FINAL CRUISE REPORT

FLORIDA'S DEEP-WATER OASES: EXPLORATION OF A DEEP REEF ECOSYSTEM

May 31- June 9, 2006

Research Vessel SEWARD JOHNSON
JOHNSON-SEA-LINK II Research Submersible

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July 14, 2006

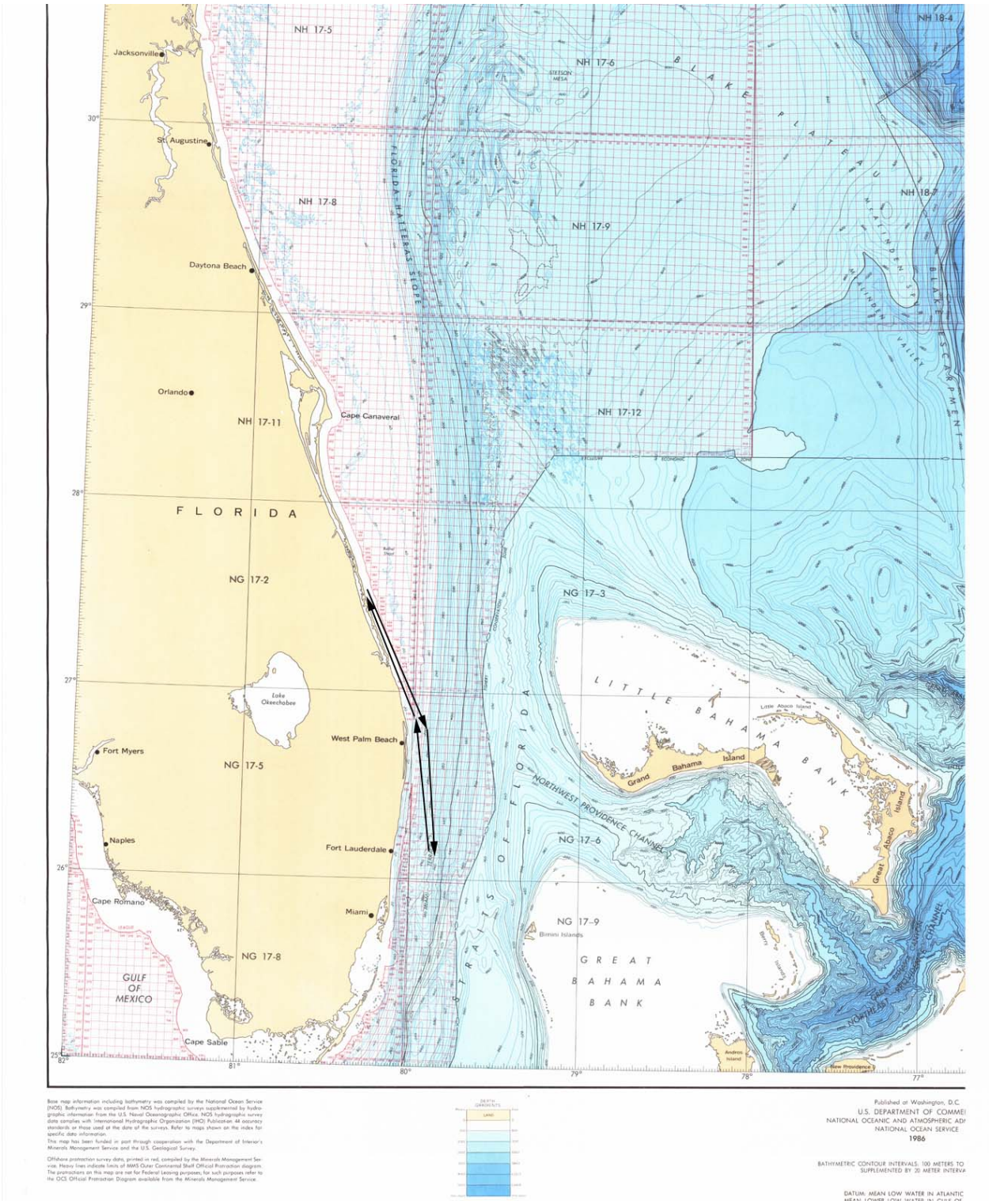

Figure 1. Cruise track of Harbor Branch Oceanographic Institution's vessel R/V *Seward Johnson*, May 31-June 9, 2006 for deep-water reef survey.

