledges up to 1 m tall. Some pavement has thin, 10-20 cm tall vertical ridges of unknown origin. Dominate fauna: Fish- *Laemonema*, shark, beardfish, catshark, greeneye, black belly rosefish; Sponges- dense fan sponges, plate, vase, barrel, and tube, Demospongiae, Pachastrellidae, Geodiidae, Petrosiidae, *Phakellia*, *Spongisorites*, Hexactinellida- *Vazella*, *Aphrocallistes*; Cnidaria- *Lophelia pertusa* (20-30 cm, sparse), Primnoidae, *Leiopathes*, Actiniaria, white gorgonians, Paramuriceidae (60 cm), Corallimorpharia; Decapoda- *Chaceon fenneri* (golden crab); Echinoderms- *Coronaster*.

Dive Number: Phantom ROV 11-160A **Location:** USA, Florida, Deep Coral HAPC, SW Miami Terrace, Near Sonar WP #18

Percent Cover of Benthic Macro-Biota and Substrate:

Phantom ROV 11-160A surveyed a portion of the Miami Terrace Deep Coral HAPC. Because of difficulty with station keeping in the 2 kn surface current, the ROV landed 2 nmi north of the target site, but still within the HAPC. The photo transect was basically on one type of habitat: rock pavement. Point count (CPCe[®]) was used to determine percent cover (see methods for details). Figure 1 shows the percent cover of hard bottom and soft bottom substrate; points on biota were scored as the underlying substrate type. Soft bottom substrate is defined as unconsolidated mud or sand. Hard bottom in this region may consist of rock pavement, ledges, coral rubble, and coral framework which is defined as standing colonial hard coral (either Stylasteridae or Scleractinia). Site 11-160A was predominately hard bottom substrate (50.4% cover), but much of the apparent soft bottom was likely rock pavement with a thin veneer of sediment. The bare hard bottom substrate consisted of rock pavement (25.1% cover) and rock rubble (16.9%) (Fig. 3). Benthic macro-biota covered 8.3% of the bottom and consisted of 4.6% Porifera (both Hexactinellida and Demospongiae), 0.7 non-scleractinian corals, 0.5% framework corals, and 2.6% other organisms (Fig. 2, Table 1; see Density section for complete species list). Since this dive only had one habitat zone, the data won't be further analyzed by habitat type.

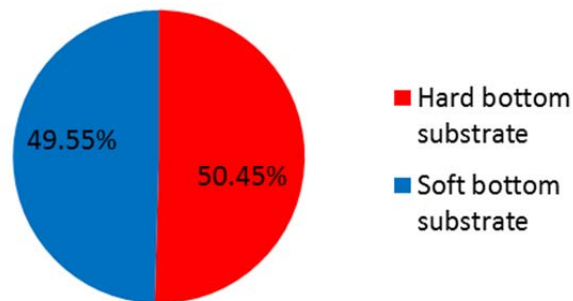


Figure 1. Percent cover of hard and soft bottom substrate at dive site 11-160A. CPCe[®] points on organisms were scored as the underlying substrate (hard or soft).

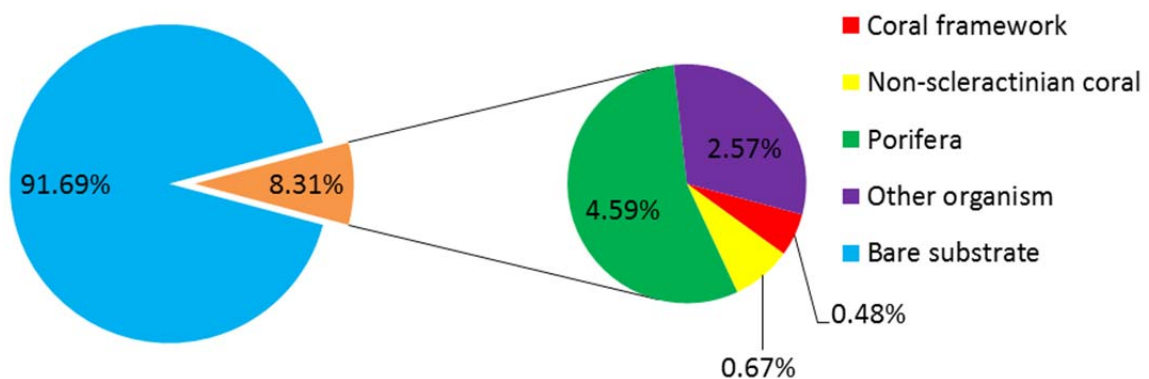


Figure 2. Percent cover of bare substrate and benthic macro-biota at dive site 11-160A. Coral framework is standing, colonial hard coral. Non-scleractinian corals are defined as Gorgonacea, other Alcyonacea, and Antipatharia.

