NOAA Office of Ocean Exploration

Final Report

I. Project Overview

Amount of funding from Ocean Exploration: $101,571

Project Title: Mapping and Characterization of Deep Sea Coral Ecosystems off the Coast of Florida

Area of Operation: St Augustine to Florida Keys

Original Principle Investigator: Sandra Brooke Ph.D., Oregon Institute of Marine Biology, PO Box 5389, Charleston, OR 97420
Tel: (541) 888-2581 Email: sbrooke@uoregon.edu

Primary Participating Institutions: University of Oregon
Harbor Branch Oceanographic Institution
Nova Southeastern University

Award Period: From _ 05/31/05 _ To __05/31/07_(includes one-year no-cost extension)

II. Project objectives

Primary objectives:

- Map selected deep-water, high relief ecosystems that support coral communities. These sites include lithoherms and high-relief escarpments on the southwest Florida shelf and the east coast of Florida from Jacksonville to Miami. Specific sites will be selected from the four proposed regions described below.
- Characterize selected sites within the four regions using *in situ* observations, ROV transects, digital images and collections of macrofauna. Collect and inventory dominant cnidarians and sponges.
- Identify dominant fish species associated with coral communities, especially those appropriate for current or future fisheries exploitation. Document aggregations or spawning behavior.
- Collect and inventory other associated fauna from coral communities, and identify key species common to all regions and endemic to each.
- Describe the geology (e.g., substrate type, topography) and hydrography (e.g., prevailing current, water temperature) at each site, and identify the characteristic features of each region.

Secondary objectives:

- Collect samples of *L. pertusa* from each study site for analysis of reproductive status, growth rates, and colony morphology.

- Collect samples of *L. pertusa* for inclusion in a larger scale population genetic analysis of this species, currently being conducted through USGS.
- Characterize the microbial communities associated with colonies of *Lophelia pertusa* and other habitat-forming coral species, ambient water and surrounding sediment.
- Conduct preliminary investigations of the chemical richness of deepwater octocorals by analyzing selected species for concentrations and types of marine natural products.
- Provide opportunities for area teachers to accompany the research cruise, to learn about these deep-water environments, to develop classroom materials and a video record that will be incorporated into classroom learning experiences throughout the state. Develop a video record of the expedition for public consumption.

III. Results

Site mapping and characterization
Fourteen sites were visited during the cruise over 7 days of diving; the site numbers, coordinates and depth ranges are summarized in ***Appendix I*** and descriptions of the sites are summarized in ***Appendix II***. Before each dive, the ship traversed across the proposed site and a geo-referenced image of the feature was produced to guide the specific course of the submersible dive, and will be used to place the habitat descriptions in geographical and topographical context. Video transects were taken during each dive and are currently being analyzed for coral cover and condition using image analysis software called Point Count for Corals (Nova Southeastern University). The details of image extraction and analysis are described in ***Appendix III***. This process is still in progress; to date 10 of the 14 dives contain transects that can be analyzed in this way. The remaining dives had primary objectives other than habitat characterization, therefore transects were not taken, this occurred when two dives were undertaken in the same area. Multiple transects have been extracted from the usable dives and are in different stages of completion. This analysis is part of a graduate student thesis at Nova Southeastern University and will be completed by the end of 2007.

Sample inventory
A total of 150 samples of the dominant macrofauna (primarily cnidaria and porifera) were collected and identified during the cruise, and are summarized in ***Appendix IV*** These samples were frequently sub-sampled for further analysis and additional samples were extracted from the primary samples. For example, samples of coral rubble were examined for small coral-associated fauna and other invertebrates, which are listed separately in ***Appendix V***. Many of the species encountered were unknown and are still being identified or described. One significant discovery was of a new genus of deep-sea amphipod that is among the rarest crustaceans known to science. These were found living in mated female-male pairs in a glass sponge in 1200 m off the central Florida coast. Tentatively placed in the family Didymochelidae, only three specimens of this family have ever been collected. Previously known only from deep Antarctic waters, the new genus from Florida is the first record outside Antarctica and the first record from the northern hemisphere.

Coral associated fish populations

Appendix VI describes the methodology and results obtained from *in situ* observations and analysis of video tapes taken during the cruise. Also included is a literature search of previous work on fish observed in association with deepwater corals in this region.

Geological characterization

The data for this is embedded in the video tapes and dive logs and is currently being extracted along with the habitat characterization information.

Assessment of reproductive status

Samples of *Lophelia pertusa* (18), *Enallopsammia profunda* (12) and *Madrepora oculata* (1) were collected during the cruise for histological processing to assess reproductive status. Of these samples, approximately half have been processed to date, and have produced an average oocyte diameter of 110 µm (SD 11) for *L. pertusa* and 166 µm (SD 50) for *E. profunda*. The maximum egg size was also much larger for *E. profunda* (250 µm) than for *L. pertusa* (150 µm). There is currently no reproductive information on reproductive cycles of *E. profunda*, but the oocytes are vitellogenic and mature as with *L. pertusa*. With few samples (and none from any other time of year) it is difficult to determine spawning time accurately, but the oocyte diameter and maturity indicate that the corals were close to spawning; however, many samples did not contain reproductive material, so the peak spawning may have passed. Samples of *L. pertusa* from the Gulf of Mexico indicated that spawning occurs in October for those populations, which is similar to the South Atlantic samples. The eastern Atlantic *L. pertusa* however spawns in early March, which is approximately 4 months later. The reasons for this difference are unknown (probably related to environmental and/or food differences), and warrant further investigation.

Lophelia *population genetics*

Effective design of marine protected areas requires knowledge of connectivity between reef areas, yet this information is difficult to obtain. Microsatellite markers allow for an indirect yet precise estimate of population structure, including estimates of gene flow between populations, facilitating the identification of recruitment sources. Geographic patterns of genetic diversity in *Lophelia pertusa* were examined by quantifying genetic diversity present in populations, and assessing levels of genetic differentiation by gathering multilocus genotypes for 190 *Lophelia* individuals using a suite of nine microsatellite markers developed for Gulf of Mexico *Lophelia*. The 30 *Lophelia* samples obtained during this NOAA-OE cruise have filled a gap in our otherwise extensive geographic sampling of *Lophelia* from the South Atlantic Bight (NC-northern FL, (NOAA-OE sponsored cruises in 2004-2005) and the northwestern Gulf of Mexico (USGS sponsored cruises, 2004-2005). *Lophelia* samples were obtained from: Cape Canaveral (N=4); Cocoa Beach (N=10); Miami Sink Hole (N=1); Miami Terrace Escarpment (N=14); and Jordan Sink Hole (N=1). Results of population genetic analysis suggest that each *Lophelia* 'reef' sampled has a unique genetic signature and populations cluster by ocean region. This suggests that dispersal of *Lophelia* larvae is generally localized, with occasional long distance dispersal occurring such that some genetic cohesion is retained regionally within the Gulf and Southeastern U.S. Genetic differentiation observed between these regions indicates more restricted gene flow than expected, suggesting that the most effective management plan for *Lophelia* may be regional reserve networks. Although final analysis is not complete, there appears to be an additional break in gene flow along the Southeastern U.S., as the Miami Terrace population appears to be the most differentiated.

***Characterization of microbial communities associated with* L. pertusa**

This study is still in progress; samples of coral, water and nearby sediment were taken during the cruise and are awaiting analysis.

Chemical richness of deepwater Octocorals

Samples of deepwater octocorals were collected during the cruise and processed by the Smithsonian Marine Station in Fort Pierce to assess the type, concentration and distribution of potential chemical defenses within the coral colonies. The results of this work are summarized in ***Appendix VII***.

Age estimates of* L. pertusa *colonies

Four samples of *L. pertusa* from dive JSL-4914 were submitted for age analyses using amino acid racemization, with one fragment from the rubble sample also submitted for 14C dating. The results for amino acid racemization and 14C analyses are presented in ***Appendix VIII***. This was a preliminary study and needs more calibration work to refine the age ranges, but we feel it is a technique worthy of further investigation to answer important questions about development, ageing and senescence of *Lophelia* and other deepwater corals.

Education and Outreach

There was a large education and outreach element included in this project:

- Two area teachers were invited on board as 'teachers at sea' to interact with students on shore and to be involved in the development of an educational video. The video is in the final stages of development and will be distributed to schools throughout the State as DVD's.
- A representative from Blue Land Media participated in the cruise and took on board video footage, which was subsequently combined with interviews with the PI's at their respective institutions. This enterprise resulted in a 3-part educational series and a one-hour documentary on deepwater corals.
- An exhibit was established at the Smithsonian Marine Ecosystem Exhibit in Fort Pierce and was displayed during the cruise, showing the daily communications from the vessel. This exhibit is mobile if needed elsewhere but is currently still on display at the SMEE, and compliments their permanent *Oculina* exhibit.

Although this cruise was plagued with bad weather and many dives were lost, the cruise was very successful both scientifically and in terms of public education. We expect at least 6 manuscripts to result from the data gathered during the cruise and more may result as sample processing and analysis continue. Our thanks and appreciation go to NOAA's Office of Ocean Exploration for funding this enterprise.

Report prepared by: Sandra Brooke Ph.D. **Date:** August 28, 2007

Appendix I:
SITE SUMMARY
NOAA OE EXPEDITION- NOVEMBER 7-20, 2005

SITE NUMBER (DATE + SITE #)	LATITUDE	LONGITUDE	METHOD	DEPTH RANGE (Feet)		NUMBER SAMPLES
8-XI-05-1	28 17.0999'N	79 36.8593'W	JSL I-4909	2380	2481	10
8-XI-05-2	28 17.0616'N	79 36.8306'W	JSL I-4910	2350	2519	3
9-XI-05-1	29 50.9248'N	79 37.9814'W	JSL I-4911	2435	2716	11
9-XI-05-2	29 50.9726'N	79 37.5976'W	JSL I-4912	2448	2857	10
10-XI-05-1	28 19.3678'N	79 45.0913'W	JSL I-4913	1291	1515	8
10-XI-05-2	28 19.3279'N	79 45.1174'W	JSL I-4914	1311	1530	12
11-XI-05-1	26 39.0962'N	79 32.5460'W	JSL I-4915	2491	2545	14
11-XI-05-2	26 45.8830'N	79 33.2380'W	JSL I-4916	2418	2482	14
16-XI-05-1	25 51.6299'N	80 01.9967'W	JSL I-4917	805	875	13
16-XI-05-2	25 45.3514'N	79 47.2097'W	JSL I-4918	2440	2847	5
17-XI-05-1	26 05.6970'N	79 50.3607'W	JSL I-4919	926	1236	17
17-XI-05-2	25 41.9492N	79 52.0346W	JSL I-4920	1057	1251	9
18-XI-05-1	24 30.0056'N	80 40.1271'W	JSL I-4921	576	977	12
18-XI-05-2	24 16.3713'N	81 02.1939'W	JSL I-4922	1081	1740	12

Appendix II

SITE DESCRIPTIONS

NOAA OE EXPEDITION- NOVEMBER 7-20, 2005

SITE NUMBER COLLECTION METHOD LATITUDE/ LONGITUDE LOCATION	HABITAT	TEMP. (C)	SALINITY	VISI-BILITY (Ft.)	CURRENT (KNOT	from)	WEATHER	(MPH	from)	SEAS	DEPTH RANGE (Ft.)	
8-XI-05-1 JSL I-4909 28 17.0999'N 79 36.8593'W FLORIDA, CAPE CANAVERAL, REED PEAK #151- LOPHELIA BIOHERM	LOPHELIA BIOHERM, STANDING DEAD AND LIVE CORAL, CORAL RUBBLE	6.9	34.9	30	0.7	150	SUNNY	15	045	4-5	2481	2380
8-XI-05-2 JSL I-4910 28 17.0616'N 79 36.8306'W FLORIDA, CAPE CANAVERAL, REED PEAK #151- LOPHELIA BIOHERM	LOPHELIA BIOHERM, LIVE CORAL, CORAL RUBBLE, STEEP SLOPE	6.8		40	0.5	155	SUNNY	15	055	4-5	2519	2350
9-XI-05-1 JSL I-4911 29 50.9248'N 79 37.9814'W FLORIDA, ST. AUGUSTINE, REED PEAK #160- LOPHELIA LITHOHERM	LOPHELIA LITHOHERM, 100% CORAL RUBBLE, STANDING DEAD CORAL 1-2' (1% LIVE); ROCK SLABS OUTCROPS	7.9		40	0.1-0.2	130	PARTLY CLOUDY	3	025	2-3	2716	2435
9-XI-05-2 JSL I-4912 29 50.9726'N 79 37.5976'W FLORIDA, ST. AUGUSTINE, REED PEAK #160- LOPHELIA LITHOHERM	CORAL LITHOHERM, CORAL RUBBLE	7.96	35.1	35	0	160	PARTLY CLOUDY	3	025	1-2	2857	2448
10-XI-05-1 JSL I-4913 28 19.3678'N 79 45.0913'W FLORIDA, COCOA BEACH, TOP SPOT- "THE PINNACLE", REED PEAK #294, LOPHELIA BIOHERM	LIVE BIOHERM, LOPHELIA CORAL, NEARLY 100% LIVE BUSHES ON SLOPE AND PEAK	7.7	35.5	15-20	0.5-0.6	180	SUNNY	10	280	1-2	1515	1291

SITE NUMBER COLLECTION METHOD LATITUDE/ LONGITUDE LOCATION	HABITAT	TEMP. (C) SALINITY	VISI-BILITY (Ft.) WEATHER	CURRENT (KNOT from) (MPH from)		SEAS	DEPTH RANGE (Ft.)	
10-XI-05-2 JSL I-4914 28 19.3279'N 79 45.1174'W FLORIDA, COCOA BEACH, TOP SPOT- "THE PINNACLE", REED PEAK #294, LOPHELIA BIOHERM	LIVE LOPHELIA BIOHERM, 100% LIVE LOPHELIA	7.3 35	35 SUNNY	0.3-0.4 14	175 295	2-3	1530	1311
11-XI-05-1 JSL I-4915 26 39.0962'N 79 32.5460'W FLORIDA, WEST PALM, NEAR SEA FARER PIPELINE SITE- PEAK #7, REED PEAK #295- LOPHELIA BIOHERM	68 FT TALL BIOHERM, MOSTLY DEAD CORAL RUBBLE AND STANDING DEAD CORAL, SPARSE LIVE, LIVE ENALLOPSAMMIA	6.5	30 SUNNY	0.2-0.3 13	S N	3	2545	2491
11-XI-05-2 JSL I-4916 26 45.8830'N 79 33.2380'W FLORIDA, FT. LAUDERDALE, SEA FARER PIPELINE SITE PEAK- #2, REED PEAK #297- CORAL BIOHERM	CORAL RUBBLE, STANDING DEAD CORAL, TOPOGRAPHIC HIGH COMPLEX OF MOUNDS, STACKED TERRACES, LIVE	6.5 34.9	35-40 SUNNY	0.1 20	170 NE	5	2482	2418
16-XI-05-1 JSL I-4917 25 51.6299'N 80 01.9967'W FLORIDA, MIAMI TERRACE, MIAMI SINKHOLE	SINKHOLE, APPROXIMATELY 400 M DIAMETER, 70 FT DEEP	7.9 35	50 SUNNY	0.1 10	055 EAST	4	875	805
16-XI-05-2 JSL I-4918 25 45.3514'N 79 47.2097'W FLORIDA, STRAITS OF FLORIDA, N OF UM SITE #3, REED PEAK #299- ENALLOPSAMMIA BIOHERM	CORAL RUBBLE, STANDING DEAD CORAL, 1-5% LIVE ENALLOPSAMMIA, 10-40 DG SLOPE	5.6 34.9	15-20 SUNNY	0.1 9	045 030	1-2	2847	2440

SITE NUMBER COLLECTION METHOD LATITUDE/ LONGITUDE LOCATION	HABITAT	TEMP. (C) SALINITY	VISI-BILITY (Ft.)	WEATHER	CURRENT (KNOT from) (MPH from)		SEAS	DEPTH RANGE (Ft.)	
17-XI-05-1 JSL I-4919 26 05.6970'N 79 50.3607'W FLORIDA, MIAMI TERRACE ESCARPMENT, REED SITE BU#4, WEST RIDGE, W SLOPE AND TOP	ROCK PAVEMENT AND ESCARPMENT, LOPHELIA THICKETS; WRECKFISH SITE	8.1-8.8 35	50	CLOUDY, 50%	 10	 NW	1-2	1236	926
17-XI-05-2 JSL I-4920 25 41.9492N 79 52.0346W FLORIDA, MIAMI TERRACE ESCARPMENT, REED SITE BU#2, WEST RIDGE, W SLOPE AND TOP	ROCK SLOPE AND ESCARPMENTS, FLAT TOP RIDGE, LOPHELIA THICKETS	7.2	35	CLOUDY	0.5 14	220 040	3	1251	1057
18-XI-05-1 JSL I-4921 24 30.0056'N 80 40.1271'W FLORIDA, POURTALES TERRACE, TENNESSEE BIOHERM #1 (REED SITE), NE SLOPE AND PEAK	500' BIOHERM, SAND, ROCK PAVEMENT	14.7	35	CLOUDY	0.6 19	250 020	5-6	977	576
18-XI-05-2 JSL I-4922 24 16.3713'N 81 02.1939'W FLORIDA, POURTALES TERRACE, JORDAN SINKHOLE, WEST LOBE	700' DEEP SINKHOLE, WEST AND NW 90 DG ROCK WALL, FLAT SAND (PTEROPOD) BOTTOM	10.9 35.3	35	CLOUDY	0- 0.5	285		1740	1081

Appendix III: Habitat characterization using image analysis software

Materials and Methods:
The video data for the transects was obtained from the NOAA OE Deep Corals cruise conducted in November 2005. The videos were recorded on a DV camera and each DV tape was labeled with the dive number, date, site name or number and the tape number in case of multiple tapes for each dive. The videos were later transferred on to DVDs.

1. **Conversion to DVDs:**
   From the DVDs, the start and stop times of the transects were determined. The program, Easy DVD Rip, was used to extract the videos from the DVDs and convert them to '.avi' files. During extraction of the clips, care was taken so as to not lose part of the transect. This was done by beginning the extraction from 1 min before, and until 1 min after the start and stop times of the transect, respectively.

2. **Image extraction:**
   Once the video clips were extracted, Windows Movie Maker software was used to obtain the images. During extraction of images, a 1-5% overlap between consecutive images was maintained. In special cases where part of the image was not discernible due to inadequate light or higher turbidity, a 5-10% overlap was maintained. All the images thus obtained, were saved as .jpg files for further analysis.