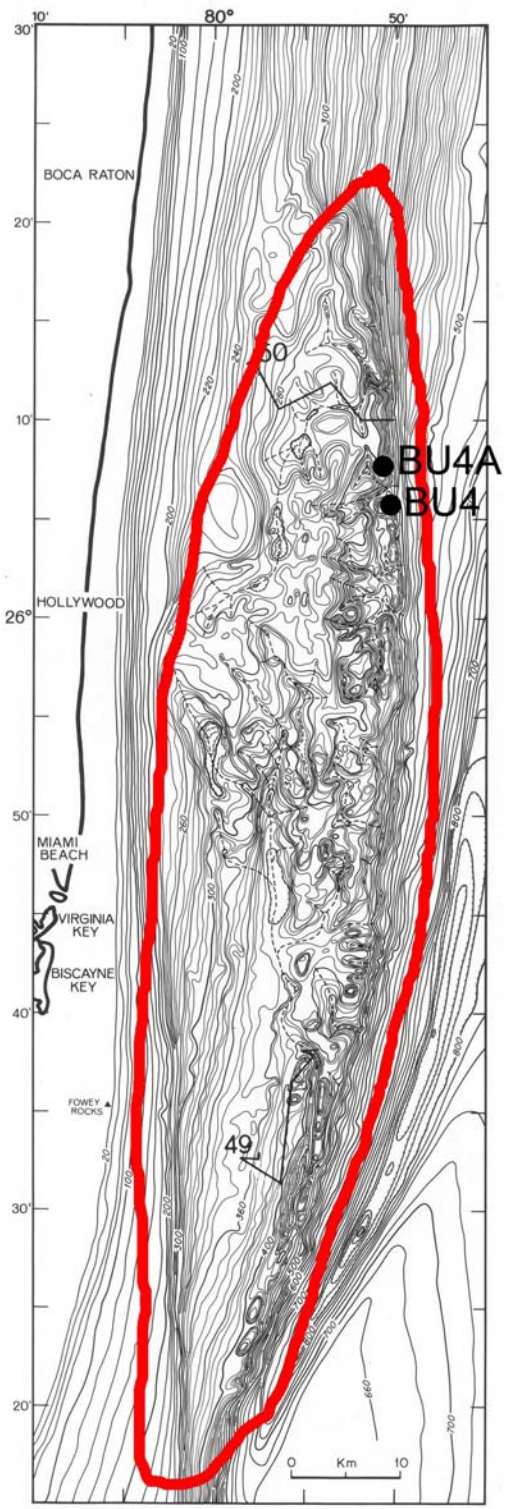

Figure 2. Miami Terrace (outlined in red) in the Straits of Florida with *Johnson-Sea-Link* dives sites (dots) indicated for the deep-water reef survey, May 31-June 9, 2006 (chart from Ballard and Uchupi, 1971; MTS Journal 5: 43-48).