Dive Number: Phantom ROV 11- 160A **Location:** USA, Florida, Deep Coral HAPC, SW Miami Terrace, Near Sonar WP #18

Table 1. Percent cover of benthic macro-biota and substrate types at dive site 11-160A.

Benthic macro-biota and substrate types	% Cover
Coral framework	0.48%
Lophelia pertusa	0.16%
Scleractinia, unid	0.14%
Standing Dead Coral	0.14%
Stylasteridae	0.05%
Non-scleractinian coral	0.67%
Alcyonacea	0.02%
Gorgonacea, Unid	0.65%
Porifera	4.58%
Porifera- Hexactinellida, Calcarea, or Demospongiae	4.58%
Other organism	2.57%
Bare substrate	91.59%
Bare Soft Bottom substrate	48.00%
Coral rubble	1.59%
Rock- pavement, boulder, ledge	25.09%
Rubble	16.92%
Human debris	0.10%
Fishing line/long line	0.03%
Human debris- Other	0.07%
Grand Total	100.00%

Density of Benthic Macro-Biota:

As discussed in the Methods, some common taxa could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phylum. Sponges, gorgonians, and black coral are especially difficult to identify without a specimen in hand. In these cases a general descriptive taxa was used, e.g., “brown lobate sponge”. These designations should not be considered equivalent to species level and should not be used for diversity (H') indices calculations. Many deepwater species in this region look nearly identical, such as fan sponges which are polyphyletic and actually include different Classes.

Dive site 11-160A had a total of 53 benthic macro-fauna taxa, consisting of 20 Porifera (including 8 Hexactinellida) and 19 Cnidaria (Table 2). Overall density of all benthic macro-fauna was 9.99 organisms/m². Cnidaria contributed to 47.1% of the total density at this site and Porifera 36.6%. Demosponges and Cnidaria dominated with densities of 3.6 and 4.7 organisms/m², respectively. The density of scleractinian corals was 0.6 colonies/m² (live *Lophelia pertusa* coral- 0.1, standing dead *Lophelia*- 1.2); stylaster corals were 1.3 colonies/m²; Alcyonacea (primarily Gorgonacea) were 1.5 colonies/m². Sponges were dominated by the hexactinellid glass sponges *Farrea* sp. (0.6), and demosponges Astrophorida (0.3) and Haplosclerida (0.15). *Aphrocallistes beatrix*, a hexactinellid sponge undergoing research for anti-pancreatic cancer properties, occurred at 0.03 colonies/m².

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Deep Coral HAPC, SW Miami Terrace, 160A Near Sonar WP #18

Table 2. Density of benthic macro-biota at site 11-160A (# organisms, number/m², percent of total density).

Phylum/Class/Order/Scientific Name	# Organisms	#/m ²	% of Site
Porifera	602	3.66	36.60%
Demospongiae	279	1.70	16.96%
Astrophorida	44	0.27	2.67%
Astrophorida	31	0.19	1.88%
Astrophorida- fan	11	0.07	0.67%
Geodia sp.	1	0.01	0.06%
Pachastrellidae	1	0.01	0.06%
Dictyoceratida	1	0.01	0.06%
Ircinia sp.	1	0.01	0.06%
Halichondrida	12	0.07	0.73%
Phakellia sp.	12	0.07	0.73%
Haplosclerida	24	0.15	1.46%
Oceanapia sp.	12	0.07	0.73%
Petrosia sp.	12	0.07	0.73%
Lithistida	17	0.10	1.03%
Lithistida	17	0.10	1.03%
Poecilosclerida	1	0.01	0.06%
Hymedesmia sp.- yellow morph	1	0.01	0.06%
Demospongiae	180	1.09	10.94%
Demospongiae	179	1.09	10.88%
Demospongiae- thin curtain	1	0.01	0.06%
Hexactinellida	323	1.96	19.64%
Hexactinosida	101	0.61	6.14%
Aphrocallistes beatrix	5	0.03	0.30%
Farrea sp.	96	0.58	5.84%
Lyssacinosa	10	0.06	0.61%
Hertwigia falcifera	3	0.02	0.18%
Nodastrella nodastrella	1	0.01	0.06%
Vazella pourtalesii	6	0.04	0.36%
Hexactinellida	212	1.29	12.89%
Hexactinellida	189	1.15	11.49%
Hexactinellida- curtain	20	0.12	1.22%
Hexactinellida- fan	3	0.02	0.18%
Cnidaria	775	4.71	47.11%
Anthozoa	531	3.23	32.28%
Actiniaria	34	0.21	2.07%
Actiniaria	33	0.20	2.01%
Actinoscyphia sp.	1	0.01	0.06%
Alcyonacea	255	1.55	15.50%

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Deep Coral HAPC, SW Miami Terrace, 160A
Near Sonar WP #18