3. **Image selection:**
   Since area analysis was a major criterion for the analysis, only those images in which the position of the laser points could be determined were used in the analysis. For some images, the time stamp, depth, salinity information was not found. These images were used if one could determine the time stamp from the time on the player.

4. **Data Distribution**:
   The images thus obtained were distributed among 1 graduate and 2 undergraduate students for further analysis. The first 10% of the images were analyzed by all the students and were used for QA/QC purposes. In case of transects where 10% would be fewer than 5 images, the first 5 images were used for QA/QC. The remaining images were divided and distributed equally among all 3 students.

5. **Area Analysis:**
   We used the program Coral Point Count with Excel extensions (CPCe) to determine the area of each image. In most images the laser points were easily seen and hence the area could be easily determined. In cases where the laser points were not seen, a different approach was used. If one could see the laser points 2 sec before or after the frame was captured, provided there was no major variation in the shape of the substrate, it was assumed that the laser points were in the same place as seen in the video. In this case, the cursor was placed on the laser point and the video was played, and later paused at the exact frame that corresponded to the image. Then the image was edited with Microsoft Paint, and dots were placed on the probable location of the laser points.

In images where only one of the laser points was seen, the cursor was placed on this point, and the video was played to determine if the point had moved from its location. If it hadn't moved, the same method was used to determine the location of the other point.

6. **Point Count**:

CPCe was again used for substrate analysis. A few images were analyzed using different numbers of random points (20, 30, 50 and 70) to determine which would best represent the data. A greater number of points were not tested as too time consuming, and because no major variation in the results were found. We used 50 points per image and noted the nature of the substrate below each point.

7. **Substrate Analysis:**

In most cases, it was easy to determine what each point represented. In cases where it was not clear, the video was used to determine the exact characteristic of that point. For the purpose of this analysis, the following categories were created:

- Live Coral: Any parts of *Lophelia*, *Enallopsammia* or *Madrepora* colonies that were live.
- Standing Dead Coral: Any 3-dimensional frame-work of dead coral. In some cases, small 3-dimensional structures were found in a rubble zones. Depending on the color and other characteristic of these structures, they were identified as standing dead coral or coral rubble.
- Coral Rubble: individual flat-lying pieces of coral chiefly found in clear defined rubble zones but sometimes also found with live and standing dead coral.
- Sediment: Varied from fine to comparatively coarse with 1-2-cm pieces of carbonate rock.
- Rock Rubble: pieces or outcrops up to ~1 m across.
- Hard Rock Substrate or Pavement: larger outcrops, slabs, boulders, *in situ* pavements, ledges.
- Sessile Organisms: Examples include stylasterids, gorgonians, hydrozoans, demosponges, hexactinellids and comatulids.
- Mobile Organisms: Examples include galatheid squat lobsters, crabs, echinoids, ophiuroids, asteroids, polychaetes and fish.
- Shadow Effects: Regions of the image which were mainly indiscernible due to inadequate lighting.
- Photo Artifacts: points falling on the data display, or if they represented the very edge of the image where the characteristic of the point could not be determined.
- Manmade Debris: Examples include bottles, cans, plastic debris, fishing line.

8. **Further Data Analysis:**

Completion of area and point count analyses will be followed by calculation of total surface area of each transect and percent coverage by each category. Each image will be again reviewed to verify organism identifications. On acquiring this data, one could investigate if there is a strong relationship between substrate composition and the distribution of the animals. Further analysis can also be done to compare different sites, and one could find if the latitude has any effect on the distribution of these animals.

Appendix IV:
SPECIES LIST
NOAA OE EXPEDITION- NOVEMBER 7-20, 2005

SAMPLE NUMBER (Date+Site+Sample)	PHYLUM	TAXONOMY	IDENTIFIED BY	DATE ID	METHOD	DEPTH (Ft.)
8-XI-05-1-001	CNI	KERATOISIS FLEXIBILIS	JOHN REED	11/19/2005	JSL I-4909	2380
8-XI-05-1-002	CNI	LOPHELIA PERTUSA (RUBBLE)	JOHN REED	12/15/2005	JSL I-4909	2380
8-XI-05-1-003	CNI	LOPHELIA PERTUSA	JOHN REED	12/15/2005	JSL I-4909	2397
8-XI-05-1-004	CNI	STYLASTERINA			JSL I-4909	2378
8-XI-05-1-005	POR	HEXACTINELLIDA			JSL I-4909	2378
8-XI-05-1-006	POR	HEXACTINELLIDA			JSL I-4909	2385
8-XI-05-1-007	CNI	LOPHELIA PERTUSA	JOHN REED	12/15/2005	JSL I-4909	2380
8-XI-05-1-008	CNI	LOPHELIA PERTUSA (DEAD RUBBLE)	JOHN REED	11/19/2005	JSL I-4909	2380
8-XI-05-1-009	CNI	ISIDELLA LONGIFLORA?	JOHN REED	12/13/2005	JSL I-4909	2370
8-XI-05-1-010	CNI	LOPHELIA PERTUSA	JOHN REED	12/13/2005	JSL I-4909	2370
8-XI-05-1-012	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4909	2378
8-XI-05-2-001	CNI	ENALLOPSAMMIA PROFUNDA	JOHN REED	11/19/2005	JSL I-4910	2519
8-XI-05-2-002	POR	HEXACTINELLIDA			JSL I-4910	2391
8-XI-05-2-003	CNI	ENALLOPSAMMIA PROFUNDA (DEAD)	JOHN REED	12/15/2005	JSL I-4910	2378
8-XI-05-2-004	POR	EUPLECTELLA? SP.	JOHN REED	12/15/2005	JSL I-4910	2519
9-XI-05-1-001	CNI	MADREPORA OCULATA?	JOHN REED	11/19/2005	JSL I-4911	2716
9-XI-05-1-002	SED	ROCK			JSL I-4911	2716
9-XI-05-1-003	SED	CORAL RUBBLE + SEDIMENT			JSL I-4911	2716
9-XI-05-1-004	CNI	EUNICELLA (VERRUCOSA GROUP)	JOHN REED	12/13/2005	JSL I-4911	2703
9-XI-05-1-005	CNI	ENALLOPSAMMIA PROFUNDA	JOHN REED	11/19/2005	JSL I-4911	2698
9-XI-05-1-007	CNI	KERATOISIS FLEXIBILIS (White Morph)	JOHN REED	11/19/2005	JSL I-4911	2458
9-XI-05-1-006	CNI	KERATOISIS FLEXIBILIS	JOHN REED	11/19/2005	JSL I-4911	2560
9-XI-05-1-008	SED	CORAL RUBBLE + SEDIMENT			JSL I-4911	2444
9-XI-05-1-009	POR	HYALONEMA SP.	JOHN REED	11/19/2005	JSL I-4911	2438
9-XI-05-1-010	CNI	EUNICELLA (VERRUCOSA GROUP)	JOHN REED	12/13/2005	JSL I-4911	2436
9-XI-05-1-011	POR	PHAKELLIA? SP.	JOHN REED	12/13/2005	JSL I-4911	2451
9-XI-05-2-001	CNI	ANTIPATHARIA + ROCK			JSL I-4912	2830
9-XI-05-2-002	CNI	KERATOISIS FLEXIBILIS (White Morph)	JOHN REED	11/19/2005	JSL I-4912	2839
9-XI-05-2-003	SED	PHOSPHORITIC ROCK			JSL I-4912	2802

SAMPLE NUMBER (Date+Site+Sample)	PHYLUM	TAXONOMY	IDENTIFIED BY	DATE ID	METHOD	DEPTH (Ft.)
9-XI-05-2-004	CNI	STYLASTERINA			JSL I-4912	2480
9-XI-05-2-005	CNI	ENALLOPSAMMIA PROFUNDA	JOHN REED	11/19/2005	JSL I-4912	2475
9-XI-05-2-006	SED	CORAL RUBBLE + SEDIMENT			JSL I-4912	2448
9-XI-05-2-007	SED	PHOSPHORITIC ROCK			JSL I-4912	2451
9-XI-05-2-008	SED	CORAL RUBBLE			JSL I-4912	2454
9-XI-05-2-009	CNI	ANTIPATHARIA			JSL I-4912	2455
9-XI-05-2-010	SED	WOOD			JSL I-4912	2459
9-XI-05-2-011	POR	PHAKELLIA? SP.	JOHN REED	12/13/2005	JSL I-4912	2480
10-XI-05-1-001	CNI	LOPHELIA PERTUSA	JOHN REED	12/15/2005	JSL I-4913	1314
10-XI-05-1-002	CNI	PARAMURICEIDAE, PARAMURICEA SP. (SP. 1)	JOHN REED	12/13/2005	JSL I-4913	1314
10-XI-05-1-003	CNI	LOPHELIA PERTUSA	JOHN REED	12/15/2005	JSL I-4913	1314
10-XI-05-1-004	CNI	LOPHELIA PERTUSA	JOHN REED	12/15/2005	JSL I-4913	1314
10-XI-05-1-005	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4913	1314
10-XI-05-1-006	CNI	LOPHELIA PERTUSA	JOHN REED	12/15/2005	JSL I-4913	1314
10-XI-05-1-007	SED	SEDIMENT			JSL I-4913	1510
10-XI-05-1-008	CHO	RAJIDAE			JSL I-4913	1510
10-XI-05-1-009	SED	SEDIMENT			JSL I-4913	1510
10-XI-05-2-001	CNI	CAPNELLA (=EUNEPHTHYA) NIGRA	JOHN REED	12/13/2005	JSL I-4914	1530
10-XI-05-2-002	CNI	CAPNELLA (=EUNEPHTHYA) NIGRA	JOHN REED	12/13/2005	JSL I-4914	1530
10-XI-05-2-003	CNI	PARAMURICEIDAE, PARAMURICEA SP. (SP.1)	JOHN REED	12/13/2005	JSL I-4914	1421
10-XI-05-2-004	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4914	1318
10-XI-05-2-005	CNI	SCLERACTINIA (CUP CORAL)			JSL I-4914	1318
10-XI-05-2-006	CNI	PLUMARELLA nr. DICHOTOMA	JOHN REED	12/13/2005	JSL I-4914	1318
10-XI-05-2-007	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4914	1318
10-XI-05-2-008	POR	APHROCALLISTES? SP.	JOHN REED	11/19/2005	JSL I-4914	1318
10-XI-05-2-009	CNI	PLUMARELLA POURTALESII	JOHN REED	12/13/2005	JSL I-4914	1318
10-XI-05-2-010	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4914	1318
10-XI-05-2-011	CNI	LOPHELIA PERTUSA			JSL I-4914	1318
10-XI-05-2-012	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4914	1318
11-XI-05-1-001	CNI	EUNICELLA nr. MODESTA	JOHN REED	12/13/2005	JSL I-4915	2544
11-XI-05-1-002	CNI	PLUMARELLA POURTALESII	JOHN REED	12/13/2005	JSL I-4915	2544
11-XI-05-1-003	ECH	ANTEDONIDAE	CHUCK MESSING	11/19/2005	JSL I-4915	2544
11-XI-05-1-004	POR	HEXACTINELLIDA			JSL I-4915	2493
11-XI-05-1-005	CNI	CORALLIUM MEDEA	JOHN REED	12/13/2005	JSL I-4915	2493
11-XI-05-1-006	CNI	BATHYPATHES ALTERNATA	JOHN REED	11/19/2005	JSL I-4915	2491

SAMPLE NUMBER (Date+Site+Sample)	PHYLUM	TAXONOMY	IDENTIFIED BY	DATE ID	METHOD	DEPTH (Ft.)
11-XI-05-1-007	ART	GALATHEIDAE			JSL I-4915	2491
11-XI-05-1-008	POR	HEXACTINELLIDA			JSL I-4915	2495
11-XI-05-1-009	CNI	PARAMURICEIDAE, PARAMURICEA SP. (SP.2)	JOHN REED	12/13/2005	JSL I-4915	2495
11-XI-05-1-010	POR	PORIFERA			JSL I-4915	2495
11-XI-05-1-011	CNI	CORALLIUM MEDEA	JOHN REED	12/13/2005	JSL I-4915	2496
11-XI-05-1-012	CNI	HYALONEMA SP. + ZOANTHIDEA	JOHN REED	12/13/2005	JSL I-4915	2528
11-XI-05-1-013	CNI	ANTHOTHELLIDAE, ANTHOTHELLA? SP. (SP.1)	JOHN REED	12/13/2005	JSL I-4915	2538
11-XI-05-1-014	CNI	CORALLEUM MEDEA? (STALK ONLY)	JOHN REED	12/13/2005	JSL I-4915	2538
11-XI-05-1-015	CNI	PARAMURICEIDAE, MURICEIDES? SP. (SP. 1)	JOHN REED	12/13/2005	JSL I-4915	2538
11-XI-05-1-016	CNI	ENALLOPSAMMIA PROFUNDA	JOHN REED	11/19/2005	JSL I-4915	2538
11-XI-05-2-001	POR	DEMOSPONGIAE			JSL I-4916	2477
11-XI-05-2-002	POR	PORIFERA			JSL I-4916	2444
11-XI-05-2-003	CNI	KERATOISIS FLEXIBILIS	JOHN REED	11/19/2005	JSL I-4916	2444
11-XI-05-2-004	CNI	ENALLOPSAMMIA PROFUNDA (DEAD) + SEDIMENT	JOHN REED	12/13/2005	JSL I-4916	2444
11-XI-05-2-005	CNI	ENALLOPSAMMIA PROFUNDA	JOHN REED	12/13/2005	JSL I-4916	2432
11-XI-05-2-006	ECH	COMATULIDA			JSL I-4916	2422
11-XI-05-2-007	POR	HEXACTINELLIDA			JSL I-4916	2421
11-XI-05-2-008	POR	PETROSIIDAE	JOHN REED	12/13/2005	JSL I-4916	2432
11-XI-05-2-009	CNI	ANTHOMASTUS SP.	JOHN REED	11/19/2005	JSL I-4916	2431
11-XI-05-2-010	SED	DEAD CORAL RUBBLE			JSL I-4916	2418
11-XI-05-2-011	POR	PORIFERA			JSL I-4916	2418
11-XI-05-2-012	CNI	ANTHOTHELLIDAE, ANTHOTHELLA? SP. (SP.2)	JOHN REED	12/13/2005	JSL I-4916	2432
11-XI-05-2-013	CNI	EUNICELLA MODESTA	JOHN REED	12/13/2005	JSL I-4916	2431
11-XI-05-2-014	CNI	PARAMURICEIDAE, MURICEIDES? SP. (SP. 1)	JOHN REED	12/13/2005	JSL I-4916	2432
11-XI-05-2-015	CNI	PLUMARELLA POURTALESII	JOHN REED	12/13/2005	JSL I-4916	2444
16-XI-05-1-001	ECH	BRISINGIDAE	CHUCK MESSING	11/19/2005	JSL I-4917	822
16-XI-05-1-002	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4917	817
16-XI-05-1-003	ART	EUMUNDA PICTA			JSL I-4917	817
16-XI-05-1-004	ART	EUMUNDA PICTA			JSL I-4917	817
16-XI-05-1-005	SED	PHOSPHORITIC ROCK			JSL I-4917	818
16-XI-05-1-006	CNI	PLUMARELLA POURTALESII	JOHN REED	12/13/2005	JSL I-4917	820
16-XI-05-1-007	MOL	CALLIOSTOMA SP.	JERRY HARASEWYCH	11/19/2005	JSL I-4917	804
16-XI-05-1-008	SED	BOTTLE W/ SEDIMENT			JSL I-4917	817
16-XI-05-1-009	SED	SEDIMENT			JSL I-4917	858
16-XI-05-1-010	MOL	CALLIOSTOMA SP.	JERRY HARASEWYCH	11/19/2005	JSL I-4917	817

SAMPLE NUMBER (Date+Site+Sample)	PHYLUM	TAXONOMY	IDENTIFIED BY	DATE ID	METHOD	DEPTH (Ft.)
16-XI-05-1-011	MOL	CALLIOSTOMA SP.	JERRY HARASEWYCH	11/19/2005	JSL I-4917	816
16-XI-05-1-012	CNI	STYLASTERINA			JSL I-4917	818
16-XI-05-1-013	CNI	SCLERACTINIA (CUP CORAL)			JSL I-4917	818
16-XI-05-2-001	CNI	STOLONIFERA, CLAVULARIIDAE?, CLAVULARIA? SP	JOHN REED	12/13/2005	JSL I-4918	2529
16-XI-05-2-002	POR	EUPLECTELLA? SP.	JOHN REED	12/13/2005	JSL I-4918	2527
16-XI-05-2-003	CNI	ENALLOPSAMMIA PROFUNDA	JOHN REED	11/19/2005	JSL I-4918	2528
16-XI-05-2-004	CNI	PARAMURICEIDAE, PARAMURICEA SP. (nr SP.2)	JOHN REED	12/13/2005	JSL I-4918	2454
16-XI-05-2-005	CNI	STYLASTERINA			JSL I-4918	2528
17-XI-05-1-001	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4919	930
17-XI-05-1-002	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4919	930
17-XI-05-1-003	CNI	STYLASTERINA			JSL I-4919	930
17-XI-05-1-004	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4919	930
17-XI-05-1-005	CNI	STYLASTERINA			JSL I-4919	930
17-XI-05-1-006	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4919	930
17-XI-05-1-007	CNI	PARAMURICEIDAE, PARAMURICEA SP. (SP.3)	JOHN REED	12/13/2005	JSL I-4919	950
17-XI-05-1-008	CNI	STYLASTERINA			JSL I-4919	930
17-XI-05-1-009	CNI	PARAMURICEIDAE, PARAMURICEA SP. (nr SP.3)	JOHN REED	12/13/2005	JSL I-4919	930
17-XI-05-1-010	CNI	PARAMURICEIDAE, PARAMURICEA SP. (nr SP.3)	JOHN REED	12/13/2005	JSL I-4919	930
17-XI-05-1-011	CNI	ISIDELLA SP. (SP.2)	JOHN REED	12/13/2005	JSL I-4919	940
17-XI-05-1-012	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4919	930
17-XI-05-1-013	CNI	ZOANTHIDEA	JOHN REED	12/13/2005	JSL I-4919	930
17-XI-05-1-014	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4919	930
17-XI-05-1-015	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4919	930
17-XI-05-1-016	ECH	ASTEROPORPA? ANNULATA?			JSL I-4919	930
17-XI-05-1-017	CNI	ACTINIARIA			JSL I-4919	930
17-XI-05-2-001	CNI	PLUMARELLA POURTALESII	JOHN REED	12/13/2005	JSL I-4920	1079
17-XI-05-2-002	POR	HEXACTINELLIDA			JSL I-4920	1079
17-XI-05-2-003	POR	APHROCALLISTIDAE?			JSL I-4920	1062
17-XI-05-2-004	CNI	MADREPORA OCULATA	JOHN REED	11/19/2005	JSL I-4920	1063
17-XI-05-2-005	CNI	STYLASTERINA			JSL I-4920	1063
17-XI-05-2-006	CNI	PRIMNOIDAE			JSL I-4920	1061
17-XI-05-2-007	POR	HEXACTINELLIDA			JSL I-4920	1060
17-XI-05-2-008	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4920	1079
17-XI-05-2-009	CNI	SCLERACTINIA (CUP CORAL)			JSL I-4920	1063
17-XI-05-2-010	CNI	LOPHELIA PERTUSA			JSL I-4920	1081