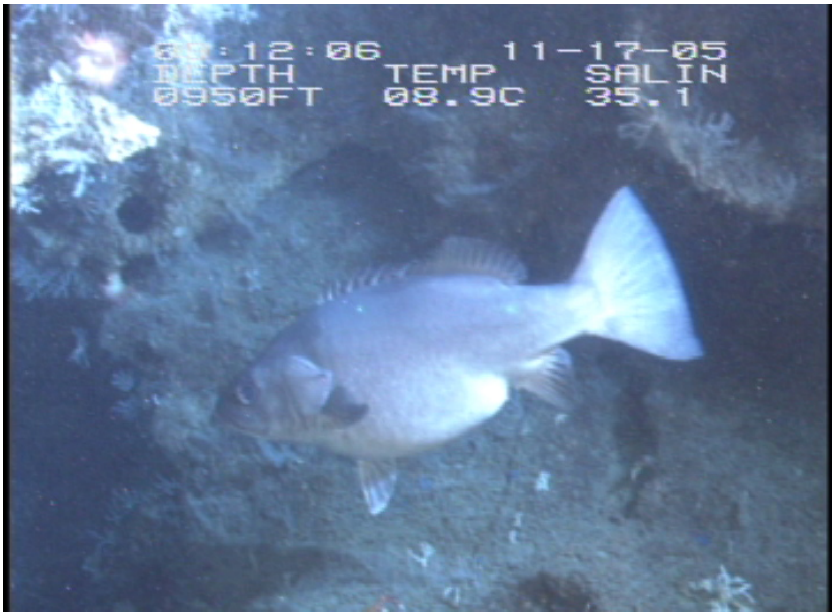

Figure 3. Spawning aggregations of deep-water wreckfish discovered on deep-water reefs.

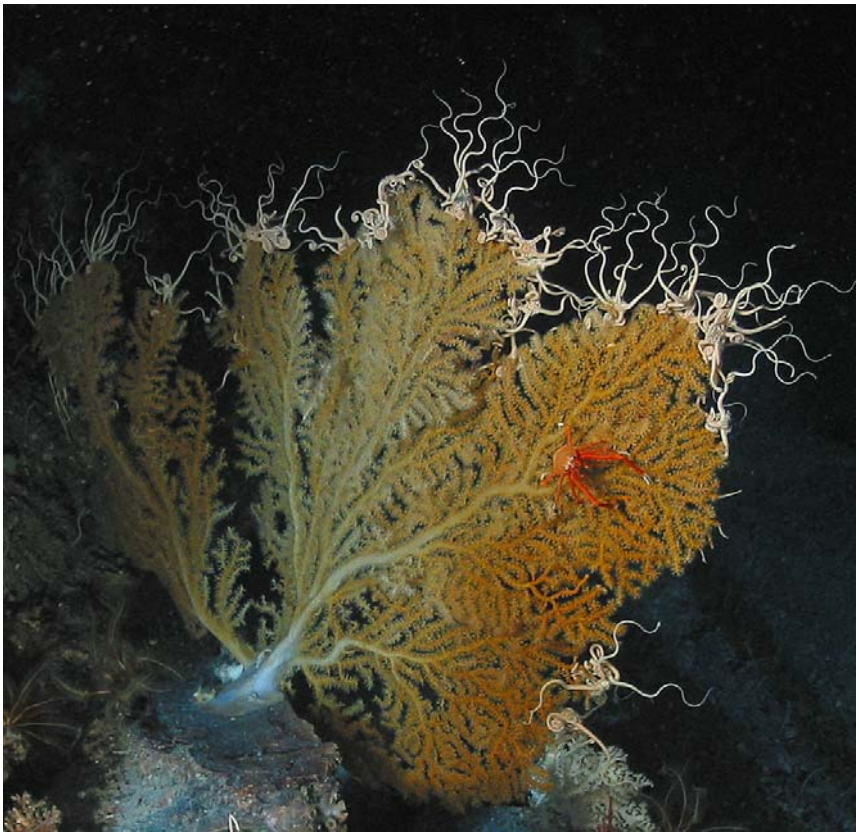

Figure 4. Deep-water corals provide habitat for numerous invertebrates such as squat crabs and brittlestars.