Alcyonacea	26	0.16	1.58%
Anthomastus sp.	53	0.32	3.22%
Capnella sp.	17	0.10	1.03%
Ellisellidae	29	0.18	1.76%
Eunicella sp.	50	0.30	3.04%
Gorgonacea (accepted as Alcyonacea)	26	0.16	1.58%
Nidalia occidentalis	1	0.01	0.06%
Paramuricea sp.	1	0.01	0.06%
Plumarella sp.	15	0.09	0.91%
Primnoidae	37	0.22	2.25%
Corallimorpharia	6	0.04	0.36%
Corallimorpharia	6	0.04	0.36%
Scleractinia	99	0.60	6.02%
Lophelia pertusa	17	0.10	1.03%
Lophelia- standing dead	20	0.12	1.22%
Scleractinia- unid colonial	10	0.06	0.61%
Scleractinia- unid cup	52	0.32	3.16%
Zoanthidea	137	0.83	8.33%
Zoanthidae	137	0.83	8.33%
Hydrozoa	244	1.48	14.83%
Anthoathecata	222	1.35	13.50%
Stylasteridae	222	1.35	13.50%
Hydrozoa	22	0.13	1.34%
Hydroidolina	22	0.13	1.34%
Mollusca	7	0.04	0.43%
Gastropoda	7	0.04	0.43%
Littorinimorpha	1	0.01	0.06%
Cypraeidae	1	0.01	0.06%
Gastropoda	6	0.04	0.36%
Arthropoda	9	0.05	0.55%
Malacostraca	8	0.05	0.49%
Decapoda	8	0.05	0.49%
Chaceon fenneri	2	0.01	0.12%
Paguroidea	6	0.04	0.36%
Pycnogonida	1	0.01	0.06%
Pantopoda	1	0.01	0.06%
Anoplodactylus lentus	1	0.01	0.06%
Bryozoa	7	0.04	0.43%
Echinodermata	233	1.42	14.16%
Asteroidea	3	0.02	0.18%
Forcipulatida	1	0.01	0.06%
Coronaster briareus	1	0.01	0.06%

Dive Number: Phantom ROV 11- 160A **Location:** USA, Florida, Deep Coral HAPC, SW Miami Terrace, Near Sonar WP #18

Asteroidea	2	0.01	0.12%
Asteroidea	2	0.01	0.12%
Crinoidea	7	0.04	0.43%
Comatulida	7	0.04	0.43%
Comatulida	7	0.04	0.43%
Echinoidea	1	0.01	0.06%
Ophiuroidea	222	1.35	13.50%
Ophiurida	2	0.01	0.12%
Ophioderma sp.	1	0.01	0.06%
Ophiothrix sp.	1	0.01	0.06%
Ophiuroidea	220	1.34	13.37%
Chordata	12	0.07	0.73%
Ascidiacea	12	0.07	0.73%
Grand Total	1645	9.99	100.00%

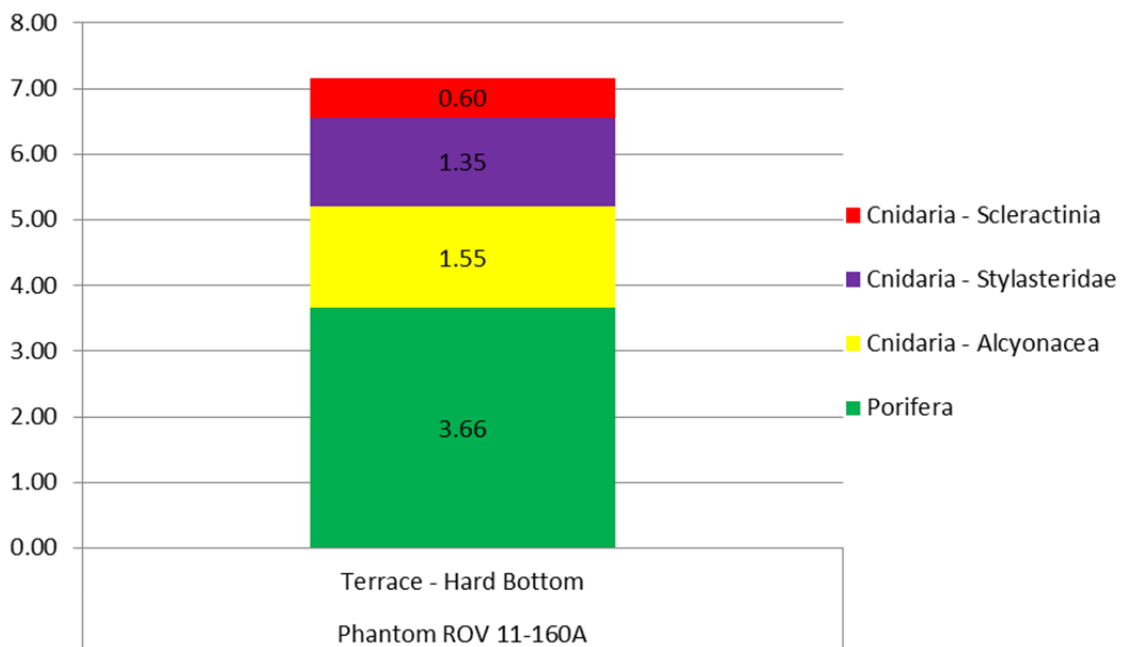


Figure 3. Density (number colonies/m²) of Porifera, hard coral (Stylasteridae, Scleractinia), Antipatharia, and Alcyonacea (Gorgonacea) at dive site 11-160A.