SAMPLE NUMBER (Date+Site+Sample)	PHYLUM	TAXONOMY	IDENTIFIED BY	DATE ID	METHOD	DEPTH (Ft.)
18-XI-05-1-001	MOL	PEROTROCHUS CHARLESTONENSIS	JERRY HARASEWYCH	11/19/2005	JSL I-4921	977
18-XI-05-1-002	MOL	PEROTROCHUS AMABILIS	JERRY HARASEWYCH	11/19/2005	JSL I-4921	833
18-XI-05-1-003	CHO	CHAUNAX? SP.	DOUG WEAVER	11/19/2005	JSL I-4921	833
18-XI-05-1-004	MOL	PEROTROCHUS AMABILIS	JERRY HARASEWYCH	11/19/2005	JSL I-4921	836
18-XI-05-1-005	MOL	PEROTROCHUS AMABILIS	JERRY HARASEWYCH	11/19/2005	JSL I-4921	770
18-XI-05-1-006	MOL	PEROTROCHUS AMABILIS	JERRY HARASEWYCH	11/19/2005	JSL I-4921	770
18-XI-05-1-007	MOL	ENTEMNOTROCHUS ADANSONIANUS	JERRY HARASEWYCH	11/19/2005	JSL I-4921	701
18-XI-05-1-008	MOL	PEROTROCHUS AMABILIS	JERRY HARASEWYCH	11/19/2005	JSL I-4921	608
18-XI-05-1-009	MOL	ENTEMNOTROCHUS ADANSONIANUS	JERRY HARASEWYCH	11/19/2005	JSL I-4921	603
18-XI-05-1-010	MOL	SCAPHELLA DOHRNI	JERRY HARASEWYCH	11/19/2005	JSL I-4921	602
18-XI-05-1-011	MOL	ENTEMNOTROCHUS ADANSONIANUS	JERRY HARASEWYCH	11/19/2005	JSL I-4921	579
18-XI-05-1-012	CNI	STYLASTERINA (6 SPP.)			JSL I-4921	579
18-XI-05-2-001	CNI	STYLASTERINA			JSL I-4922	1081
18-XI-05-2-002	CNI	STYLASTERINA			JSL I-4922	1081
18-XI-05-2-003	SED	DUGONG RIB BONE (PETRIFIED)	JOHN REED	11/19/2005	JSL I-4922	1081
18-XI-05-2-004	SED	SEDIMENT (100% PTEROPOD SHELLS)	JOHN REED	11/19/2005	JSL I-4922	1740
18-XI-05-2-005	CNI	STYLASTERINA			JSL I-4922	1733
18-XI-05-2-006	CNI	SOLENOSMILIA VARIABILIS	JOHN REED	11/19/2005	JSL I-4922	1696
18-XI-05-2-007	CNI	ISIDELLA SP. (SP.2)	JOHN REED	12/13/2005	JSL I-4922	1592
18-XI-05-2-008	ECH	COMATONIA CRISTATA	CHUCK MESSING	11/19/2005	JSL I-4922	1535
18-XI-05-2-009	CNI	PLEXAURIDAE, UNID. SP.	JOHN REED	12/13/2005	JSL I-4922	1535
18-XI-05-2-010	CNI	LOPHELIA PERTUSA	JOHN REED	11/19/2005	JSL I-4922	1494
18-XI-05-2-011	ECH	COMATONIA CRISTATA	CHUCK MESSING	11/19/2005	JSL I-4922	1494
18-XI-05-2-012	MOL	BAYEROTROCHUS MIDAS	JERRY HARASEWYCH	11/19/2005	JSL I-4922	1400

Appendix V: Report on invertebrates other than sponges, corals and mollusks

A wide diversity of invertebrates belonging to a variety of phyla was collected during the cruise. The following report outlines the organisms collected and their current distributions, as well as notes on their ecology and distribution. The sponges, scleractinian and hydrozoan corals, octocorals and mollusks are being treated by other researchers. The remaining groups have so far been examined to different extents.

1. Hydroids (Cnidaria: Hydrozoa)

Most non-calcareous (i.e., non-Stylasteridae) hydroid colonies belonging to the Anthoathecata and Leptothecata were sent to Lea-Anne Henry, Scottish Association for Marine Science (Oban, Argyll, United Kingdom). She returned the following identifications.

Anthoathecata: 4 species
Bougainvilliidae sp. 1
Eudendrium rameum (Pallas, 1766)
Leptothecata: 9 species
Campanularia macroscypha Allman, 1877
Zygophylax convallaria (Allman, 1877)
Synthecium tubithecum (Allman, 1877)
Sertularella megastoma Nutting, 1904
Nemertesia geniculata (Nutting, 1900)
Aglaophenopsis hirsuta Fewkes, 1881

Species by sample
8-XI-05-1-6
   Zygophylax convallaria (Allman, 1877) (epizoic on barnacle)
8-X1-05-1-9 (first sample)
   Aglaophenopsis hirsuta Fewkes, 1881 (epizoic on dead *Lophelia pertusa*)
8-XI-05-1-9 (second sample)
   Aglaophenopsis hirsuta Fewkes, 1881. Fertile colonies.
10-XI-05-2-3
   Campanularia macroscypha Allman, 1877 (epizoic on *Paramuricea* sp.), multiple fertile colonies.
   Nemertesia geniculata (Nutting, 1900) (epizoic on *Paramuricea* sp.). Fertile colony.
   Zygophylax convallaria (Allman, 1877) (epizoic on *Paramuricea* sp.)
10-XI-05-2-7
   Eudendrium rameum (Pallas, 1766) (Fertile male colony on *Lophelia pertusa*)
10-XI-05-2-12
   Zygophylax convallaria (Allman, 1877), with reproductive coppiniae mass
   Campanularia macroscypha Allman, 1877 (epizoic on *Z. convallaria* and dead coral polyp). Fertile colony, some with planulae extrusion.
   Bougainvilliidae sp. 1 (epizoic on *Z. convallaria*)
17-XI-05-1-3
   Aglaophenopsis hirsuta Fewkes, 1881

17-XI-05-1-13 (hydroid #2)
Nemertesia geniculata (Nutting, 1900). Fertile colonies.
17-XI-05-1-3 (hydroid #1)
Aglaophenopsis hirsuta Fewkes, 1881. Fertile colony.
17-XI-05-1-12 (hydroid #3)
Sertularella megastoma Nutting, 1904 (Fertile colonies, attached to dead coral.)
Synthecium tubithecum (Allman, 1877)
Nemertesia geniculata (Nutting, 1900) (Epizoic on *S. megastoma*)
17-XI-05-1-13 (hydroid #2)
Nemertesia geniculata (Nutting, 1900). Multiple fertile colonies.

2. Actiniaria

Thirteen lots of sea anemones have been sent to Marymegan Daly, Ohio State University, for identification. These include specimens attributed to the genus *Fagesia*, which has never been reported from this region before (Figure 1). This small anemone apparently takes up residence exclusively in the calices of dead corals, in this case, *Enallopsammia profunda*. Dr. Daly is currently working on this taxon.

Figure 1. *Fagesia* (?) in dead coral calice.

Samples that included *Fagesia* anemones

8-XI-05-1-10	10-XI-05-1-3	17-XI-05-2-1
9-XI-05-1-5	10-XI-05-2-8	
10-XI-05-1-2	17-XI-05-1-4	

3. Crustacea

The chyrostylid anomuran *Eumunida picta* is the most abundant and obvious decapod on most deep reefs visited. It typically sits on exposed perches with its rostrum directed obliquely upward and its chelae raised. From this posture, it has been observed to catch small fishes. Ten lots of decapod crustaceans have been sent for identification to Dr. Rafael Lemaitre, National Museum of Natural History, Smithsonian Institution, Washington, DC. A verrucomorph barnacle was also found, sometimes commonly, attached to dead *L. pertusa.*

Sample list

08-XI-05-2-1	3 shrimps commensal in *Euplectella*
08-XI-05-2-2	paired commensal shrimp in hexactinellid
9-X1-05-2-6	crab
9-X1-05-1-2	unknown
11-XI-05-2-7	thalassinidean
11-XI-05-2-9	galatheid
16-XI-05-1-10B	crab
16-XI-05-2-2	commensal shrimp in hexactinellid
17-XI-05-1-5	shrimp
17-XI-05-1-11	galatheid on isidid octocoral

4. Echinoderms

Representatives of all classes of echinoderms except Holothuroidea were collected. The relatively few Asteroidea and Echinoidea have not yet been distributed. Twenty lots of ophiuroids have been sent for identification to Dr. David Pawson, National Museum of Natural History, Smithsonian Institution, Washington, DC. One specimen of the large basketstar *Gorgonocephalus arcticus* was collected, although numerous specimens were observed chiefly clinging to sponges (e.g., Pachastrellidae) on the phosphoritic limestone substrates of the Miami Terrace rather than on coral substrates.

The crinoid fauna has been examined by the author. Five species have been recorded. One of them, *Comatilia iridometriformis*, was known previously only in association with deep coral assemblages from southern Georgia to the Strait of Florida (Messing 1984). It is one of the smallest unstalked crinoids and the only brooding species known from the northern hemisphere. *Zenometra columnaris* was previously known only from a few records scattered around the tropical western Atlantic plus one from west of Gibraltar. The new records from off Florida are all of specimens found in association with *Lophelia pertusa*. This material represents the most intact specimens known. *Comatonia cristata* was previously known almost entirely from the Pourtalès Terrace south of the Florida Keys (Messing 1981), where it was collected via trawls and dredges on rugged hard bottoms. The current records include specimens collected from hard bottoms, on sponges and on corals, and extend its range northward on the continental side of the Strait to the Miami Terrace. One juvenile specimen of the charitometrid *Crinometra brevipinna* was collected. Although occurring widely throughout the tropical western Atlantic, especially in the Bahamas, Cuba and West Indies, this is only the second record of this taxon from east Florida waters. The most commonly seen and collected crinoid is a small unidentified antedonid that may represent a new species.

Crinoidea

Family Antedonidae

Comatonia cristata
Unidentified antedonid
Comasteridae
Comatilia iridometriformis
Family Charitometridae
Crinometra brevipinna
Family Zenometridae
Zenometra columnaris

Sample list

8-XI-05-1-4	Unknown comatulid
8-XI-05-1-5	Unknown comatulid
8-XI-05-1-6	Unknown comatulid
8-XI-05-1-9	Unknown comatulid
8-XI-05-2-1	Unknown comatulid
8-XI-05-2-2	Unknown comatulid
9-XI-05-2-1	*Comatilia iridometriformis*
9-XI-05-2-4	*Comatilia iridometriformis*
	Crinometra brevipinna
9-XI-05-2-6	Unknown comatulid
10-XI-05-2-9	Unknown comatulid
11-XI-05-1-3	*Zenometra columnaris*
11-XI-05-2-6	*Zenometra columnaris*
17-XI-05-1-3	*Comatonia cristata*
17-XI-05-1-5	*Comatonia cristata*
17-XI-05-2-6	*Comatonia cristata*
18-XI-05-2-8	*Comatonia cristata*
18-XI-05-2-11	*Comatonia cristata*

Samples containing Ophiuroidea

9-XI-05-1-1	10-XI-05-2-3	17-XI-05-2-1
9-XI-05-1-5	10-XI-05-2-8	17-XI-05-2-4
9-XI-05-1-8	11-XI-05-1-4	17-XI-05-2-8
9-XI-05-2-3	11-XI-05-1-5	18-XI-05-1-10
9-XI-05-2-4	16-XI-05-1-3	18-XI-05-2-4
9-XI-05-2-5	16-XI-05-1-6	
9-XI-05-2-6	17-XI-05-1-16	

5. Foraminifera

Perhaps the most interesting discovery of this expedition was the observation that in many places the dead standing coral and partly collapsed rubble is covered by a dense carpet that in shallow water would be initially identified as an algal turf. The components of this turf have been most closely examined so far on coral habitats in 600-700 m. They consist chiefly of arborescent astrorhizacean foraminiferans up to ~15 mm tall. Densities have not yet been precisely quantified, but there appear to be up to at least 10 cm^{-2}. At least one taxon constructs a central kernel composed chiefly of planktonic globigerinid foram tests surrounded by a branching webwork of sponge spicules that together form a delicate "dust kitten"-like sphere up to 1.5 cm across (Figure 2). The dominant form is a tree-like growth covered with fine sediment including diatom frustules and coccolithophorids (Figures 3 & 4). Brooke *et al*. (2006) briefly hypothesized that the enormous surface area generated by these forams, and made adhesive by their pseudopods, may represent a more direct pathway for sediment deposition and consequent mound growth than via simple baffling of suspended sediment by coral branches. Specimens have been prepared both for scanning and transmission electron microscopy.

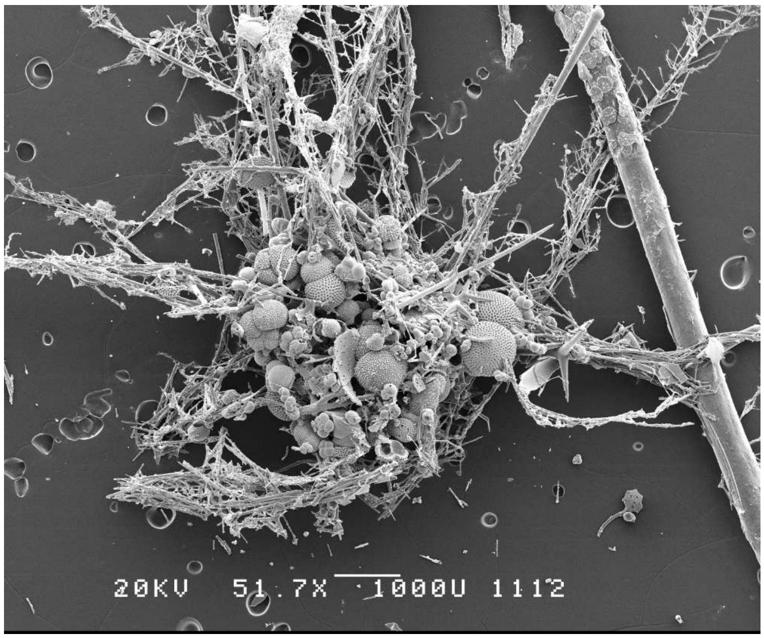

Figure 2. Agglutinating foraminifer with central kernel composed of planktonic foram tests and radiating webwork of sponge spicules. This specimen was attached to a primnoid octocoral (slender cylinder at right).

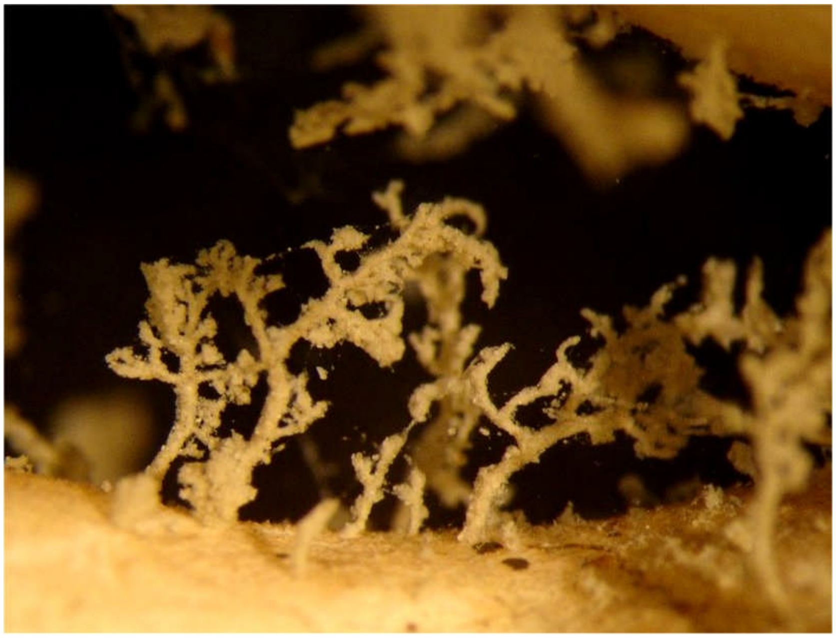

Figure 3. Arborescent agglutinating forams covering dead coral colony.

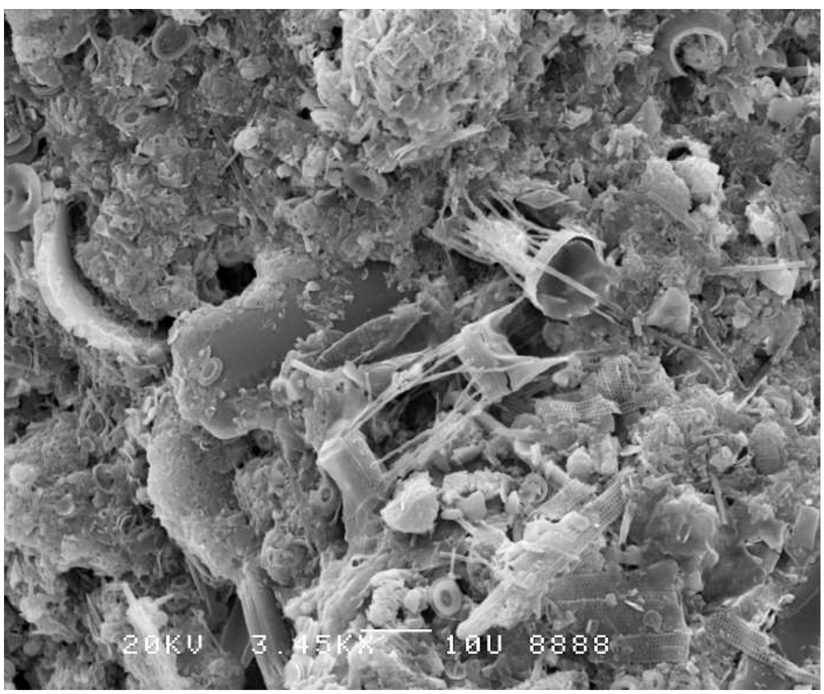

Figure 4. Close-up of previous showing diatom frustules and coccolithophorids.