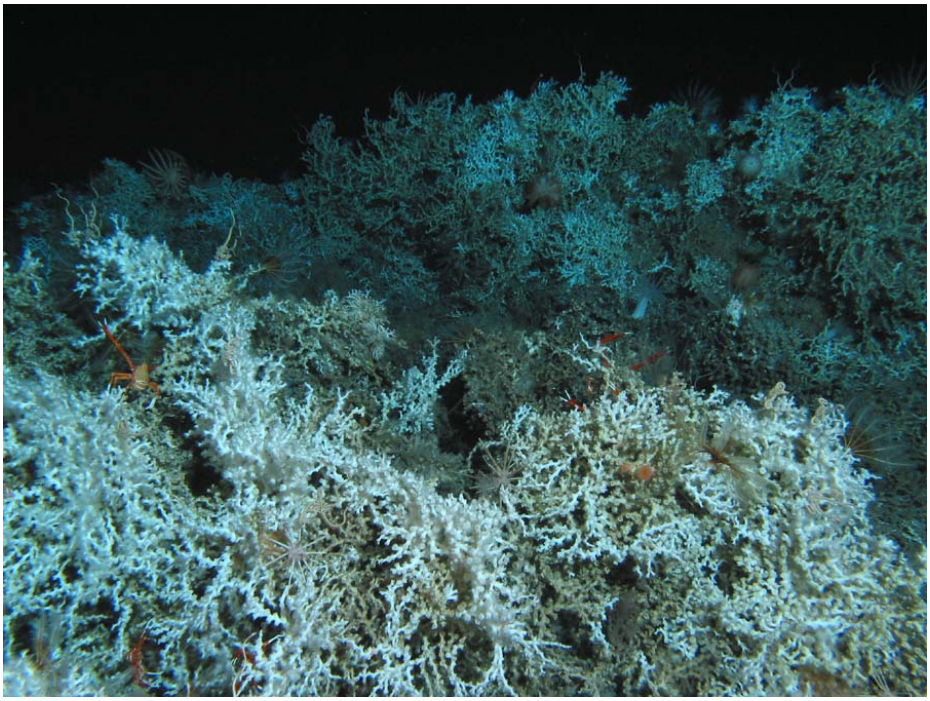

Figure 5. Deep-water *Lophelia* thickets on Miami Terrace escarpment provide habitat for high diversity of associated invertebrates and fish.

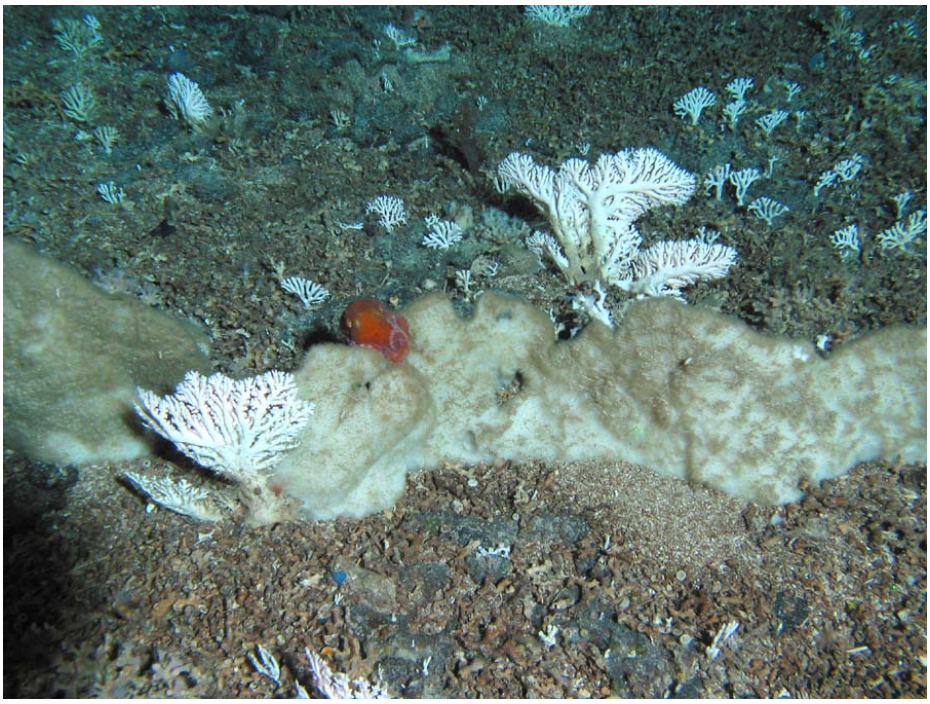

Figure 6. Hard-bottom habitat on Miami Terrace escarpment with rock, coral rubble, sponges, and stylaster corals.