Figure 3 shows the density of Porifera and coral at dive site 11-160A. Coral is defined as hard coral (Stylasteridae and Scleractinia), Antipatharia, and Gorgonacea. Scleractinian coral density was 0.6 colonies/m², stylaster coral- 1.3, Alcyonacea- 1.5, and sponges- 3.7.

Fish Data Analysis:

Video transects were used to analyze the fish populations and densities. A Kongsberg high-definition video camera was used with 10-cm lasers for scale. Protocol for the fish analyses was to divide the continuous HD video into 5 minute segments, or whenever there was a change in habitat type, whichever came first, so each

Dive Number: Phantom ROV 11-160A **Location:** USA, Florida, Deep Coral HAPC, SW Miami Terrace, Near Sonar WP #18

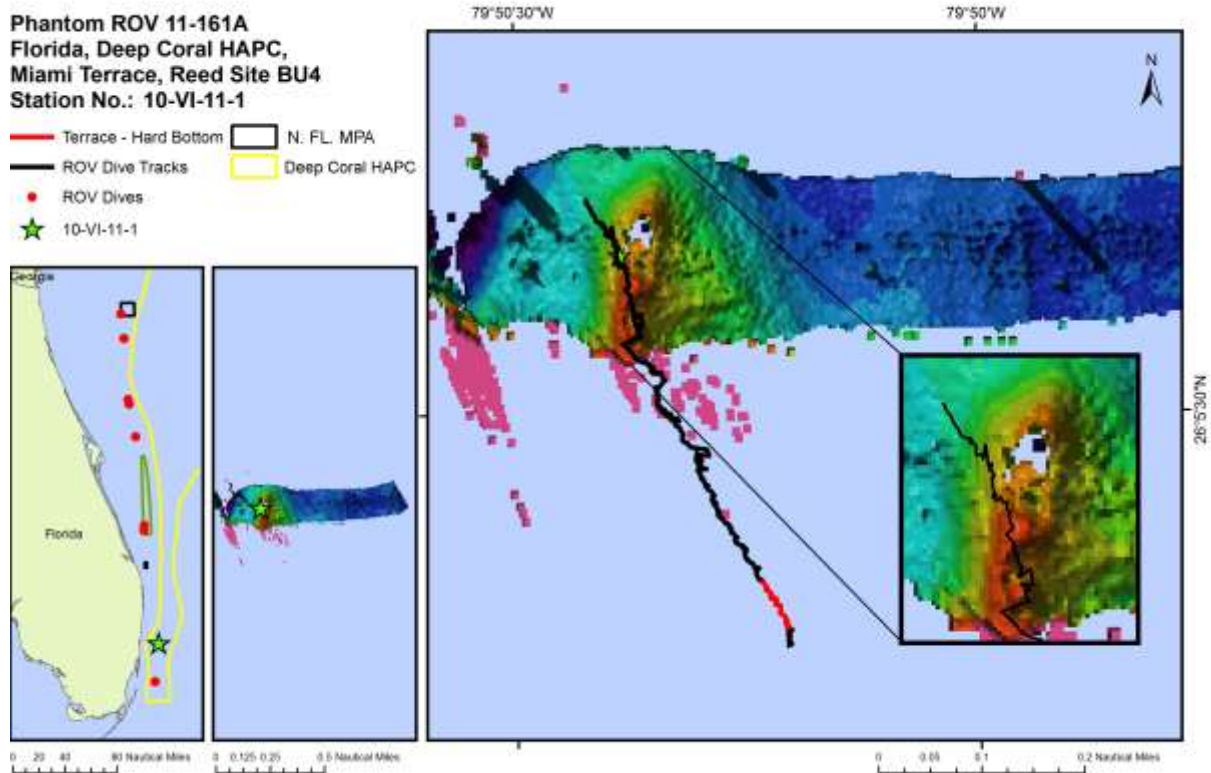
video segment only contained one habitat type (see Methods for details). These were also correlated with the habitat types used for the benthic analyses. All fish were identified for each ROV dive to species level and counted. The total distance (km) of each dive was used to calculate the density (# individuals/km) of each fish species. Very few fish were seen on the dive; a total of 6 species of fish were identified from dive site 11-160A for a total density of 10 individuals/km (Table 3). These were dominated by *Polymixia* sp. (7.3 individuals/km), and *Laemonema* spp. (2.2).

Table 3. Density of fish for all transects at dive site 11-160A (number individuals/km).