Appendix VI: ICHTHYOLOGICAL OBSERVATIONS: *LOPHELIA* CORAL EXPEDITION FLORIDA STRAITS, NOVEMBER 2005.

R. Grant Gilmore, Jr., Ph.D.
Estuarine, Coastal and Ocean Science, Inc.
Vero Beach, Florida

INTRODUCTION

One of the most detailed demersal fish assemblage studies limited to the Florida Straits was conducted by Staiger (1970) for his doctoral dissertation at the Rosenstiel School of Marine and Atmospheric Science, University of Miami. This was a R/V Gerda trawl and dredge survey listing 185 species that occurred at depths between 200 and 1,000 m. from latitude 25° 20.000' to 27° 30.00 N., 79° 00.00' to 83° 00.00' W. Staiger classified his fauna based on depth zonation patterns, and did not have the ability to make microhabitat associations.

Staiger's list is biased toward demersal fishes and is therefore a gage of benthic fish diversity in the Florida Straits, particularly those susceptible to trawl capture. For this reason it has been included in this analysis. Staiger's work complements submersible observations as it is based on captured fish whose identity was verified. Although the Johnson-Sea-Link submersibles are the only research submarines in the world that can effectively chase and capture fish (over 2,000 specimens and 100 new species described from Gilmore et al submersible expeditions alone, Gilmore, pers. obs.), they were not used to capture fish during this survey. Fish observations were limited to study of the video images made during coral transects. The manned submersible has the advantage of classifying sessile invertebrate communities, particularly sponge and coral faunas. However, it cannot adequately classify the fish communities without clear close-up photography or specimen capture. Staiger's study (ibid) was instrumental in allowing the diversity of the Florida Straits demersal fish fauna to be assessed, with the hope that one day fish captures will occur on Florida *Lophelia* reef formations allowing identification and verification in this tropical transition zone.

JSL submarine observations made during a low illumination bait survey of large predator populations in the Florida Straits off Bimini March – April 1997. These observations are included in this analysis due to the proximity of the present study to the 1997 observation sites.

Preliminary Florida studies of *Lophelia* fish assemblages were made by Reed et al (2006), based on photography and in situ observation during coral and invertebrate surveys of the Florida Straits. Fifty eight fish taxa, 55 species were listed for *Lophelia* reefs, excluding fish faunas listed for shallower *Oculina* coral reef habitats. Since the techniques for fish assessment differ significantly from coral and sessile invertebrate assessment using manned submersibles, it is likely that additional fish species associated with *Lophelia* will be documented in the future. The reason is low submarine illumination (red filtered light), low light cameras (SIT), and fish capture equipment normally associated with JSL fish surveys were not used in the coral – sessile invertebrate surveys.

The presence of a moving brightly lit noisy object on the seabed in a normally dark habitat can be detected miles away by deep sea fishes. It has been documented that intense lights associated with manned submersible activities allows a wide variety of fish to avoid the submersible and therefore, the observers (Barans et al. 1986). Most fishes in the twilight zone, between 200 and 1,000 m depths are highly sensitive to light (Montgomery and Pankhurst 1997). Most of these species are highly mobile and may avoid the submarine observers all together by hiding deep in the coral formation or leaving the vicinity of the slow moving submarine (Barans et al. 1986; R.G. Gilmore pers obser.). For this reason baiting, or toxin dispersal has been the most effective way of capturing and identifying fish from the submarine (Gilmore 2001). The use of low light black and white SIT cameras with red filters on low intensity submarine lights has also been effective to allowing some fish populations to emerge from coral crevices and become more apparent to submarine observers. Deep sea fishes are sensitive to sound and are major sound producers themselves based on anatomical studies and the few recordings available (Talvolga, 1971; Marshall 1979; Montgomery and Pankhurst 1997). Considering the diverse faunas brought to the surface with normally highly biased trawl sampling versus the very limited number of fish species recorded from the submarine to date, it is likely that the fish fauna associated with *Lophelia* will become apparent as new techniques are utilized to assess this mobile fauna.

The most effective methods for fish assessment utilize low light, red light, or no light under twilight conditions (Gilmore and Jones 1992), fish traps, and fish toxins (Gilmore et al. 1981; Gilmore and Jones 1985; Gilmore 1995). Over 100 new fish species, and over 1,000 fish specimens have been captured on JSL submersible ichthyological expeditions using these techniques from 1977 to 1997 (Gilmore and Jones 1988, 1992; Gilmore et al. 1993; Gilmore, 1997, 2001, pers. obs).

In contrast, some species are photophilic and often associate the a will lit submarine. Examples of these species are the groupers, serranidae, and the wreckfish, polyprionidae, both of which occur commonly in the Florida Straits and are reef associates.

METHODOLOGY

In order to obtain the greatest geographic coverage of terrains, geological formations, sessile invertebrates and coral with a very limited number of submarine dives (14 dives) and multiple investigators, strict adherence to timed transects was necessary. These transect required that bright lights be on as the submarine moved just over the bottom. Video cameras ran most of the time documenting bottom characteristics and the periodic coral collections. Since the survey covered several hundred miles north to south along the Florida east coast JSL dives had to be conservative in their objectives and scientific observations. Fish were to be assessed strictly from video images taken during the benthic transects. Fish collections and stationary low light point counts would have taken valuable time away from the geographic assessment. For this reason the fish identified in this work are based on the few seconds of video that may include their entire body or portions of a body that at least allowed placement to family. In some cases excellent close up video was taken of accommodating specimens, but often taxonomic characters of closely related species were not discernable. Using sub video transects alone is mot the most effective means for assaying a fish fauna (Barans et al. 1986; Gilmore 2001), particularly the larger bodied species that could be of fishery value. These limitations must be realized in interpreting the data presented on fish observations during this expedition.

Historic trawl, dredge and long line collections within the study area indicate that several hundred species variously occur in the benthic environs of the Florida Straits (Steiger 1970; Sulak 1982). Trawls are notoriously biased in their collections. It is obvious from the JSL observations that have been made to date that more species than those listed by Staiger occur association with the deep reef formations in the Florida Straits. We have added to the species list in Table 1, fishes observed or captured from the only deep reef (200 to 1,000 m) Johnson-Sea-Link fish capture expedition that we are aware of within the Florida Straits. This expedition occurred between the Grand and Little Bahama Banks and the Florida Slope, 28 March- 1 April 1997, working primarily between Bimini and the Cat Cays and Miami. The objective of this expedition was to document mating populations of the ragged tooth shark, *Odontaspis ferox,* first captured in the Western Atlantic in the Florida Straits between 300 and 1,000 m, off Bimini. This latter survey used red light, low light camera systems, baited baskets, laser guided spear systems, and suction devices to capture various fish species. However, the ragged tooth shark expedition did not use rotenone ejection systems that have been so effective in capturing hundreds of fish specimens on previous expeditions (Gilmore 1994, 1995, 1997; Gilmore and Jones 1988; Gilmore and McCosker 1996; Gilmore et al. 1993). The expedition also utilized the expertise of deep sea bottom fishermen who were also fishing with electric deep sea reels on board the submarine mother ship during the expedition.

Complicating strictly photographic identification of the deep reef fish fauna is the presence in the Florida Straits of both insular and continental sibling species, as well as warm temperate and tropical sibling species that have few taxonomic characters effectively separating them. In fact, most taxonomic studies of the major groups encountered, the anguilliformes, aulopiformes, gadiformes, beryciformes, scorpaeniformes are based on museum descriptions of preserved specimens, often in poor condition from being trawled from great depths. The taxonomic characters used for classification are typically not good field characters, particularly for submarine based observers and in-situ photography. Color descriptions are almost useless, often being completely different from live specimens, as red and yellow pigments are quickly lost after the fish dies and is fixed in formalin.

The Staiger (1970) benthic fish list, 185 species, is the basis on which the fauna is defined for the Florida Straits. The Staiger list does not allow us to determine the degree fish associate with *Lophelia* coral reefs. Submarine observations also include species that may not associate intimately with coral formations. However, without major long duration systematic studies of trophic habits, migratory habits and broad habitat association, fish behavior, it is presently difficult to list which species are truly associated with Lophelia and which are not at all. Many epibenthic and bathypelagic fishes may routinely associate with deep coral reef structure and visit these habitats to prey on invertebrate and vertebrate coral associates. This latter fish group would not be captured in the trawl and dredge samples taken in the Staiger studies.

Based on prior studies of reef fish faunas in shallow water it is likely that a wide variety of reef associations occur and may vary depending with diel and seasonal periodicity. Epigonid and anthiine fishes are predictable deep reef associates. The epigonids, so common on the Miami terrace, are undoubtedly carnivores foraging on invertebrates that associate with the water column around rock formations. We have encountered epigonids routinely on deep reef formations throughout the tropical western Atlantic. They are the most abundant fish on rock formations between 400 and 700 m depths, with predictable occurrence in all seasons. The anthiine serranids, also abundant, forage on small invertebrates near structure, but are often more abundant between 100 and 400 m. These species were easily identified, but are decidedly photophobic, so were likely greatly underestimated in high light video transects.

A number of other fish species have been recorded from the Florida Straits based on a variety of techniques including commercial and recreational fishing gear, trawls, dredges and planktonic sampling. Not all of these species have been included in this list.

The lists presented are dividing into several tables organized by dive number, previous literature surveys and by apparent degree of association with *Lophelia* coral formations. This latter classification system is based on what is now known of the life history and behavior of fishes inhabiting the Florida Straits.

Even though the depths of 200 to 1,000 m are considered substantial, many fish species migrate this distance within minutes, often making frequent migrations between surface, midwater and benthic environments during diel feeding forays, or to spawn. The degree of association with benthic communities is difficult to determine unless detailed feeding studies are conducted and tagging studies that allow depth duration to determined via satellite link. Enough of this has been done with large pelagic predators such as the billfishes, tuna and sharks that we do know the resident time near the bottom may be more substantial than previously acknowledged. Pelagic predaceous fishes with obvious movements between the mesopelagic, epipelagic and bathal regions should be considered in future treatments, particularly if they have been observed in the Florida Straits at various depths considered to be in association with the bottom. For instance the longfin mako, *Isurus paucus*, captured frequently within the Florida Straits, may be considered a bathypelagic/mesopelagic predator, while the closely related shortfin mako, *I. oxyrinchus*, is not due to the longfin's adaptation to foraging in deeper water, the shortfin mako in epipelagic waters. Longfin makos prey on another deep water predator, the swordfish, *Xiphias gladius*, commonly occurring near the bottom, and observed on several occasions during *Lophelia* reef surveys. The swordfish is on the list as are mesopelagic migrators, gonostomatids, myctophids and sternoptichthids and the ocean sunfish. All these latter species have been observed on several occasions in association with *Lophelia* reef formations. However the list (Table 1) is largely devoted to demersal fish species.

RESULTS

The total list of 216 fish species is provided in Table 1. Sixty species were observed during the November 2005 JSL survey (Tables 1 & 2). Some of the most abundant species observed from the JSL, *Epigonus* spp. and *Atractodenchelys phrix*, were not common in the Steiger trawl collections (Tables 1, 3, & 4). Of the 39 fish families observed in the November 2005 JSL mission, five contain species the appear to numerically dominate the coral associate fauna: synaphobranchidae - cutthroat eels, macrouridae - grenadiers, moridae – codlings, scorpeanidae – scorpeanfishes, and epigonidae – deepwater cardinalfishes (Tables 3 & 4). The diversity of species within the macrourids and scorpeanids did not permit all photos taken of individuals to be identified to species. So types were designated based on obvious differences observed in the photos and images and drawings kept for future reference when specimens may be captured for species verification.

Scorpeanids occurred (50% of dives, Table 3) more often than any other species in association with *Lophelia* coral formations. *Epigonus* spp., *Atractodenchelys phrix*, and *Laemolema melanurum* are the most commonly occurring fishes after the scorpeanfishes occurring in 43% of the observations. The shortbeard codling, *Laemolema barbatulum* and various rattails, (*Nesumia spp., Coryphaenoides spp. and Hymenocephalus spp*.) were next in abundance (36% of the observations).

Historical fishery species are designated in Table 3 with an “F”. Twenty species fall into this category.

Except for the epigonids, ariommatids, gempylids and xiphids perciform fishes were typically outnumbered by elasmobranchs and gadiforme fishes in demersal assemblages below 300 m (Table 5). Perciform species (serranids, epigonids, carangids) dominated numerically at depths shallower than 300 m.

DISCUSSION

A brief survey of a historical demersal fish survey in the Florida Straits indicates that a far richer fauna occurs at depths over 200 m in this geographic region than JSL submarine observations indicate. Many Table 1 fish species are open bottom associates (rajids, pleuronectiform fishes, triglids/peristeids, some scorpaenids) and were most common in the Steiger trawl/dredge collections. Many of the perciform fishes are structure associates and may have an more intimate association with Lophelia formations than a few sub dives can document. These families include the acropomatids, serranids, epigonids, carangids, lutjanids, chaetodontids, pomacentrids, percophids, and gobiids.

Tropical Bahamian, Antillean and Central American deep reef ichthyofaunas at depths between 200 and 700 meters are numerically dominated by acropomatids, symphysanodontids, anthiine serranids, lutjanids and epigonids. These families were better represented in the vicinity of the Miami and Portales Terrace and related sink holes below 26 ^{o} 30' latitude.

One of the most noteworthy observations on the Miami Terrace in a predictable concentration (observed on several earlier dives by John Reed) of wreckfish and an encounter with obviously mated (mating scars were apparent) ragged tooth shark, *Odontaspis ferox,* at this location. The former species is a fishery species while the latter species is protected species based on international conservation agreements protecting specific shark species from exploitation. The wreckfish were very rotund indicating that either they were all well fed, feeding equally well for all members of the schools of several hundred individuals, or that they were gravid in spawning condition.

Other species observed that commonly utilized in U.S. fisheries are the dogfishes, groupers, jacks, snappers, mackerels and swordfish. The jacks, mackerels and swordfish are pelagic predators and likely visit the Lophelia reefs periodically to forage. The swimming and diving abilities of these fish allow them to move from surface waters to the bottom at depths as deep as 1,000 m in a few minutes or less. The swordfish has been clocked at 35 mph, or 948 m/min (=16 m/sec). Mackerels and tunas are also quite fast and may forage periodically between the surface on and the reef.

Fishes that have been used variously in fisheries elsewhere in the world, but not necessarily in U.S. waters include the catsharks, skates, roughies, rattails, codlings, and various flatfishes.

There is little doubt that the rich invertebrate fauna associated with *Lophelia* formations feeds a rich and diverse fish community (Sedberry and Musick 1978; Weaver and Sedberry 1997) and potentially serves as a spawning site, at least in the Florida Straits, for wreckfish and ragged tooth sharks.

We highly recommend additional studies of the *Lophelia* reef fish assemblage and that new and proven techniques of assessing active nekton on these vital reef formations be considered for future verification of fish species and the determination of trophic interactions through feeding studies.

Present literature can be used to develop a more comprehensive list of Florida Straits fish species and also delineate which species are most likely to have a more intimate association with *Lophelia* coral formations at tropical latitudes. The increased numerical abundance and occurrence of epigonids and anthiine serranids on the Miami Terrace and further south agrees with previous biogeographic studies of deep reef fishes in the Bahama Islands (Gilmore et al. 1993) and Caribbean Basin (Gilmore 1994, 1995;

Gilmore and McCosker 1996) using Johnson-Sea-Link submarines. The basic disappearance of major epigonid schools in the north of Cape Canaveral is not unexpected. We anticipate a detailed literature survey of Florida Strait fishes that will include unpublished federal, state reports, theses (Staiger 1970; Sulak 1982) and consulting activities giving the most comprehensive ichthyofaunal description of this diverse and productive region of the tropical and subtropical western Atlantic.