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ACKNOWLEDGEMENTS

We thank the crews of the ship and submersible whose efforts made this cruise possible. All the scientists, students and technicians are acknowledged for their help in making this a successful expedition. We thank NOAA National Marine Fisheries Service for the Letter of Acknowledgment for collections within the U.S. EEZ (Permit #SER06-037). Funding for ship and submersible time was generously provided by an internal grant from Harbor Branch Oceanographic Institution. This is Division of Biomedical Marine Research Miscellaneous Publication Number 259.

PROJECT SUMMARY

This multi-disciplinary, multi-institutional research cruise with the Research Vessel *Seward Johnson* and *Johnson-Sea-Link* (JSL) submersible provided the first detailed look at a relatively unknown deep-water reef ecosystem off the coast of Florida. The region investigated is the Miami Terrace, a thousand foot tall, steep rocky slope, which provides habitat for a rich community of deep-water hard and soft corals, gorgonian sea fans, black corals, and sponges. These sessile species in turn provide habitat for a high diversity of associated invertebrates and fish at depths from 800 ft to over 2000 ft. Participants included scientists from the Harbor Branch Oceanographic Institution's (HBOI) Deep Ocean Exploration Working Group (Divisions of Marine Science, Biomedical Marine Research, and Ocean Engineering), and colleagues from various Florida universities, government agencies and NGOs, including the University of Miami, University of Florida, Florida Fish and Wildlife Institute, NOVA Southeastern University, and Ocean Research and Conservation Association.

A multi-disciplinary approach provided a preliminary assessment of the biodiversity and relative abundance of the benthic, fish and zooplankton communities; geological features; physical processes within this ecosystem; and biochemical compounds of interest for drug discovery. The results will be made available to the State of Florida's Ocean Commission to enhance development of research goals and priorities for deep-water reef studies off Florida's coast. In addition, the South Atlantic Fishery Management Council (SAFMC) and NOAA Fisheries are currently developing a Deep-Water Coral Research and Monitoring Plan as part of the Coral and Coral Reefs Fishery Management Plan in which the Miami Terrace region is one of six proposed deep-water Habitat Areas of Particular Concern (HAPC). This research cruise will provide data for various aspects of this management plan. In addition, the Miami Terrace is an area of interest by various companies planning to develop deep-water pipelines and ports for the natural gas industry which could impact the benthic communities.

CRUISE SUMMARY

- 10 day expedition explored the deep-water reefs on the Miami Terrace in the Straits of Florida
- 17 submersible dives with *Johnson-Sea-Link* submersible, 7 deep-water plankton net trawls to 1000 ft

- Submersible video/photographic surveys of the reef habitat and associated fish and benthic communities
- Deployed 'Eye-in-the-Sea' time-lapse videocamera with the *Johnson-Sea-Link* submersible to record fish behavior
- 104 deep-water samples collected with the *Johnson-Sea-Link* submersible including 21 sponges, 30 octocorals and corals, 11 crustaceans, and 22 sediment and rock samples
- Sponges and octocorals will be used to test for novel compounds with biological activity
- Documentation of deep-water species and habitat included 35 hours of videotapes, 1170 digital photographs, 87 museum specimens, 27 samples extracted for chemical and biological analyses, and Access database with detailed data for each collection site and sample
- Media and Outreach

  TV National and Regional:

  http://www.abcnews.go.com/WNT/story?id=2183233&page=1

  ABC World News Tonight report on June 12 by Jeffrey Koffman. Also, web materials

  http://www.nbc6.net/news/9538297/detail.html

  Miami NBC6 Report by Jeff Burnside. Also, web Materials

  Newpapers Regional and AP International:

  (http://www1.tcpalm.com/tcp/local_news/article/0,2545,TCP_16736_4763895,00.html) "Months of research to follow from Harbor Branch's sea expedition," June 10, 2006, TCPalm, by Suzanne Wentley

  (http://www.tcpalm.com/tcp/local_news/article/0,2545,TCP_16736_4760946,00.html) "Living the life aquatic on a research vessel," June 9, 2006, TCPalm, by Suzanne Wentley

  (http://www1.tcpalm.com/tcp/local_news/article/0,2545,TCP_16736_4758065,00.html) "Harbor Branch finds net worth in coral reefs," June 8, 2006, TCPalm, by Suzanne Wentley

  (http://www1.tcpalm.com/tcp/local_news/article/0,2545,TCP_16736_4755794,00.html) "Scientists go deep to learn about coral reefs," June 7, 2006, TCPalm, by Suzanne Wentley

  (http://www.tcpalm.com/tcp/local_news/article/0,,TCP_16736_4752506,00.html) "Science peeks at deep sea coral habitat," June 6, 2006, TCPalm, by Suzanne Wentley (also series June 6-10 in all Scripps Howard Treasure Coast newspapers- Stuart News, Port St. Lucie, Fort Pierce, Vero; and AP international releases- Miami, Europe)

GOALS AND PURPOSE

- Develop a team of Florida researchers to address questions and priority research on Florida's Deep-water Coral Reef Ecosystems (DWCEs)
- Provide Florida legislators (Ocean Initiative) with questions and potential answers regarding Florida's DWCEs
- Initiate priority research goals on Florida's DWCEs to seed potential funding sources from the State of Florida and federal grants (NSF, NOAA, etc.)

RESEARCH OBJECTIVES

Primary Objectives

- Map the highly diverse Miami Terrace deep-water reef ecosystem
- Characterize the habitat and associated communities of fish and invertebrates on the Miami Terrace deep-water reef
- Determine controlling relationships between Miami Terrace deep-water reef biotic and abiotic factors
- Characterize the chemical diversity of benthos and associated microorganisms
- Education and outreach regarding the importance and protection of Florida's deep-water reefs

Specific Objectives

1) Locate and map the biodiversity "hotspots" (e.g., 'narrow ridge') of the Miami Terrace escarpment using available topographic maps as a guide.
2) Conduct video/photographic transects using the *Johnson-Sea-Link* submersible and collect specimens from selected areas to document and inventory the biodiversity of epibenthic invertebrates, fishes, and other mobile megafauna.
3) Quantitatively compare reef biota in zones of high biodiversity to adjacent areas with lower biodiversity.
4) Use the *Johnson-Sea-Link* to collect and quantify the abundance, distribution and diel behavior of pelagic and demersal zooplankton that are likely to sustain the deep-water corals and fishes that characterize the epibenthic community.
5) Make time-lapse video recordings to determine the diel abundance and behavior of fishes and macrocrustaceans associated with deep-water coral habitats.
6) Document signs of human disturbance and/or map human activities that may impact the deep-water coral ecosystem (e.g., fishing gear, trash).
7) Place acoustic monitoring gear on the seafloor to record acoustic signatures of fishes and crustaceans.
8) Procure living specimens of microbes, sponges, and octocorals for research on sustainable use of marine natural resources, including microbial fermentation, aquaculture, cell culture, molecular biology, and biomedical research.
9) Collect live specimens of the deep-water *Lophelia* coral for laboratory experiments on feeding behavior and reproduction.
10) Provide public outreach and education on undersea discoveries through HBOI's at-sea web site and releases to the media.