Common Name	Species Name	Density (#/km)
beardfish	<i>Polymixia</i> sp.	7.3
mora	<i>Laemonema</i> sp.	1.8
mora	<i>Laemonema melanurum</i>	0.4
shortnose greeneye	<i>Chlorophthalmus agassiz</i>	0.4
blackbelly rosefish	<i>Helicolenus dactylopterus</i>	0.2
catshark	<i>Scyliorhinus</i> sp.	0.2

Dive Number: Phantom ROV 11-161A **Location:** USA, Florida, Deep Coral HAPC, Miami Terrace, Reed Site BU4

General Location and Dive Track:



Site Overview:		Dive Overview:	
Project:	2011 Extreme Corals, NOAA DSCP	Vessel:	NOAA Ship <i>Pisces</i>
Principal Investator:	Andrew W. David	Sonar Data:	Pisces bump1.tif
PI Contact Info:	3500 Delwood Beach Rd. Panama City FL 32408	Purpose:	Map and characterize DSCE off SE USA
Website:	http://coralreef.noaa.gov/deepseacorals	ROV:	NOAA SW Fisheries Super Phantom ROV
Scientific Observers:	Andrew W. David, Charles Messing, Diego Figueroa, Jana Thoma, John Reed, Stephanie Farrington	Sensors Used:	Temperature (°C), Dissolved Oxygen (ml/l), Salinity (PSU), Conductivity
Data Management:	Access Database, Excel Spreadsheet, WinFrog	Date of Dive:	6/10/2011
ROV Navigation Data:	WinFrog	Specimens:	0
Ship Position System:	DGPS	Digital Photos:	74
Report Analyst:	John Reed, Stephanie Farrington	DVD:	2
		Hard Drive:	1
		Date Compiled:	2/20/2013

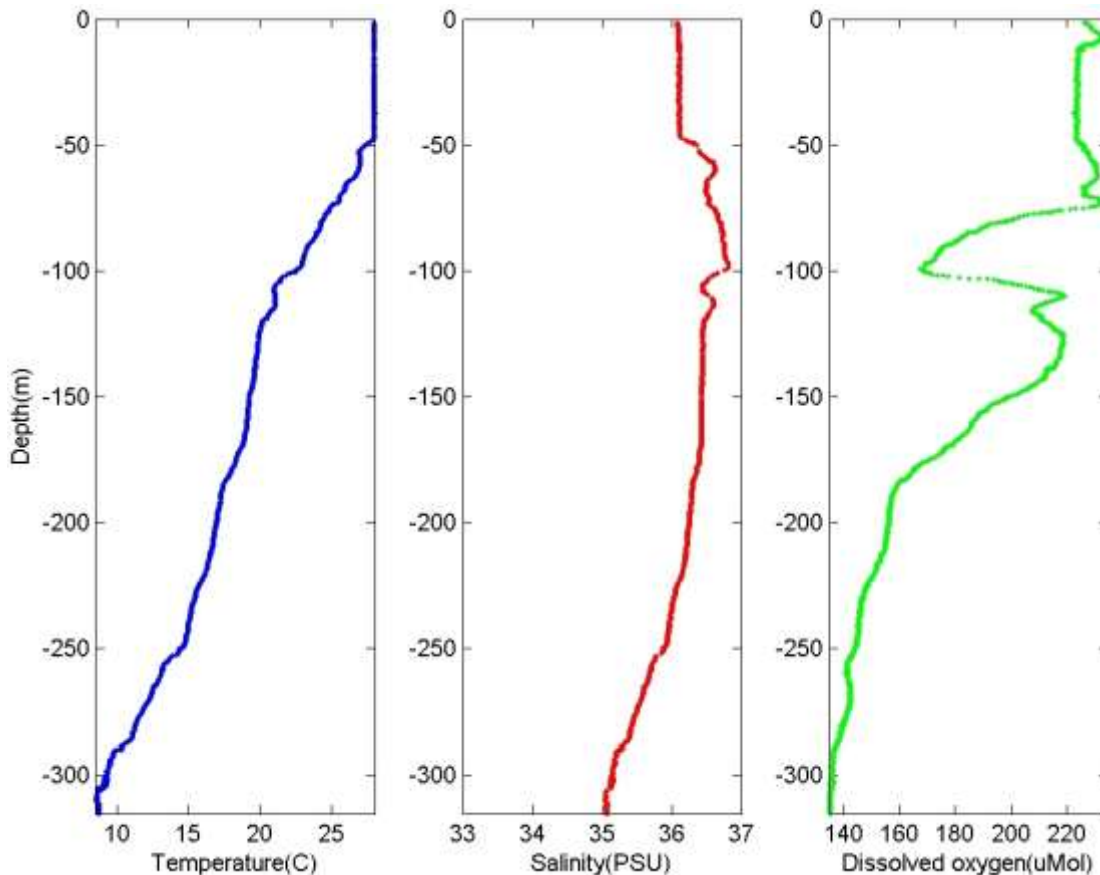
Dive Number: Phantom ROV 11- 161A **Location:** USA, Florida, Deep Coral HAPC, Miami Terrace, Reed Site BU4