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TABLE 1. MASTER LIST: DEMERSAL, BENTHO-PELAGIC, MESOPELAGIC FISHES OF THE FLORIDA STRAITS

	STEIGER DISSERTATION		BROOKE.REED.MESSING 2005		GILMORE JSL.0BS 1997	
TAXON	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**
O. MYXINIFORMES						
Myxinidae - HAGFISHES						
1 *Myxine glutinosa* - ATLANTIC HAGFISH	6	274-370			12	462
= M. limosa						
O. CHIMAERIFORMES						
Chimaeridae - SHORTNOSE CHIMAERAS						
2 *Hydrolagus sp. A.* (SPOTTED CHIMAERA)			2	731-762		
3 *Hydrolagus sp. B.*			1	835		
O. CHLAMYDOSELACHIFORMES						
Chlamydoselachidae						
4 *Chlamydoselachus anguineus* - FRILL SHARK					1	462
O. HEXANCHIFORMES						
Hexanchidae						
5 *Hexanchus griseus* , BLUNTNOSE SIXGILL SHARK					6	462-769
6 *H. nakamurai* , BIGEYE SIXGILL SHARK					4	462-769
O. SQUALIFORMES						
Squalidae - DOGFISH SHARKS						
7 *Squalus. cubensis* - CUBAN DOGFISH	2	335-494	2	264-415	10	462-769
Dalatidae - KITEFIN SHARKS						
8 *Dalatias licha* - KITEFIN SHARK			1	868		
Centrophoridae - GULPER SHARKS						
9 **Centrophorus squamosus - LEAFSCALE GULPER SHARK**	**2**	**733-805**			5	462-769
Entmopteridae - LANTERNSHARKS						
10 **Entmopterus bullisi - LINED LANTERNSHARK**	**7**	**541-692**				
11 **Entmopterus hillianus - CARIBBEAN LANTERNSHARK**	**6**	**463-815**				
12 **Entmopterus virens - GREEN LANTERNSHARK**	**9**	**531-558**				
Somniosidae - SLEEPER SHARKS						
13 Centroscymnus coelolepis - PORTUGESE DOGFISH					1	462-769
O. LAMNIFORMES						
Odontaspididae - SAND TIGERS						
14 Odontaspis ferox - RAGGED TOOTH SHARK			2	310	3	462-769

	STEIGER DISSERTATION		BROOKE.REED.MESSING 2005		GILMORE 1997	
O. CARCHARINIFORMES	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**

Scyliorhinidae - CAT SHARKS						
15 Galeus arae - MARBLED CAT SHARK	132	190-642	29	500-732		
16 Scyliorhinus retifer - CHAIN DOGFISH	3	348				
17 **Scyliorhinus torrei - DOGFISH**	**4**	**366-512**				
18 **Apristurus profundorum**	**2**	**915-988**				
19 **Apristurus riveri**	**1**	**739**				
Carcharhinidae - REQUIEM SHARKS						
20 Carcharhinus perezi - CARIBBEAN REEF SHARK					3	50-500
Triakidae - Houndsharks						
Mustelus sp.			1	376		
21 M. sinusmexicanus - GULF SMOOTHHOUND					5	462-769
22 ***Triakis barbouri***	**10**	**549**				
O. RAJIFORMES						
Torpedinidae - ELECTRIC RAYS						
23 Benthobatis marcida	18	320-600	1	759		
Rajidae - SKATES						
Breviraja sp.	**1**	**567**				
24 *Breviraja claramaculata* - LIGHTSPOTTED SHORTSKATE			1	500		
25 ***Breviraja colesi***	**8**	**174-527**				
26 ***Breviraja cubensis***	**6**	**394-503**				
27 ***Breviraja ishiyamsi***	**7**	**803-891**				
28 ***Fenestraja plutonia***	**70**	**215-860**	4	2465-2483		
29 ***Breviraja spinosa***	**3**	**274-366**				
30 ***Cruriraja atlantis***	**12**	**365**				
31 ***Cruriraja cadenati***	**2**	**640-785**				
32 ***Cruriraja poeyi***	**1**	**558**				
33 ***Cruriraja rugosa***	**6**	**531-805**				
34 *Fenestraja (= Breviraja) sinusmexicanus*	6	392-595				
35 ***Raja bathyphila***	**1**	**840**				
36 ***Raja floridana***	**1**	**338-384**				
37 ***R. garmani* - ROSETTE SKATE**	**42**	**119-366**				
38 ***Raja oregoni***	**1**	**692**				
Anacanthobatidae						
39 **Anacanthobatis longirostris**	**1**	**640**				

	STEIGER DISSERTATION		BROOKE.REED.MESSING 200		GILMORE 1997	
	NO.	**DEPTH (m)**	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**
OSTEICHTHYS						
O. ALBULIFORMES						
Halosauridae - Halosaurs						
40 *Halosaurus guentheri*	5	977-1281				

41 *Aldrovandia rostrata*	10	988-1709				
O. ANGUILLIFORMES						
Chlopsidae - FALSE MORAYS						
42 Chlopsis bicolor - BICOLOR EEL	4	91-205				
Synaphobranchidae - CUTTHROAT EELS						
43 Atractodenchelys phrix	**1**	**366**	**28**	**737-871**		
44 Dysommina rugosa	**6**	**274-642**				
45 Synaphobranchus kaupi - NORTHERN CUTTHROAT EEL	19	773-776				
46 Synaphobranchus oregoni	40	747-1171				
47 Ilyophis brunneus	11	760-1402				
Ophichthidae - SNAKE EELS						
48 Pisodonophis sp.?(=daspilotus) - BLUNT TOOTHED SNAKE EEL	5	183-336				
Congridae - CONGER EELS						
Congrid spp.			4	291-735		
49 **Ariosoma selenops**	**9**	**230-469**				
50 **Conger esculentus**	**1**	**692**				
51 **Congrina thysanochila**	**2**	**375-380**				
52 **Paraxenomystax sp**	**10**	**288-430**				
53 **Promyllantor schmitti**	**84**	**503-824**				
54 **Promyllantor pertubator**	**6**	**719-1171**				
55 **Facciolella sp**	**1**	**373**				
56 Hoplunnis tenuis - SPOTTED PIKECONGER	1	180				
57 **Venefica procera**	**1**	**810**				
Nettodaridae						
58 Nettodarus brevirostris	**1**	**351**				

	STEIGER DISSERTATION		BROOKE.REED.MESSING 200!		GILMORE 1997	
TAXON	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**
O. ARGENTINIFORMES						
Argentinidae - ARGENTINES						
59 A. striata - ATLANTIC ARGENTINE	53	154-393				
60 Glossanodon pygmaeus - PYGMY ARGENTINE	1	190				
Alepocephalidae - SLICKHEADS						
61 Conocara sp	1	920				
62 Conocara macdonaldi	1	1224				
63 Leptoderma macrops	2	810-1224				
64 Tallsmania bifurcata	1	1171				
O. STOMIIFORMES						
Gonostomatidae						

65 Gonostomatid spp.			100+	500		
Sternoptychidae - MARINE HATCHETFISHES						
66 Sternoptyx diaphana	24	661-1647 m				
Sternoptyx spp.			31	500-770		
O. AULOPIFORMES						
Synodontidae - LIZARDFISHES						
67 Saurida brasiliensis - LARGESCALE LIZARDFISH	14	401				
68 S. caribbeaea - SMALLSCALE LIZARDFISH	10	215-457				
69 S. normani - SHORTJAW LIZARDFISH	6	101-225				
70 S. poeyi - OFFSHORE LIZARDFISH	2	274				
Chlorophthalmidae - GREENEYES						
Chlorophthalmid spp.			17	332-771		
71 Chlorophthalmus agassizi - SHORTNOSE GREENEYE	379	173-760				
72 Parasudis truculenta	22					
Ipnopidae - DEEPSEA TRIPOD FISHES						
73 Bathyphlops (marionae or sewelli)			1	630		
74 Bathypterois bigelowi	6	541-600				
75 Bathypterois phenax	2	760-1150				
76 Bathypterois viridensis	6	733-1224				
77 Ipnops murrayi	5	1241-1427				
O. MYCTOPHIFORMES						
Myctophidae - LANTERNFISHES						
78 Myctophid spp.			100+	500		
O. POLYMIXIIFORMES						
Polymixiidae - BEARDFISHES				733		
79 Polymixia lowei - BEARDFISH	47	119-805	43	332-379		

	STEIGER DISSERTATION		**BROOKE.REED.MESSING 2005**		**GILMORE 1997**	
TAXON	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**
O. GADIFORMES						
Macrouridae - GRENADIERS			10	733-763		
Macrourid Type A			18	732-775		
Macrourid Type B			11	326-763		
Macrourid Type C			1	853		
80 Bathygadus favosus	4	1134-1224				
81 Bathygadus macrops	4	575-751				
82 Bathygadus vaillanti	1	631				
83 Coelorhynchus carminatus	141	227-760				
84 Coelorhynchus caribbeus	1	1030				
85 Coryphaenoides sp.	1	1171	1	405-464		
86 Coryphaenoides colon	2	739-810				
87 Gadomus arcuatus	10	751-1030				
88 Gadomus longifilis	11	796-1030				

89	Hymenocephalus cavernosus	39	320-824				
90	Malacocephalus occidentalis	22	190-672				
91	Nezumia bairdi	3	334-604				
92	Nezumia hildebrandi	124	335-890				
93	Nezumia sp.	1	694				
94	Sphagemacrurus grenadae	1	1171				
95	Squalogadus intermedius	2	979				
96	Trachonurus sulcatus	1	906				
97	Ventrifossa macropogon	2	503-635				
Moridae - CODLINGS							
98	Physiculus fulvus - HAKELING	5	302-393				
99	Brosmiculus imberbis	19	190-403				
100	Laemonema barbatulum - SHORTBEARD CODLING	1018	174-760	91	247-536		
101	Laemonema melanurum - CODLING	83	329-890	33	286-755		
Merlucciidae - MERLUCID HAKES							
102	Merluccius albidus	53	195-692				
Phycidae - PHYCID HAKES							
103	Enchelyopus cimbrius- FOURBEARD ROCKLING	2	208-261				
	Urophycis sp.	1	119	3	327-771		
104	Urophycis cirratus	8	83-183				
105	U. regius - SPOTTED HAKE	58	112-393				
106	U. chesteri	7	347-567				

		STEIGER DISSERTATION		**BROOKE.REED.MESSING 200**		**GILMORE 1997**	
	TAXON	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**
O. OPHIDIIFORMES							
Ophidiidae - CUSK-EELS							
	Ophidiid spp.			1	783		
107	Barathronus bicolor	5	780				
108	Benthocometes robustus	1	604				
109	Lepophidium cervinum	51	90-212				
	Lepophidium sp.	1	329				
110	Lepophidium kallion	4	366-512				
111	Lepophidium marmoratum	4	366-502				
Bythitidae - VIVIPAROUS BROTULAS							
	Bythitid spp.			1	292		
112	Bythites sp.	2	796-817				
113	Dicrolene intronigra	14	915 - 1695				
114	Diplacanththopoma brachysoma	12	549-747				
115	Monomitropus agassizi	32	549-1030				
	Neobythites sp.	30	302-724				

116 Neobythites gilli	13	180-434				
117 Neobythites marginatus	14	329-658				
118 Saccogaster sp.	1	208				
119 Sciadonus sp	1	803				
O. LOPHIIFORMES						
Lophiidae						
120 *Lopius* spp. (*gastrophysus or americanus*)	32	90-403				
Antennariidae - FROGFISHES						
121 A. radiosus - SINGLESPOT FROGFISH	15	65-320				
Antennarius sp.	1	312				
Chaunacidae - CHAUNACIDS						
Chaunax sp.	2	430-494	1	288		
122 Chaunax pictus	212	256-658	2	256-300		
Ogcocephalidae - BATFISHES						
123 Dibrachus atlanticus	158	190-988				
124 Halieutichthys caribbeus	28	225-421				
125 Zalieutes mcgintyi	19	91-430				

	STEIGER DISSERTATION		BROOKE.REED.MESSING 200!		GILMORE 1997	
TAXON	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**
O. BERYCIFORMES						
Trachichthyidae - ROUGHIES						
126 Hoplostethus mediterraneus	21	375-796	17	366-539		
Berycidae - ALFONSINOS						
127 Beryx decadactylus - RED BREAM			8	291-293		
Holocentridae - SQUIRRELFISHES						
128 Osteichthys trachypoma - BIGEYE SQUIRRELFISH	18	226-549				
O. ZEIFORMES						
Zeidae- DORIES						
129 Cyttopsis rosea RED DORY	3	348-549				
Zeniontidae - ZENIONTIDS						
130 Zenion hololepis	100	384-576	2	331-350		
Caproidae - BOARFISHES						
131 Antigonia capros	13	91-288	55	175-180		
132 Antigonia combatia	10	149-320				
O. GASTEROSTEIFORMES						
Centriscidae - SNIPEFISHES						
133 Macrorhamphosus scolopax - LONGSPINE SNIPEFISH	34	106-226				
O. SCORPAENIFORMES						
Scorpaenidae - SCORPIONFISHES			136	247-745		

	Scorpaenid A			6	286-537		
	Scorpaenid B			1	333		
	Scorpaenid D			2	359-361		
	Scorpaenid T			1	331		
	Scorpaenid X			1	336		
	Scorpaenid Y			1	528		
	Scorpaenid z			1	475		
134	Helicolenus dactylopterus	52	226-558				
135	Neomerinthe beanorum	7	193-457				
136	Pontinus longispinis - LONGSPINE SCORPIONFISH	8	83-375				
137	Pontinus macrolepis	2	87-252				
138	P. rathbuni - HIGHFIN SCORPIONFISH	24	77-494	10	400-470		
139	Setarches guentheri	39	215-403				
140	Trachyscorpia cristulata	8	313-549				
Triglidae - SEAROBINS							
141	Bellator brachychir - SHORTFIN SEAROBIN	9	229-366				
142	B. egretta - STREAMER SEAROBIN	20	83-310				
143	P. stearnsi - SHORTWING SEAROBIN	8	90-388				
		STEIGER DISSERTATION		**BROOKE.REED.MESSING 200**		**GILMORE 1997**	
TAXON		**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**
Peristediidae - ARMORED SEAROBINS							
144	**P. ecuadorense**	**24**	**256-814**				
145	P. greyae - ALLIGATOR SEAROBIN	29	227-567				
146	**P. longispathum**	**4**	**531-540**				
147	P. miniatum - ARMORED SEABROBIN	1	192				
148	**P. platycephalum**	**7**	**252-457**				
149	P. thompsoni - RIMSPINE SEAROBIN	7	119-185				
150	**P. tomentum**	**31**	**320-549**				
151	**P. tuncatum**	**16**	**531-795**				
Cottidae - SCULPINS							
152	*Myoxocephalus (=Cottunculus) thompsonii* - DEEPWATER SCULPIN	1	891				
O. PERCIFORMES							
Acropomatidae - LANTERNBELLIES							
153	*Synagrops bellus* - BLACKMOUTH BASS	53	91-344				
154	***Synagrops pseudomicrolepis***	**2**	**366-549**				
155	*Verilus sordidus* - PARGO CHINO			1	458		
Scombropidae - GNOMEFISHES							
172	*Scombrops oculatus* - VAMPIRE GNOMEFISH					10	462-769
Symphysanodontidae - SLOPEFISHES							
156	*Symphysanodon sp.*	2	284				
Polyprionidae - WRECKFISHES							
157	*Polyprion americanus* - WRECKFISH			53	286-349		

Serranidae - SEA BASSES & GROUPERS						
Anthinnae spp.			350	268-253		
158 *Anthias nicholsi* - NICHOLS BASSLET			354	154-291		
159 ***A. asperilinguis* (likely *A. woodsi*)**	**61**	**128-220**				
160 *Epinephelus nigritus* - WARSAW GROUPER			3	300-313		
161 *E. niveatus* - SNOWY GROUPER			5	178-268		
162 *H. vivanus* - RED BARBIER	43	148-229				
163 *Jeboehlkia gladifer* - GLADIATOR BASSLET			1	288		
164 *Pronotogrammus martinicensis* - ROUGHTONGUE BASS			236	175-252		
165 *Plectranthias garrupellus* - ORANGE BASSLET	3	207-220	1	188		
166 *Serranus atrobranchus*	17	71-227				
167 *S. notospilus* - SADDLE BASS	47	50-366				
Opisthognathidae						
168 *Lonchistium lemur*	4	210-284				
Priacanthidae - BIGEYES						
169 *Cookeolus japonicus* - BULLEYE			6	175-202		

	STEIGER DISSERTATION		**BROOKE.REED.MESSING 200**		**GILMORE 1997**	
TAXON	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**	**NO.**	**DEPTH (m)**
Epigonidae -						
170 Epigonus occidentalis	2	549-558				
171 Epigonus pandionis	2	751				
Epigonus sp.	7	320-550	543	252-789		
Carangidae - JACKS & POMPANOS						
173 Decapterus spp.			30	288		
174 S. rivoliana - C, S - LESSER AMBERJACK			102	178		
Bramidae - POMFRETS						
175 Brama brama - ATLANTIC POMFRET					10	462-769
Lutjanidae - SNAPPERS						
176 Apsilus dentatus - BLACK SNAPPER					10	462-769
177 Etelis oculatus - QUEEN SNAPPER					10	462-769
178 L. vivanus - SILK SNAPPER					10	333
179 Pristipomoides aquilonaris - C,S - WENCHMAN					10	462-769
180 P. macrophthalmus	17	366-421				
Bathyclupeidae - BATHYCLUPEIDS						
181 *Bathyclupea argentea* - BATHYCLUPEUS	11	110-137				
Zoarcidae -EELPOUTS						
182 *Melanostigma atlanticum* (=sp.) ATLANTIC SOFT POUT	6	302-692				
Chaetodontidae - BUTTERFLYFISHES						
183 *Chaetodon aya* - BANK BUTTERFLYFISH			2	180		

TAXON	STEIGER DISSERTATION NO.	STEIGER DISSERTATION DEPTH (m)	BROOKE.REED.MESSING 200 NO.	BROOKE.REED.MESSING 200 DEPTH (m)	GILMORE 1997 NO.	GILMORE 1997 DEPTH (m)
Pomacentridae - DAMSELFISHES						
184 *Chromis insolata* - SUNSHINEFISH			1	190		
Percophidae - DUCKBILLS						
185 B. gobioides - GOBY FLATHEAD	25	315-724				
186 Chriomystax squamentum	3	252-329				
Uranoscopidae - STARGAZERS						
187 Gnathagnus (= Arioscopus) egregius	2	384				
188 Kathetostoma cubana	10	183-540				
Callionymidae - DRAGONETS						
189 *Foetorepus (=Callionymus) agassizii* - SPOTFIN DRAGONET	52	106-549				
Gobiidae - GOBIES						
190 *Varicus bucca*	2	384				
Gempylidae - SNAKE MACKERELS						
191 *Nesiarchus nasutus* - BLACK GEMFISH	5	733-840				
192 *Neopinnula americana* - ATLANTIC SACKFISH			1	777		
Scombridae - MACKERELS-TUNAS						
193 *Scomber colias* - ATLANTIC CHUB MACKEREL			3000	326-332		
Xiphiidae - SWORDFISH						
194 *Xiphias gladius* - SWORDFISH			2	801		
Ariommatidae - ARIOMMATIDS						
195 H. perciformis - BARRELFISH			61	286-777		
O. PLEURONECTIFORMES						
Bothidae - LEFTEYE FLOUNDERS						
196 Monolene antillarum - SLIM FLOUNDER	47	192-549				
197 M. sessilicauda - DEEPWATER FLOUNDER	6	256-347				
198 Trichopsetta ventralis - SASH FLOUNDER	4	71-274				
Paralichthyidae - SAND FLOUNDERS						
200 *Anclopsetta antillarum*	19	229-457				
201 *A. dilecta* - THREE-EYE FLOUNDER	6	91-320				
202 *Citharichthys arctifrons* - GULF STREAM FLOUNDER	492	83-503				
203 *C. cornutus* - HORNED WHIFF	143					
204 *C. dinoceros* - SPOINED WHIFF	40	65-392				
205 ***Hippoglossina oblonga***	**9**	**119-403**				
Poecilopsettidae - BIGEYE FLOUNDERS						
206 *Poecilopsetta beani* - DEEPWATER DAB	14	183-226				
207 ***Poecilopsetta albomarginata***	**3**	**380-549**				
Achiridae - AMERICAN SOLES						

208	*Trinectes inscriptus* - SCRAWLED FLOUNDER	14	183-226		
Cynoglossidae - TONGUEFISHES					
209	*S. marginatus* - MARGINED TONGUEFISH	2	191-658		
210	*S. piger* - DEEPWATER TONGUEFISH	13	225-380		
211	*S. plagiusa* - BLACKCHEEK TONGUEFISH	1	132		
212	***S. pterospilotus***	**2**	**98-274**		
213	*S. pusillus* - NORTHERN TONGUEFISH	7	141-258		
214	*S. urospilus* - SPOTTAIL TONGUEFISH	1	324		
O. TETRAODONTIFORMES					
Triacanthodidae - SPIKEFISHES					
215	*Hollardia meadi* - SPOTTED SPIKEFISH	5	150-375		
Molidae - MOLAS					
216	*Mola mola* - OCEANFISH SUNFISH			1	401
.	**216 SPECIES**				

TABLE 2. SUBMERSIBLE FISHES OBSERVED FLORIDA STRAITS NOVEMBER 2005

NUMBER OF INDIVIDUALS FOLLOWED BY DEPTH IN FEET IN PARENTHESIS

TAXON	**4909**	**4910**	**4911**	**4912**	**4913**	**4914**	**4915**	**4916**	**4917**	**4918**	**4919**	**4920**	**4921**	**4922**
O. CHIMAERIFORMES														
Chimaeridae														
Hydrolagus sp A		2(2377-2478)												
Hydrolagus sp B			1 (2715)											
O. SQUALIFORMES														
Squalidae - DOGFISH SHARKS														
Squalus cubensis - CUBAN DOGFISH						1(1348)			1(859)					
Dalatidae														
Dalatias licha - KITEFIN SHARK										1(2821)				
O. LAMNIFORMES														
Odontaspididae - SAND TIGERS														
Odontaspis ferox - RAGGED TOOTH SHARK											2(930)			
O. CARCHARINIFORMES														
Scyliorhinidae - CAT SHARKS														
Galeus arae - MARBLED CAT SHARK	1				28(1500-1508)									
Triakidae - Houndsharks														
Mustelus spp.														1(1222)
O. RAJIFORMES														
Torpedinidae - ELECTRIC RAYS														
Benthobatis marcida	1(2465)													
Rajidae - SKATES														
Breviraja claramaculata - LIGHTSPOTTED SHORT SKATE					1(1508)									
Fenestraja (=Breviraja) plutonia (possib	3 (2465-2483)	1(2493)												

TAXON	**4909**	**4910**	**4911**	**4912**	**4913**	**4914**	**4915**	**4916**	**4917**	**4918**	**4919**	**4920**	**4921**	**4922**
OSTEICHTHYS														
Synaphobranchidae - CUTTHROAT EELS														
Atractodenchelys phrix	1(2395)	5(2431-2500)	7(2440-2714)	10(2458-2829)			4(2549-2563)	1(2400)						
Congridae - CONGER EELS	1(2390)													
Unidentified congrid											2(947-948)			1(1511
O. STOMIIFORMES														
Gonostomatidae - BRISTLEMOUTHS														
Unidentified gonostomatid					100(1500)									
Sternoptychidae - MARINE HATCHETFISHES														
Sternoptyx diaphana					30(1500)		1(2502)							
Sternoptyx spp.														
O. AULOPIFORMES														
Chlorophthalmidae - GREENEYES														
Unidentified chlorophthamid		1(2505)												16(1079-1210)
Ipnopidae - DEEPSEA TRIPOD FISHES														
Bathyphlops (marionae or sewelli)										1(2047)				
O. POLYMIXIIFORMES														
Polymixiidae - BEARDFISHES														
Polymixia lowei - BEARDFISH											38(1178-1232)	2(1081-1121)		3(1080-1082)

TAXON	4909	4910	4911	4912	4913	4914	4915	4916	4917	4918	4919	4920	4921	4922
O. GADIFORMES														
Macrouridae - GRENADIERS														
Macrourid spp. Cannot be identified	10(2381-2480)											1(1059)		
Macrourid type A		17(2380-2518)								1(2455)				
Macrourid Type B														
Blue macrourid Type C										1(2771)				
Coryphaenoides sp.					? 1(1316-1509) note.4									
Hymenocephalus cavernosus					note.4									
Nezumia hildebrandi					note.4									
Moridae - CODLINGS														
Laemonema barbatulum - SHORTBEARD CODLING					1(1500)				21(804-884)		39(930-1189)	13(1059-1244)		17(1180-1741)
Laemonema melanurum - CODLING	1(2381)			1(2455)	4(1500-1522)						11(930-1232)	8(1059-1190)		8(1080-1741)
Phycidae - PHYCID HAKES														
Unidentified Phycid										1(2506)		2(1061-1077)		
O. OPHIDIIFORMES														
Bythitidae - VIVIPAROUS BROTULAS														
Unidentified bythitid											1(949)			
O. LOPHIIFORMES														
Chaunacidae - CHAUNACIDS														
Chaunax stigmaeus - REDEYE GAPER														
Chaunax sp.											1(937)			
Chaunax pictus													2(833-975)	

TAXON		4909	4910	4911	4912	4913	4914	4915	4916	4917	4918	4919	4920	4921	4922
O. BERYCIFORMES															
Trachichthyidae - ROUGHIES															
Gephyroberyx darwini - BIG ROUGHY												?			
Hoplostethus mediterraneus - SILVER ROUGHY						2(1383), 1(1378), 1(1374)						2(1190-1227)			10(1237-1750)
Berycidae - ALFONSINOS															
Beryx decadactylus - RED BREAM												8(947-953)			
O. ZEIFORMES															
Zeidae- DORIES															
Cyttopsis roseus - RED DORY												2(1074-1136)			
Caproidae - BOARFISHES															
Antigonia capros														55(570-586)	

TAXON		4909	4910	4911	4912	4913	4914	4915	4916	4917	4918	4919	4920	4921	4922
O. SCORPAENIFORMES															
Scorpaenidae - SCORPIONFISHES		1 (2420)													
Unidentified scorpaenids										131(802-821), possibly P.rathbuni		3(1133-1232)	1(1245)		
Scorpaenid type A												2(930)			4(1080-1745)
Scorpaenid type B													1(1083)		
Scorpaenid type D													2(1166-1172)		
Scorpaenid type Z												1(1077see drawing)			
Scorpaenid type X															1(1093)
Scorpaenid type Y															1(1717)
Scorpaenid type T															1(1545)
P. rathbuni - HIGHFIN SCORPIONFISH						5(1300-1528)	5(1320-1511)								

TAXON		4909	4910	4911	4912	4913	4914	4915	4916	4917	4918	4919	4920	4921	4922
O. PERCIFORMES															
Acropomatidae - LANTERNBELLIES															
Verilus sordidus - PARGO CHINO							1(1487)								
Polyprionidae - WRECKFISHES															
Polyprion americanus - WRECKFISH												53(930-1133)			
Serranidae - SEA BASSES & GROUPERS															
Anthianae spp.(?)										349(802-821)				1(771)	
Anthias nicholsi - NICHOLS BASSLET										351(817-821)		2(930-944)		1(500)	
Pronotagrammus martinicensis - ROUGHTONGUE BASS										10(819)				226(570-728)	
E. nigritus - C,S - WARSAW GROUPER														3(975-1016)	
E. niveatus - C,S - SNOWY GROUPER														5(578-832)	
Joebohlkia gladifer - SWORD CLOWN												1(935)			
Plectranthias garrupellus - ORANGE BASSLET														1(610)	
Priacanthidae - BIGEYES															
Cookeolus japonicus - BULLEYE														6(570-	
Epigonidae -															
Unidentifiable Epigonus sp.								10(2495-	1(2400	113(8		205(930-	7(1058-		207(1163-
Carangidae - JACKS & POMPANOS															
Alectis ciliaris - S - AFRICAN POMPANO															
Decapterus spp.												30(936)			
S. rivoliana - C, S - LESSER AMBERJACK														102(577-578)	
Chaetodontidae - BUTTERFLYFISHES															
Chaetodon aya - BANK BUTTERFLYFISH														2(586)	
Pomacentridae															
Chromis insolata														1(617)	

TAXON	4909	4910	4911	4912	4913	4914	4915	4916	4917	4918	4919	4920	4921	4922
Gempylidae - SNAKE MACKERELS														
Neoepinnula americana - AMERICAN SACKFISH							?1(2526)							
Scombridae - MACKERELS														
Scomber japonicus - CHUB MACKEREL												2700(1060-1080)		
Xiphiidae - SWORDFISH														
Xiphias gladius - SWORDFISH			1(2602)											1(?)
Ariommatidae - ARIOMMATIDS														
Hyperglyphe bythites - BLACK DRIFTFISH							?1(2526) see above							
H. perciformis - BARRELFISH											60(930-952)			
O. TETRAODONTIFORMES														
Molidae - MOLAS														
Mola mola - OCEANFISH SUNFISH					1(1304)									

TABLE 3. NOVEMBER 2005 LOPHELIA FISH RANKED BY % OCCURRENCE

TAXON	OCC. %	INDIV. NO.	OCC. RAW	FISHERY SPECIES
Scorpaenidae - SCORPIONFISHES	50.00	159	7	
Atractodenchelys phrix - BLACKFIN CUTTHROAT EEL	42.86	28	6	
Laemonema melanurum - CODLING	42.86	33	6	
Unidentifiable Epigonus sp.- DEEPWATER CARDINALFISHES	42.86	543	6	
Laemonema barbatulum - SHORTBEARD CODLING	35.71	91	5	
Macrourid spp. - RATTAILS	35.71	31	5	F
Polymixia lowei - BEARDFISH	21.43	43	3	F
Hoplostethus mediterraneus - SILVER ROUGHY	21.43	16	3	F
Anthias nicholsi - NICHOLS BASSLET	21.43	354	3	
Squalus cubensis - CUBAN DOGFISH	14.29	2	2	F
Galeus arae - MARBLED CAT SHARK	14.29	29	2	
Unidentified congrid - CONGER EELS	14.29	3	2	F
Sternoptyx spp. - HATCHETFISHES	14.29	31	2	
Unidentified chlorophthamid - GREENEYES	14.29	17	2	
Unidentified Phycid - PHYSCID HAKES	14.29	3	2	F
P. rathbuni - HIGHFIN SCORPIONFISH	14.29	10	2	
Anthianae spp.(?) - BASSLETS	14.29	350	2	
Pronotagrammus martinicensis - ROUGHTONGUE BASS	14.29	236	2	
Xiphias gladius - SWORDFISH	14.29	2	2	F
Hyperglyphe bythites - BLACK DRIFTFISH	14.29	61	2	
Hydrolagus spp - CHIMAERAS	14.29	3	2	
Dalatias licha - KITEFIN SHARK	7.14	1	1	
Odontaspis ferox - RAGGED TOOTH SHARK	7.14	2	1	
Mustelus spp. - DOGFISH SHARK	7.14	1	1	F
Benthobatis marcida	7.14	1	1	F
Breviraja claramaculata - LIGHTSPOTTED SHORT SKATE	7.14	1	1	F
Unidentified gonostomatid - BRISTLEM0UTHS	7.14	100	1	
Bathyphlops (marionae or sewelli)	7.14	1	1	F
Unidentified ophidiid - CUSKEELS	7.14	1	1	
Unidentified bythitid - BYTHITIDS	7.14	1	1	
Chaunax sp. - GAPERS	7.14	1	1	
Chaunax pictus - REDEYE GAPER	7.14	2	1	
Beryx decadactylus - RED BREAM	7.14	8	1	F
Cyttopsis roseus - RED DORY	7.14	2	1	
Antigonia capros - BOARFISH	7.14	55	1	F
Verilus sordidus - PARGO CHINO	7.14	1	1	
Polyprion americanus - WRECKFISH	7.14	53	1	F

TAXON	%	NO.	RAW	
E. nigritus - C,S - WARSAW GROUPER	7.14	3	1	F
E. niveatus - C,S - SNOWY GROUPER	7.14	5	1	F
Joebohlkia gladifer - CLOWN BASSLET	7.14	1	1	
Plectranthias garrupellus - ORANGE BASSLET	7.14	1	1	
Cookeolus japonicus - BULLEYE	7.14	6	1	F
Decapterus spp. - MACEKEREL SCADS	7.14	30	1	F
S. rivoliana - C, S - LESSER AMBERJACK	7.14	102	1	F
Chaetodon aya - BANK BUTTERFLYFISH	7.14	2	1	
Chromis insolata -	7.14	1	1	
Neoepinnula americana - AMERICAN SACKFISH	7.14	1	1	
Scomber japonicus - CHUB MACKEREL	7.14	2700	1	F
Mola mola - OCEANFISH SUNFISH	7.14	1	1	

TABLE 4. JSL LOPHELIA FISHES, NOVEMBER 2005 RANKED BY NUMBER INDIVIDUALS

	TAXON	% OCC.	NO. INDIV.	RAW OCC.
1	Scomber japonicus - CHUB MACKEREL	7.14	2700	1
2	Unidentifiable Epigonus sp.	42.86	543	6
3	Anthias nicholsi - NICHOLS BASSLET	21.43	354	3
4	Anthianae spp.(?)	14.29	350	2
5	Pronotagrammus martinicensis - ROUGHTONGUE BASS	14.29	236	2
6	Scorpaenidae - SCORPIONFISHES	50.00	159	7
7	Unidentified scorpaenids	28.57	149	5
8	S. rivoliana - C, S - LESSER AMBERJACK	7.14	102	1
9	Unidentified gonostomatid	7.14	100	1
10	Laemonema barbatulum - SHORTBEARD CODLING	35.71	91	5
11	Hyperglyphe bythites - BLACK DRIFTFISH	14.29	61	2
12	Antigonia capros	7.14	55	1
13	Polyprion americanus - WRECKFISH	7.14	53	1
14	*Polymixia lowei* - BEARDFISH	21.43	43	3
15	Laemonema melanurum - CODLING	42.86	33	6
16	Macrourid spp.	35.71	31	5
17	Sternoptyx spp.	14.29	31	2
18	Decapterus spp.	7.14	30	1
19	Galeus arae - MARBLED CAT SHARK	14.29	29	2
20	Atractodenchelys phrix	42.86	28	6
21	Unidentified chlorophthamid	14.29	17	2
22	Hoplostethus mediterraneus - SILVER ROUGHY	21.43	16	3
23	P. rathbuni - HIGHFIN SCORPIONFISH	14.29	10	2
24	Beryx decadactylus - RED BREAM	7.14	8	1
25	Cookeolus japonicus - BULLEYE	7.14	6	1
26	E. niveatus - C,S - SNOWY GROUPER	7.14	5	1
27	Unidentified congrid	14.29	3	2
28	Unidentified Phycid	14.29	3	2
29	E. nigritus - C,S - WARSAW GROUPER	7.14	3	1
30	*Hydrolagus spp.* CHIMAERAS	7.14	3	1
31	*Squalus cubensis* - CUBAN DOGFISH	14.29	2	2
32	Xiphias gladius - SWORDFISH	14.29	2	2
33	Odontaspis ferox - RAGGED TOOTH SHARK	7.14	2	1
34	Chaunax pictus	7.14	2	1
35	Cyttopsis roseus - RED DORY	7.14	2	1
36	Chaetodon aya - BANK BUTTERFLYFISH	7.14	2	1
37	*Dalatias licha* - KITEFIN SHARK	7.14	1	1
38	Mustelus spp. - DOGFISH	7.14	1	1

TABLE 4. JSL LOPHELIA FISHES, NOVEMBER 2005 RANKED BY NUMBER INDIVIDUALS

	TAXON	% OCC.	NO. INDIV.	RAW OCC.
39	Benthobatis marcida	7.14	1	1
40	*Breviraja claramaculata* - LIGHTSPOTTED SHORT SKATE	7.14	1	1
41	*Bathyphlops* (marionae or sewelli)	7.14	1	1
42	Unidentified ophidiid	7.14	1	1
43	Unidentified bythitid - LIVERBEARING BROTULAS	7.14	1	1
44	Chaunax sp.- GAPERS	7.14	1	1
45	*Verilus sordidus* - PARGO CHINO	7.14	1	1
46	Joebohlkia gladifer - SWORD CLOWN	7.14	1	1
47	Plectranthias garrupellus - ORANGE BASSLET	7.14	1	1
48	Chromis insolata	7.14	1	1
49	Neoepinnula americana - AMERICAN SACKFISH	7.14	1	1
50	Mola mola - OCEANFISH SUNFISH	7.14	1	1

TABLE 5. DEPTH DISTRIBUTION: JSL FISH OBSERVATIONS NOVEMBER 2005

DEPTH 2000 TO 3000 FT														
TAXON / Dive number	**4909**	**4910**	**4911**	**4912**	**4913**	**4914**	**4915**	**4916**	**4917**	**4918**	**4919**	**4920**	**4921**	**4922**
O. CHIMAERIFORMES														
Chimaeridae														
Hydrolagus sp A		2(2377-2478)												
Hydrolagus sp B			1 (2715)											
O. SQUALIFORMES														
Dalatidae														
Dalatias licha - KITEFIN SHARK										1(2821)				
O. ANGUILLIFORMES														
Synaphobranchidae - CUTTHROAT EELS														
Atractodenchelys phrix	1(2395)	5(2431-2500)	7(2440-2714)	10(2458-2829)			4(2549-2563)	1(2400)						
Congridae - CONGER EELS	1(2390)													
O. RAJIFORMES														
Torpedinidae - ELECTRIC RAYS														
Benthobatis marcida	1(2465)													
Rajidae - SKATES														
Fenestraja (= Breviraja) cubensis	?	?												
Fenestraja (=Breviraja) plutonia (possibly F. cubensis)	3 (2465-2483)	1(2493)												
O. AULOPIFORMES														
Chlorophthalmidae - GREENEYES														
Unidentified chlorophthamid		1(2505)												
Ipnopidae - DEEPSEA TRIPOD FISHES														
Bathyphlops (marionae or sewelli)										1(2047)				