Dive Data:

Minimum Bottom Depth (m): 295	Total Transect Length (km): 1.83
Maximum Bottom Depth (m): 316	Surface Current (kn): 2 kt
On Bottom (Time- GMT): 13:53	On Bottom (Lat/Long): 26°05.2720'N; 79°50.2090'W
Off Bottom (Time- GMT): 14:11	Off Bottom (Lat/Long): 26°05.7459'N; 79°50.4240'W
Physical (bottom); Temp (°C): 8.60	Salinity: 35.05 Visibility (ft): 50 Current (kn):

Physical Environment:

CTD Number 11-161A_CTDD



All CTD data were collected with the Super Phantom ROV which recorded depth, temperature (°C), conductivity (salinity, PSU), pressure (mbar), sound velocity (m/sec), oxygen concentration (uMol), and oxygen saturation. These data were used both to support multibeam surveys (sound velocity) and to characterize hydrographic conditions at the dive sites.

The following values were recorded at the maximum depth of this CTD cast (315.4 m): temperature- 8.7, salinity- 35.1, and dissolved oxygen- 135.4. Surface temperature was 28.0 and there was a thermocline at 50 m depth; salinity peaked between 50 and 100 m, dissolved oxygen peaked at 10-70 m. Visibility was estimated at 15-18 m from the ROV video.

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Deep Coral HAPC, Miami Terrace, Reed Site BU4
161A

Dive Imagery:



Figure 1: 26°5.2981'N, 79°50.2119'W 320.6 m
Unfortunately, due to strong currents, this ROV dive totally missed the target site, a high relief plateau. Instead we landed on hard rock pavement with a variety of sponges including this mesh fan sponge (*Raspailia* sp.) and pencil sea urchins (*Cidaroida*, *Cidaris* sp.).



Figure 2: 26°5.3365'N, 79°50.2384'W 318.3 m
Koosh-ball anemone (*Liponema* sp.) is common on the rock pavement habitat along with these small solitary cup corals, white coral (*Stylaster* sp.), and dense numbers of ophiuroid brittlestars with arms protruding.

Dive Number: Phantom ROV 11- **Location:** USA, Florida, Deep Coral HAPC, Miami Terrace, Reed 161A Site BU4

Dive Notes:

Objectives, Site Description, Habitat, Fauna:

Objective: Survey portion of Miami Terrace within the Deep Coral Habitat Area of Particular Concern (CHAPC) and ground truth *Pisces* sonar survey of the site. Target site- Reed Site BU4; 26° 05'N, 79° 50'W; 286 m.

Dive Events: Surface current is 2.0 kn and unable to station keep, or to slow the ROV down to less than 2.0 kn speed over ground. Dive terminated after 18 minutes; only 5 minutes on bottom south and SE of target site, but drifted 20 m above the target site. [Note- The *Phantom* ROV's top parallel lasers are calibrated at 20 cm, bottom lasers 61 cm. Depth recorded in WinFrog is correct; video overlay display is incorrect.]

Site Description/Habitat/Fauna: ROV track ground-truthed Ballard and Uchupi's (1970) bathymetric contour map and the 2011 *Pisces* multibeam sonar; the Ballard Uchupi map appears shifted west by 500 m of BU4 position in new multibeam. The dive was only on bottom south of the target site and consisted of 100% hard bottom with rock pavement and sediment veneer over pavement. Some pavement has thin, 10-20 cm tall vertical ridges of unknown origin. The black rock appears to be Miocene-age phosphoritic limestone. Dominate fauna: dense sponges, Pachastrellidae, Axinellidae, sea urchins, and Ophiuroidea.

Dive Number: Phantom ROV 11-161A

Location: USA, Florida, Deep Coral HAPC, Miami Terrace, Reed Site BU4

Percent Cover of Benthic Macro-Biota and Substrate:

Phantom ROV 11-161A attempted to survey a high-relief feature (Reed Site BU4) on the Miami Terrace HAPC. However, the ship and ROV were unable to station-keep in the 2.0 kn surface current and the ROV was traveling 2.0 kn over the bottom during the dive. The dive did not survey the target site but was on flat hard bottom habitat southeast of the feature. Point count (CPCe[®]) was used to determine percent cover (see methods for details). Figure 1 shows the percent cover of hard bottom and soft bottom substrate; points on biota were scored as the underlying substrate type. Soft bottom substrate is defined as unconsolidated mud or sand. Site 11-161A was predominately soft bottom substrate (68.3% cover), which was probably rock pavement with sediment veneer, and exposed hard bottom (31.6% cover) which was rock pavement and rubble. Benthic macro-biota covered 3.3% of the bottom and consisted of 1.0% coral framework (*Lophelia pertusa* and Stylasteridae), 0.86% Porifera (both Hexactinellida and Demospongiae), and 1.4% other organisms (Fig. 2, Table 1; see Density section for complete species list). Since this dive only had one habitat zone, the data won't be further analyzed by habitat type.