DEPTH 2000 TO 3000 FT														
TAXON	**4909**	**4910**	**4911**	**4912**	**4913**	**4914**	**4915**	**4916**	**4917**	**4918**	**4919**	**4920**	**4921**	**4922**
O. GADIFORMES														
Macrouridae - GRENADIERS														
Unidentified Macrourids	10(2381-2480)	17(2380-2518)								2(2455-2771)				
Phycidae - PHYCID HAKES														
Unidentified Phycid										1(2506)				
O. OPHIDIIFORMES														
Ophidiidae - CUSK-EELS														
Unidentified ophidiid							1(2544)							
O. PERCIFORMES														
Epigonidae -														
Unidentifiable Epigonus sp.							10(2495-2565)	1(2400)						
Gempylidae - SNAKE MACKERELS														
Neoepinnula americana - AMERICAN SACKFISH							1(2526)							
Xiphiidae - SWORDFISH														
Xiphias gladius - SWORDFISH			1(2602)											1(?)
Ariommatidae - ARIOMMATIDS														
H. perciformis - BARRELFISH							1(2526)				60(930-952)			

DEPTH 1000 TO 2000 FT														
TAXON	**4909**	**4910**	**4911**	**4912**	**4913**	**4914**	**4915**	**4916**	**4917**	**4918**	**4919**	**4920**	**4921**	**4922**
O. SQUALIFORMES														
Squalidae - DOGFISH SHARKS														
Squalus cubensis - CUBAN DOGFISH						1(1348)			1(859)					
O. CARCHARINIFORMES														
Scyliorhinidae - CAT SHARKS														
Galeus arae - MARBLED CAT SHARK	1				28(1500-1508)									
Triakidae - Houndsharks														
Mustelus spp.														1(1222)
O. RAJIFORMES														
Rajidae - SKATES														
Breviraja claramaculata - LIGHTSPOTTED SHORT SKATE					1(1508)									
O. AULOPIFORMES														
Chlorophthalmidae - GREENEYES														
Unidentified chlorophthamid														16(1079-1210)
O. STOMIIFORMES														
Gonostomatidae - BRISTLEMOUTHS														
Unidentified gonostomatid					100(1500)									
Sternoptychidae - MARINE HATCHETFISHES														
Sternoptyx diaphana					30(1500)		1(2502)							
Sternoptyx spp.														
O. POLYMIXIIFORMES														
Polymixiidae - BEARDFISHES														
Polymixia lowei - BEARDFISH											38(1178-1232)	2(1081-1121)		3(1080-1082)

DEPTH 1000 TO 2000 FT														
TAXON	**4909**	**4910**	**4911**	**4912**	**4913**	**4914**	**4915**	**4916**	**4917**	**4918**	**4919**	**4920**	**4921**	**4922**
O. GADIFORMES														
Macrouridae - GRENADIERS														
Unidentified Macrourids												1(1059)		
Coryphaenoides sp., Hymenocephalus sp., Nezumia sp.					1(1316-1509)									
Moridae - CODLINGS														
Laemonema barbatulum - SHORTBEARD CODLING					1(1500)				21(804-884)		39(930-1189)	13(1059-1244)		17(1180-1741)
Laemonema melanurum - CODLING	1(2381)			1(2455)	4(1500-1522)						11(930-1232)	8(1059-1190)		8(1080-1741)
Phycidae - PHYCID HAKES														
Unidentified Phycid												2(1061-1077)		
O. BERYCIFORMES														
Trachichthyidae - ROUGHIES														
Hoplostethus mediterraneus - SILVER ROUGHY					2(1383), 1(1378), 1(1374)						2(1190-1227)			10(1237-1750)
O. ZEIFORMES														
Zeidae- DORIES														
Cyttopsis roseus - RED DORY											2(1074-1136)			

DEPTH 1000 TO 2000 FT														
TAXON	**4909**	**4910**	**4911**	**4912**	**4913**	**4914**	**4915**	**4916**	**4917**	**4918**	**4919**	**4920**	**4921**	**4922**
O. SCORPAENIFORMES														
Scorpaenidae - SCORPIONFISHES	1 (2420)													
Unidentified scorpaenids, Helicoleus, Neomerinthe, Pontinus, Scorpaena, Scorpeanodes, Setarches, Trachyscorpia.									131(802-821), possibly P.rathbuni		3(1133-1232)	1(1245)		
Scorpaenid type A											2(930)			4(1080-1745)
Scorpaenid type B												1(1083)		
Scorpaenid type D												2(1166-1172)		
Scorpaenid type Z											1(1077)			
Scorpaenid type X														1(1093)
Scorpaenid type Y														1(1717)
Scorpaenid type T														1(1545)
P. rathbuni - HIGHFIN SCORPIONFISH					5(1300-1528)	5(1320-1511)								
O. PERCIFORMES														
Acropomatidae - LANTERNBELLIES														
Verilus sordidus - PARGO CHINO						1(1487)								
Polyprionidae - WRECKFISHES														
Polyprion americanus - WRECKFISH											53(930-1133)			
Epigonidae -														
Unidentifiable Epigonus sp.												7(1058-1125)		207(1163-1750)
Scombridae - MACKERELS														
Scomber japonicus - CHUB MACKEREL												2700(1060-1080)		
O. TETRAODONTIFORMES														
Molidae - MOLAS														
Mola mola - OCEANFISH SUNFISH					1(1304)									

DEPTH 500 TO 1000 FT														
TAXON	**4909**	**4910**	**4911**	**4912**	**4913**	**4914**	**4915**	**4916**	**4917**	**4918**	**4919**	**4920**	**4921**	**4922**
O. LAMNIFORMES														
Odontaspididae - SAND TIGERS														
Odontaspis ferox - RAGGED TOOTH SHARK											2(930)			
O. ANGUILLIFORMES														
Congridae - CONGER EELS														
Unidentified congrid											2(947-948)			1(1511
O. OPHIDIIFORMES														
Bythitidae - VIVIPAROUS BROTULAS														
Unidentified bythitid											1(949)			
O. LOPHIIFORMES														
Chaunacidae - CHAUNACIDS														
Chaunax sp.											1(937)			
Chaunax pictus													2(833-975)	
O. BERYCIFORMES														
Berycidae - ALFONSINOS														
Beryx decadactylus - RED BREAM											8(947-953)			
O. ZEIFORMES														
Caproidae - BOARFISHES														
Antigonia capros													55(570-586)	
O. PERCIFORMES														
Serranidae - SEA BASSES & GROUPERS														
Anthianae spp.(?)									349(802-821)				1(771)	
Anthias nicholsi - NICHOLS BASSLET									351(817-821)		2(930-944)		1(500)	
Pronotagrammus martinicensis - ROUGHTONGUE BASS									10(819)				226(570-728)	
E. nigritus - C,S - WARSAW GROUPER													3(975-1016)	
E. niveatus - C,S - SNOWY GROUPER													5(578-832)	
Joebohlkia gladifer - SWORD CLOWN											1(935)			
Plectranthias garrupellus - ORANGE BASSLET													1(610)	

DEPTH 500 TO 1000 FT														
TAXON	**4909**	**4910**	**4911**	**4912**	**4913**	**4914**	**4915**	**4916**	**4917**	**4918**	**4919**	**4920**	**4921**	**4922**
Priacanthidae - BIGEYES														
Cookeolus japonicus - BULLEYE													6(570-656)	
Epigonidae -														
Unidentifiable Epigonus sp.									113(819-884)		205(930-990)			
Carangidae - JACKS & POMPANOS														
Decapterus spp.											30(936)			
S. rivoliana - C, S - LESSER AMBERJACK													102(577-578)	
Chaetodontidae - BUTTERFLYFISHES														
Chaetodon aya - BANK BUTTERFLYFISH													2(586)	
Pomacentridae														
Chromis insolata													1(617)	
Ariommatidae - ARIOMMATIDS														
H. perciformis - BARRELFISH											60(930-952)			

Appendix VII: Chemical ecology of deep sea octocorals

During recent years the production of natural products by marine organisms has received increased attention as potential sources of medicinal drugs. In shallow water habitats gorgonian soft corals produce a rich array of secondary metabolites, particularly compounds with a terpene skeleton. These compounds are known to have a defensive function by deterring potential predators from eating these sessile animals (Pawlik et al., 1987, Puglisi et al., 2002). Gorgonians also contain calcium carbonate sclerites that may act as a structural defense (Van Alstyne and Paul, 1992, Van Alstyne et al., 1992). Since gorgonians contain both chemical and structural defenses they can be used to test the relative trade-offs of chemical versus structural defenses. Some studies have been done on shallow water gorgonians to determine the relative importance of chemical versus structural defenses, but little is known about deep sea gorgonians. Deep sea coral habitats remain poorly studied due to the expense and difficulty of accessing these communities; however, it is possible that these habitats are a source of biomedically important novel natural products (Reddy et al., 2005). In this study we collected multiple genera of deep sea gorgonians to determine whether they have variable concentrations of chemical and structural defenses. Indeed, as deep sea coral reefs become more exploited, basic research such as trends in chemical and structural defenses will be the foundation for future studies to understand deep sea community dynamics.

All gorgonians were collected using the Johnson-Sea-Link submersible in November 2005. When the specimens were returned to the boat the gorgonians were labeled and immediately frozen (-20°C). The frozen specimens were transferred to the Smithsonian Marine Station at Fort Pierce where they remained frozen until extraction. Just before extraction each individual gorgonian was thawed, and then cut into three regions. *Eunicella modesta* is a small white octocoral with a sea whip morphology. We separated *E. modesta* into three regions, the tips (the top 2 cm), the base (the bottom 4 cm) and the middles (everything in between the tips and bases). *Plumarella pourtalesii* is a small plumose octocoral, often too small to be separated into different regions, so the 5 largest individuals were cut into the tips (the top 4 cm), the base (the bottom 4 cm), and the middles (everything in between the tips and bases). *Paramuricea* spp. colonies are large colonies with a sea fan morphology. These colonies were cut into the tips (top 5 cm), the bases (bottom 10 cm), and the middles (everything in between the tips and bases).

For each individual region the volume and wet weight were measured. The samples were then refrozen and freeze dried. The freeze dried specimens were weighted for dry weight and then soaked in 1:1 ethyl acetate:methanol 3 times, each subsequent extraction was pooled together, dried under vacuum and weighted. Each individual region was then extracted with 1:1 ethanol:DI water 3 times, pooled together, and dried under vacuum and weighted. After extraction each specimen was soaked in 3% sodium hypochlorite (bleach) to remove the tissue. The sodium hyperchlorite was removed and replaced until all of the tissue from each specimen was dissolved. The resultant sclerites and gorgonin branches were rinsed with DI water and then dried in an oven at 54° C for 24 hours. Immediately after drying they were weighted. The dry weight of the gorgonin branches and the sclerites were subtracted from the total dry weight of the specimen to calculate the dry weight of the tissue.

Shallow water gorgonians typically contain a diverse array of mostly terpene natural products. These terpenes are most often found in the non-polar extract (in this study ethyl acetate:methanol). For our data analysis we compared the non-polar extracts from replicate regions within a species. The extract yield for each specimen was calculated as the dry weight of each extract per the total dry weight of the specimen. To determine if this was a function of the amount of tissue present in each specimen we also calculated the yield of extract per tissue dry weight. Within a species the extract yield for each region (tips, middles, and bases) was compared using a one-way ANOVA. If the data was not normally distributed, a log transformation was applied to the data. The post-hoc Tukey's (HSD) test was used to determine which groups were different from each other. If the data was not normally distributed after transformation it was analyzed with the non-parametric Kruskal-Walis test.

Eight individuals of *Eunicella modesta* were collected from 3 sites. There was no difference in the yield of the crude extract (per total dry weight and per tissue dry weight) between the three regions (Figure 1). There were significantly more sclerites in the tips when compared to the bases per total dry weight. When normalized by the amount of tissue there was no difference in sclerite concentration between the regions. Further work will be done to determine the chemical constituents of *E. modesta* crude extracts.

Eighteen individuals of the plumose octocoral *Plumarella pourtalesii* were collected from 2 sites. Only five of these colonies were large enough to compare regions. There is a significant trend for concentration of crude extracts (per total dry weight) in the tips of these gorgonians when compared to the bases (Figure 2). However, this trend is not significant when the crude extract concentration is calculated per tissue dry weight. The sclerites were always the most concentrated in the tips and middles compared to the bases, even when normalized by the amount of tissue. *P. pourtalesii* may invest more resources into the structural defense of sclerites than the other gorgonian genera in this study.

Eight colonies of *Paramuricea* spp. were collected from 5 sites. These eight colonies have tentatively been placed into three species groups. The taxonomy of the *Paramuricea* spp. is poorly described so for this study we split our samples into 3 unidentified species based on morphology; however, there are few replicates for each species so we also present the data for all 8 individuals combined. *Paramuricea* sp. 1 has greater concentrations of the crude extracts (per total dry weight) in the tips and the middles when compared to the bases (Figure 3). However when the data is converted to crude extract per tissue dry weight this trend is not significant. Neither *Paramuricea* sp. 2 nor *Paramuricea* sp. 3 had significantly different concentrations of crude extracts (per total dry weight or per tissue dry weight) in different regions but both of these species have low replication so statistical trends maybe limited by under sampling. For the genus, i.e. when all three species are pooled, there are significantly higher concentrations of crude extracts (for both per total dry weight and per tissue dry weight) in the tips and middles when compared to the bases. Similar trends were found for sclerite concentrations in this genus. The amount of sclerites per total dry weight were more concentrated in the tips when compared to the bases for each of the three *Paramuricea* species (Figure 4). However, similar to *E. modesta* this trend is no longer significant when the sclerite concentration is calculated as per tissue dry weight. Only *Paramuricea* sp. 1 had higher concentrations of sclerites per tissue in the tips and middles than the bases.

For all three of these genera there are higher concentrations of sclerites per total dry weight in the tips, and sometimes in the middles than in bases. Previous work showed that there was an inverse relationship between chemical defenses and sclerites, i.e. as the extract concentration increased the sclerite concentrations decreased (Harvel and Fenical, 1989). As a general trend in these deep sea gorgonians, there are higher concentrations of both the extracts and the sclerites in the tips, showing that these gorgonians are investing in both chemical and structural defenses. For both *Plumarella pourtalesii* and *Paramuricea* sp. 1 there are higher concentrations of crude extracts in the tips compared to the bases per total dry weight. This trend is not present if the extract concentrations are calculated as a function of tissue dry weight. The values for extract concentration per total dry weight are biased since they include both the gorgonin skeleton and the calcium carbonate sclerites, both of which do not contain extract.

While these trends in the allocation of resources to chemical vs. structural defense are an important step in understanding defensive adaptations in the deep sea, further work is necessary to determine the ecological roles of the crude extracts and the sclerites. While chemical defenses are well documented in shallow gorgonians no experiments have tested whether deep sea predators are deterred by natural products. Further analysis will be done on the extracts to isolate and structurally characterize novel secondary metabolites from these deep sea gorgonians. Future work will screen the extracts and isolated compounds for medical and biological activity. This work will result in a peer reviewed journal article on the natural products of these deep sea gorgonians.

Chemical ecology of Pleurotomariidae mucus

Snails in Pleurotomariidae have previously been observed to excrete large amounts of mucus when prodded, which is thought to be a defensive reaction. In order to better understand the ecological significance of this behavior we collected the mucus of 8 snails, froze them, and brought them back to the Smithsonian Marine Station for chemical analysis. The mucus from each individual snail was freeze-dried and then extracted with 1:1 ethyl acetate:methanol. Each extract was further separated using column chromatography and individual compounds were isolated using High Performance Liquid Chromatography (HPLC). We have examined the mucus from three species including *Perotrochus amabilis*, *Entermnotrochus adansonianus*, and *Bayerotrochus midas*. All three of these species contain structurally related compounds all of which contain aromatic rings. *P. amabilis* has at least 4 similar compounds one of which has been isolated, however more material is necessary to complete the structural characterization. *E. adansonianus* contained one major compound but more of this compound is necessary for structural characterization. *B. midas* contains two major compounds that are structurally similar, however these two compounds are difficult to separate, and further HPLC method development is necessary to isolate the compounds. Through further chemical isolation and structural characterization we will identify the compounds in the mucus of these slit shell snails. This work will culminate in a peer reviewed paper on the natural products found in *Perotrochus amabilis*, *Entermnotrochus adansonianus*, and *Bayerotrochus midas*. Further work will focus on the ecological role of these compounds for the slit shell snails.

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Figure 1

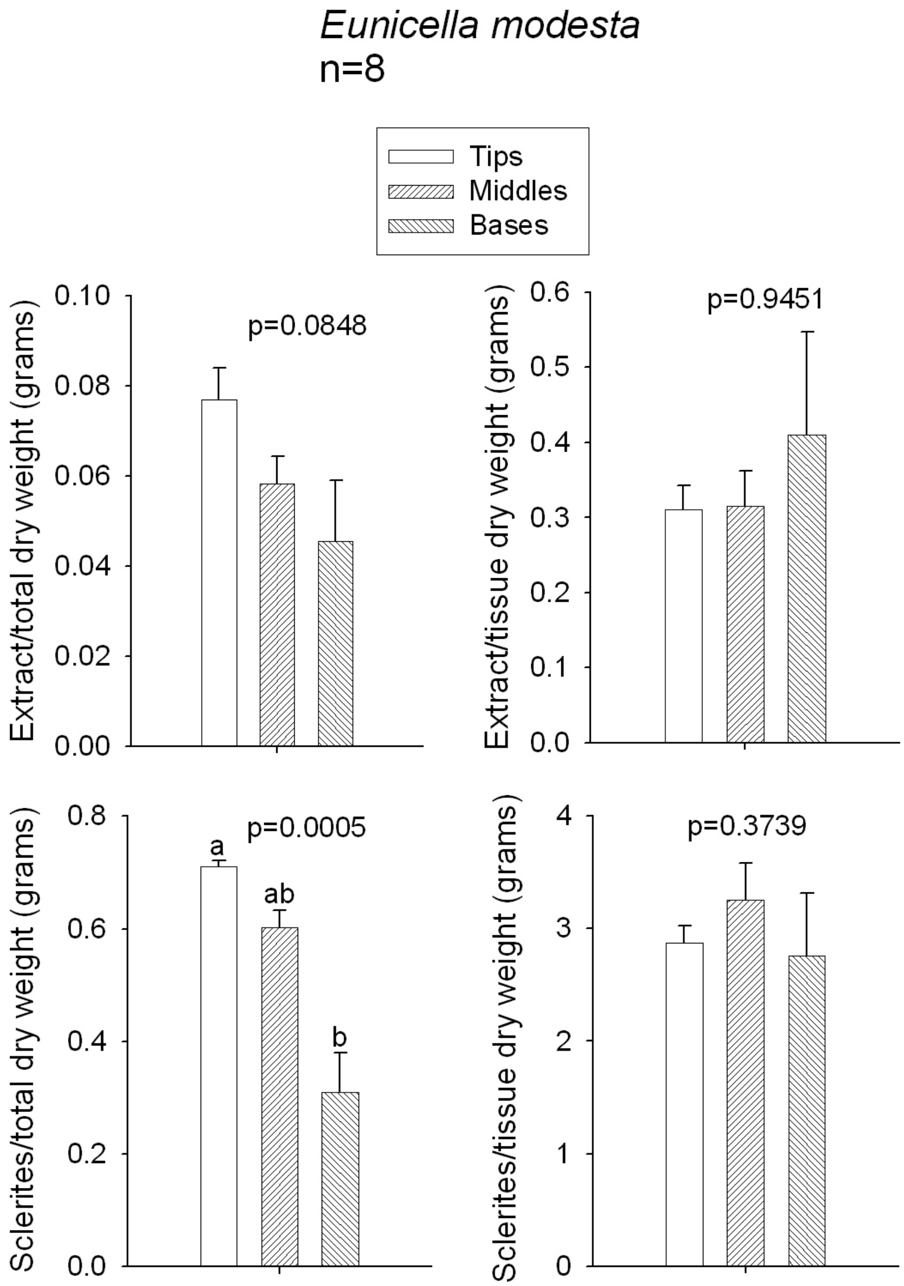

Eunicella modesta
n=8
Tips
Middles
Bases
p=0.0848
Extract/total dry weight (grams)
0.10
0.08
0.06
0.04
0.02
0.00
p=0.9451
Extract/tissue dry weight (grams)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
p=0.0005
a
ab
b
Sclerites/total dry weight (grams)
0.8
0.6
0.4
0.2
0.0
p=0.3739
Sclerites/tissue dry weight (grams)
4
3
2
1
0

Figure 2

Plumarella pourtalesii
n=5

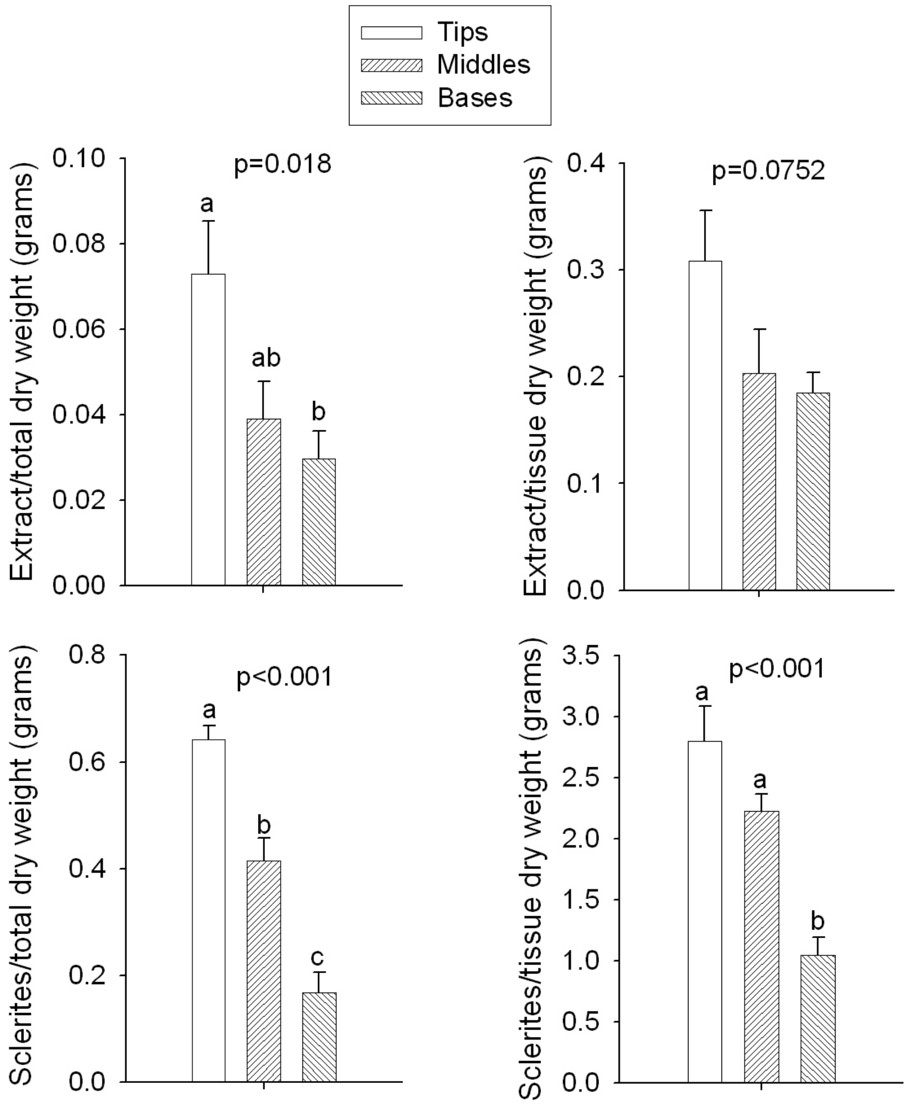
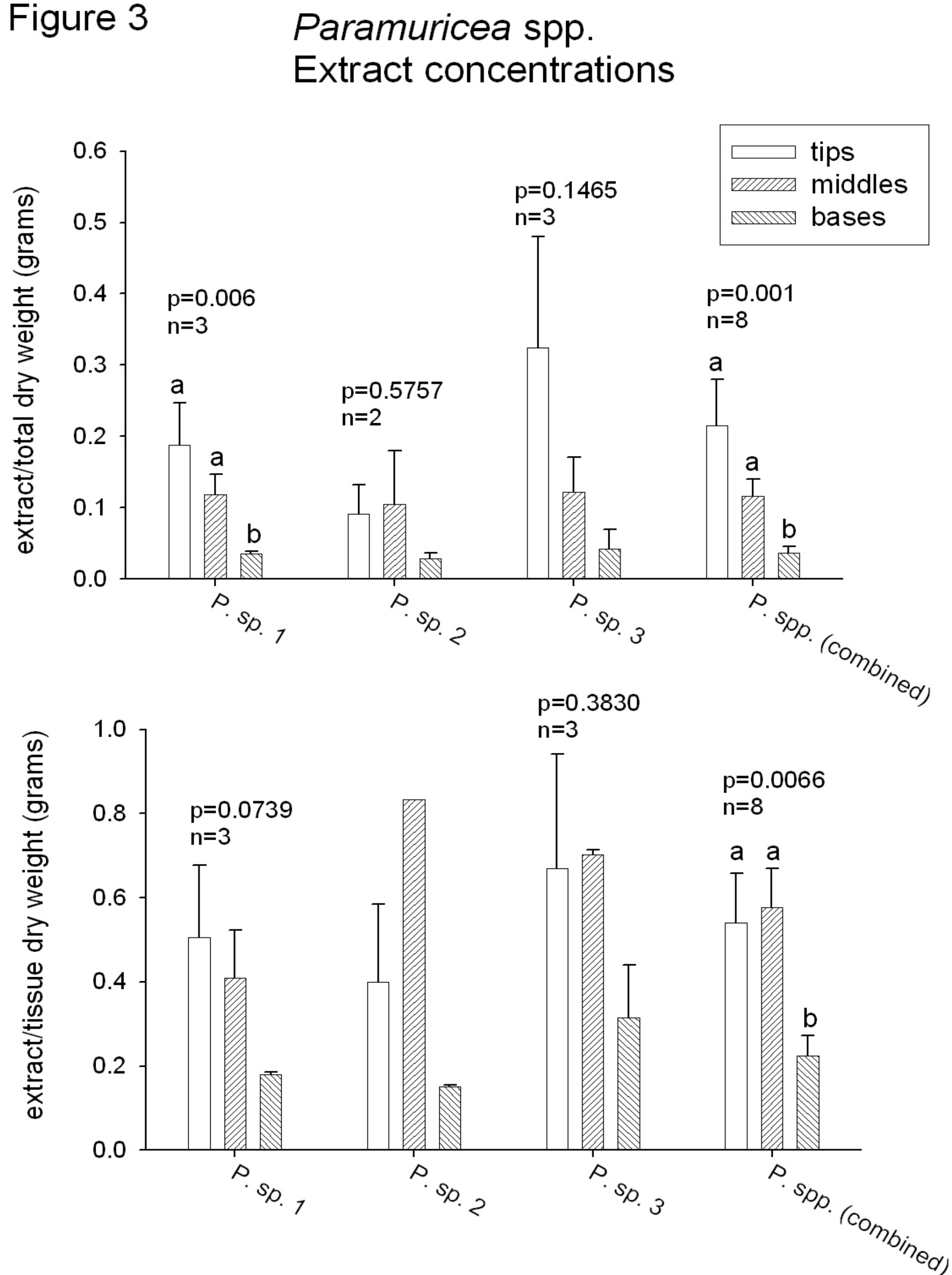
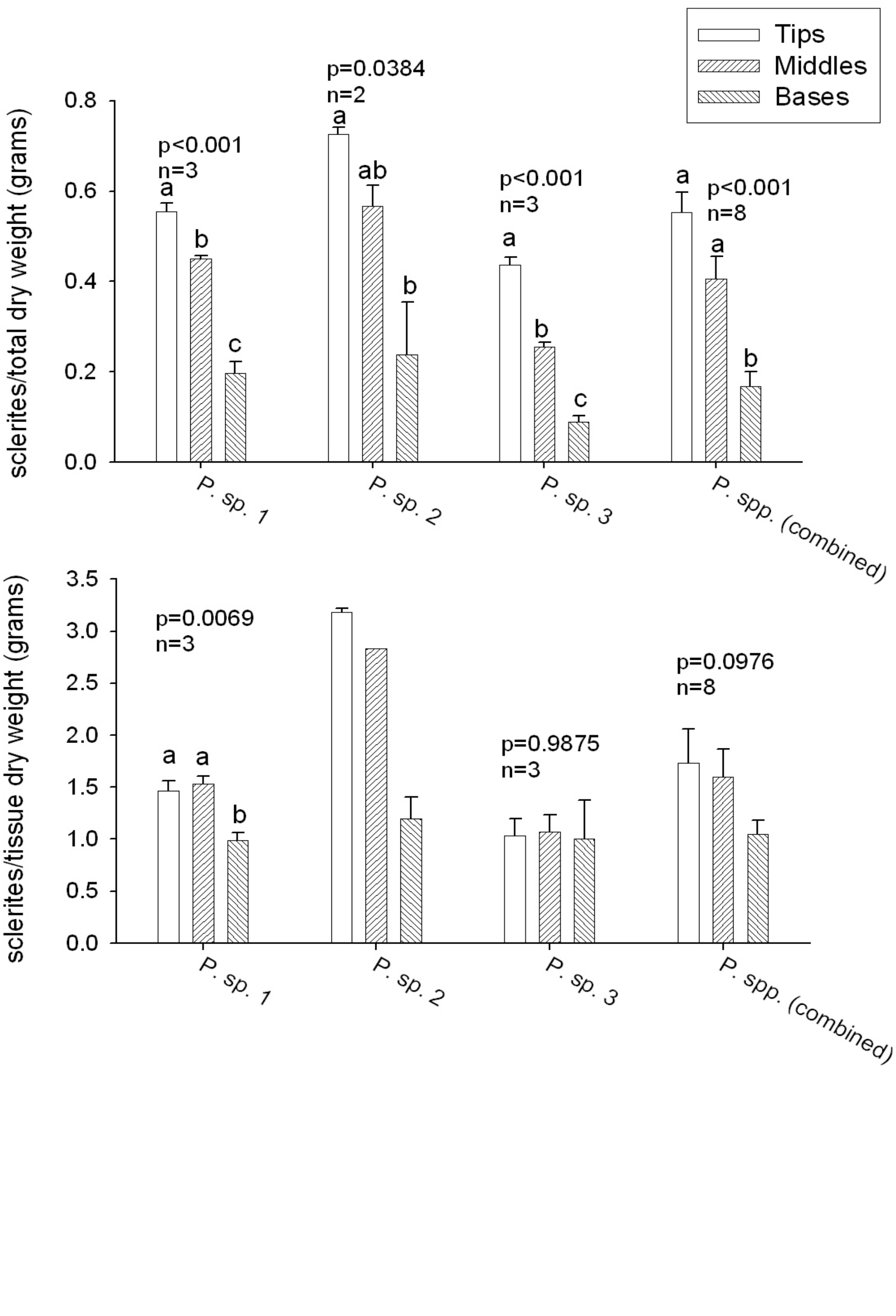


Figure 3



Paramuricea spp.
Extract concentrations
tips
middles
bases
extract/total dry weight (grams)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
p=0.006
n=3
a
a
b
p=0.5757
n=2
p=0.1465
n=3
p=0.001
n=8
a
a
b
P. sp. 1
P. sp. 2
P. sp. 3
P. spp. (combined)
extract/tissue dry weight (grams)
0.0
0.2
0.4
0.6
0.8
1.0
p=0.0739
n=3
p=0.3830
n=3
p=0.0066
n=8
a
a
b
P. sp. 1
P. sp. 2
P. sp. 3
P. spp. (combined)

Figure 4 *Paramuricea* spp.
Sclerite concentrations



Appendix VIII: Preliminary results of amino acid racemization techniques applied to *L. pertusa* skeleton from different parts of the coral mound

Four samples of *Lophelia pertusa* from dive JSL-I-4914 (below) were submitted for age analyses using amino acid racemization, with one fragment from the rubble sample also submitted for 14C dating. The raw results for racemization rates using reverse-phase chromatography for amino acid racemization and accelerator mass spec analyses for 14C are provided in Table 1

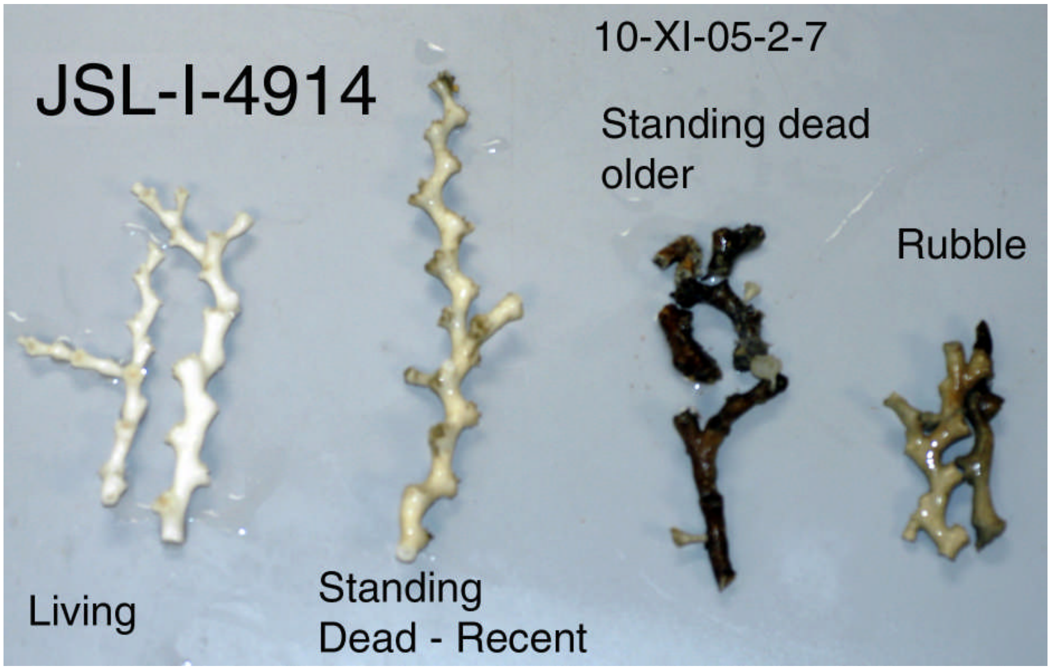


Table 1

Sample	description	Genus/sp.	(mg)	DL Asp	DL Glu	DL Ser
5415 A	living	*Lophelia pertusa*	33.1	0.034	0.065	0.030
5415 B	living	*Lophelia pertusa*	31.5	0.035	0.040	0.030
				0.035	**0.053**	**0.030**
				0.001	**0.018**	**0.000**
				2.0	**33.7**	**0.0**
5416 A	standing, dead, white	*Lophelia pertusa*	38.8	0.040	0.030	0.062
5416B	standing, dead, white	*Lophelia pertusa*	41.0	0.039	0.032	0.052
				0.040	**0.031**	**0.057**
				0.001	**0.001**	**0.007**
				1.8	**4.6**	**12.4**
5417 A	standing, dead, old	*Lophelia pertusa*	40.5	0.058	0.062	0.070
5417 B	standing, dead, old	*Lophelia pertusa*	34.4	0.054	0.065	0.052
				0.056	**0.064**	**0.061**

				0.003	**0.002**	**0.013**
				5.1	**3.3**	**20.9**
5418 A	rubble	*Lophelia pertusa*	39.6	0.197	0.114	0.115
5418 B	rubble	*Lophelia pertusa*	33.1	0.194	0.098	0.148
14C: 10,770 ± 115 yr BP (1σ)				**0.196**	**0.106**	**0.132**
				0.002	**0.011**	**0.023**
				1.1	**10.7**	**17.7**
5418 C	rubble	*Lophelia pertusa*	41.8	0.205	0.112	0.185
5418 D	rubble	*Lophelia pertusa*	38.6	0.220	0.115	0.170
This sample would be a bit older by a couple thousand years.				**0.213**	**0.114**	**0.178**
				0.011	**0.002**	**0.011**
That age would be calculated at ~12, 720 ± 200 yr BP by apparent parabolic kinetics.				**5.0**	**1.9**	**6.0**

The age of one of the pieces from the rubble sample, as determined by 14C analysis, was 10,770 ± 115 years.

Depending on the sophistication of the modeling techniques, the age of the living coral sample would range from 0 [set as a calibration] to 78 years old, the standing dead, recent sample is on the order of 330 to 400 years old, the dark, standing dead, older sample on the order of 1,100 years old, while two rubble fragments are 10,770 ± 115 years old [corrected 14C date] and 12,720 ± 200 years old. All but the 10,770 year old date are based on D/L ASP data.

The data from this pilot study indicate that the techniques of amino acid racemization calibrated by 14C analyses work well with *Lophelia pertusa* and should be quiet capable of addressing a variety of questions, ranging from the age structure of individual coral branches, as in the above mentioned papers, to mapping the age distribution of corals and coral rubble throughout the entire reef, depending on sampling design. The most urgent consideration is to obtain cores or samples from deep within the reef.