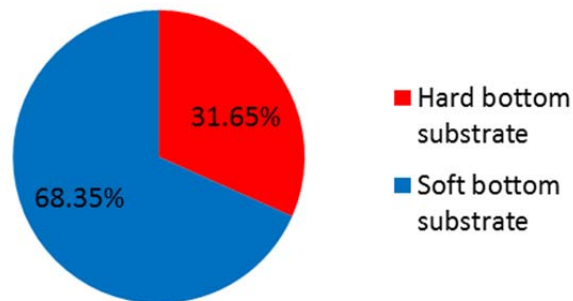


Figure 1. Percent cover of hard and soft bottom substrate at dive site 11-161A. CPCe[®] points on organisms were scored as the underlying substrate (hard or soft).

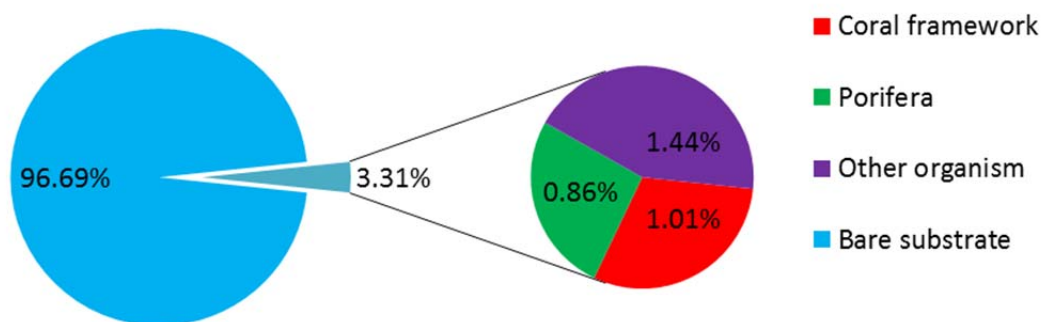


Figure 2. Percent cover of bare substrate and benthic macro-biota at dive site 11-161A. Coral framework is standing, colonial hard coral. Non-scleractinian corals are defined as Gorgonacea, other Alcyonacea, and Antipatharia.

Dive Number: Phantom ROV 11-161A **Location:** USA, Florida, Deep Coral HAPC, Miami Terrace, Reed Site BU4

Table 1. Percent cover of benthic macro-biota and substrate types at dive site 11-161A.

Benthic macro-biota and substrate types	% Cover
Coral framework	1.01%
Lophelia pertusa	0.29%
Scleractinia, unid	0.14%
Standing Dead Coral	0.29%
Stylasteridae	0.29%
Porifera	0.86%
Porifera- Hexactinellida, Calcarea, or Demospongiae	0.86%
Other organism	1.44%
Bare substrate	96.69%
Bare Soft Bottom substrate	68.06%
Coral rubble	9.21%
Rock- pavement, boulder, ledge	12.09%
Rubble	7.34%
Grand Total	100.00%

Density of Benthic Macro-Biota:

As discussed in the Methods, some common taxa could be identified to genus or species level but many could only be identified to a higher level such as family, class, order or even phylum. Sponges, gorgonians, and black coral are especially difficult to identify without a specimen in hand. In these cases a general descriptive taxa was used, e.g., “brown lobate sponge”. These designations should not be considered equivalent to species level and should not be used for diversity (H') indices calculations. Many deepwater species in this region look nearly identical, such as fan sponges which are polyphyletic and actually include different Classes.

Dive site 11-161A had a total of 19 benthic macro-fauna taxa, consisting of 4 Porifera and 11 Cnidaria (Table 2). Overall density of all benthic macro-fauna was 18.9 organisms/m². Cnidaria contributed to 27.5% of the total density at this site and Porifera 14.6%. Demosponges and Cnidaria dominated with densities of 2.7 and 5.2 organisms/m², respectively; the density of hard corals was 1.9 colonies/m² (0.2 *Lophelia*, 0.7 Stylasteridae). Alcyonacea density was 1.8 including bamboo coral (Isididae) at 0.1. Of the sponges, Poecilosclerida were common (2.4/m²) and Raspailiidae fan sponges had a density of 2.1 colonies/m².

Table 2. Density of benthic macro-biota at site 11-161A (# organisms, number/m², percent of total density).

Phylum/Class/Order/Scientific Name	# Organisms	#/m ²	% of Site
Porifera	25	2.76	14.62%
Demospongiae	25	2.76	14.62%
Astrophorida	1	0.11	0.58%
Astrophorida- fan	1	0.11	0.58%
Poecilosclerida	22	2.43	12.87%
Hymedesmia sp.- blue morph	3	0.33	1.75%
Raspailiidae- fan mesh	19	2.10	11.11%

Dive Number: Phantom ROV 11-161A

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Demospongiae	2	0.22	1.17%
Cnidaria	47	5.19	27.49%
Anthozoa	40	4.42	23.39%
Actiniaria	7	0.77	4.09%
Actiniaria	6	0.66	3.51%
Liponema sp.	1	0.11	0.58%
Alcyonacea	16	1.77	9.36%
Alcyonacea- brown sphere	8	0.88	4.68%
Anthomastus sp.	5	0.55	2.92%
Ellisellidae	1	0.11	0.58%
Gorgonacea (accepted as Alcyonacea)	1	0.11	0.58%
Isididae	1	0.11	0.58%
Scleractinia	17	1.88	9.94%
Lophelia pertusa	2	0.22	1.17%
Scleractinia- unid cup	15	1.66	8.77%
Hydrozoa	7	0.77	4.09%
Anthoathecata	6	0.66	3.51%
Stylasteridae	6	0.66	3.51%
Hydrozoa	1	0.11	0.58%
Hydroidolina	1	0.11	0.58%
Arthropoda	1	0.11	0.58%
Malacostraca	1	0.11	0.58%
Decapoda	1	0.11	0.58%
Echinodermata	98	10.83	57.31%
Crinoidea	2	0.22	1.17%
Comatulida	2	0.22	1.17%
Echinoidea	11	1.22	6.43%
Cidaroida	11	1.22	6.43%
Ophiuroidea	85	9.39	49.71%
Ophiuroidea	85	9.39	49.71%
Grand Total	171	18.90	100.00%

Dive Number: Phantom ROV 11-161A

Location: USA, Florida, Deep Coral HAPC, Miami Terrace, Reed Site BU4

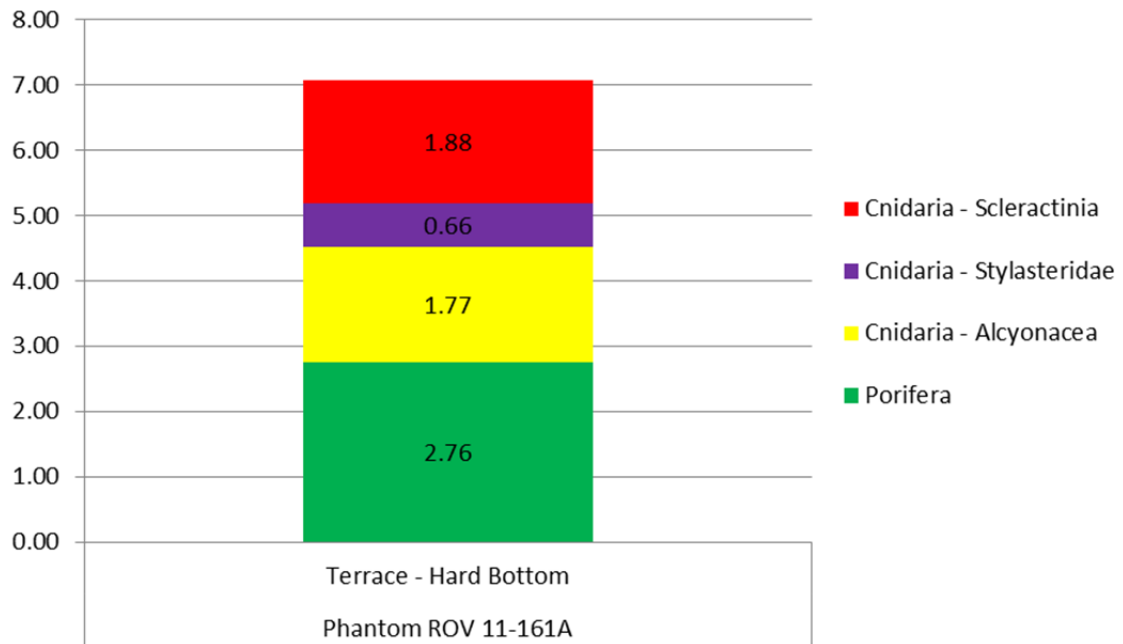


Figure 3. Density (number colonies/m²) of Porifera, hard coral (Stylasteridae, Scleractinia), Antipatharia, and Alcyonacea (Gorgonacea) at dive site 11-161A.

Figure 3 shows the density of Porifera and coral at dive site 11-161A. Coral is defined as hard coral (Stylasteridae and Scleractinia), Antipatharia, and Gorgonacea. Porifera dominated with 2.7 colonies/m², 1.9 scleractinia, 0.7 Stylasteridae, and 1.8 Alcyonacea.

Fish Data Analysis:

Because of the short time the ROV was on bottom the few fish observed were not analyzed.