DESCRIPTION OF DEEP-WATER REEFS

Deep-Water Reefs off the Southeastern US (from Reed et al., 2006)

Deep-sea coral ecosystems are common off the southeastern U.S. within the Exclusive Economic Zone (EEZ). These include a variety of high-relief, hard-bottom habitats at numerous sites from the Blake Plateau off North Carolina, southward through the Straits of Florida, and in the eastern Gulf of Mexico. However, only a few have been mapped or have had their benthic and fish resources characterized. Deep-water reefs are sometimes defined as coral banks, coral mounds, bioherms, or lithoherms. In general, deep-water banks occur below the effects of waves and the

corals lack symbiotic algae (zooxanthellae). A bioherm is a deep-water coral bank that over centuries has formed a mound of unconsolidated sediment and coral debris and is capped with thickets of coral, such as *Oculina* or *Lophelia*, whereas lithoherms are high-relief, lithified carbonate mounds, rather than unconsolidated sediment mounds, and also may be covered with thickets of live coral. The dominant corals on deep-water reefs in this region are the azooxanthellate, colonial scleractinian hard corals, *Oculina varicosa*, *Lophelia pertusa*, *Enallopsammia profunda*, *Madrepora oculata*, and *Solenosmilia variabilis*. These reefs provide hard-bottom substrate and habitat for sessile macrofauna including scleractinian corals, gorgonians, black corals, and sponges, which in turn provide habitat and living space for a biologically rich and diverse community of associated fishes, crustaceans, mollusks, echinoderms, and other fauna.

Site Description- Miami Terrace Escarpment (from Reed et al., 2006)

The Miami Terrace is a 65-km long carbonate platform that lies between Boca Raton and South Miami at depths of 200-600 m in the northern Straits of Florida. It consists of high-relief, Tertiary-age limestone rock ridges and scarps that provide extensive hard-bottom habitat for a variety of fish and invertebrates. Previous investigations include geological studies and trawl-based faunal surveys in the 1970s. Deep-water coral mounds are present at the base of the Miami Terrace escarpment (~670 m) within the axis of the Straits of Florida, but little is known of their distribution, abundance or associated fauna.

In 2004 and 2005, JSL submersible dives and echosounder transects were conducted by HBOI scientists from the Division of Biomedical Marine Research (DBMR) at several sites along the eastern edge of the Miami Terrace. These revealed that the outer terrace rim consisted of a ridge system with steep, phosphoritic limestone escarpments and relief >90 m. The ridges provide habitat for a rich, deep-water reef ecosystem of corals, sea fans, sponges, and fish. Both habitat and faunal zonation varied considerably among the sites. In general, the lower slopes below the ridges and the flat pavement on top of the terrace were relatively barren and had low biodiversity compared to the ridge tops and upper escarpments. Dominant sessile fauna consisted of colonial corals (*Lophelia pertusa*), stylasterine corals (Stylasteridae), gorgonian sea fans (Gorgonacea), bamboo coral (Isididae), black coral (Antipatharia), and diverse sponge populations (Hexactinellida and Demospongiae). Motile invertebrates included the echinoderms, mollusks, and decapod crustaceans. In total, 19 fish taxa were identified, including conger eel, red dory, blackbelly rosefish, codling, dogfish, schools of jacks, and wreckfish.

SCIENTIFIC PARTICIPANTS

Leg 1 (May 31 to June 5); Leg 2 (June 5 to June 9)

HBOI Personnel (both legs unless noted):

John Reed	Chief Scientist, Principal Investigator; Division of Biomedical Marine Research (May 31 to June 7)
Tracey Sutton	Co-Chief Scientist, Principal Investigator; Division of Marine Science
Dr. Tammy Frank	Principal Investigator; Division of Marine Science
Marsh Youngbluth	Principal Investigator; Division of Marine Science
Tara Pitts	Research Assistant; Division of Biomedical Marine Research

Jill Roberts	Graduate Student; Division of Biomedical Marine Research
Aubri Steele	Research Assistant; Division of Marine Science
Tess Geers	HBOI intern (T. Sutton)
Brian Cousin	HBOI Media Lab
Mark Carroll	HBOI Media Lab

Collaborating Scientists (both legs unless noted):

Erika Heine Raymond	Ocean Research & Conservation Assoc. (Ocean Recon); Eye-in-the-Sea time-lapse camera system
Dr. Charles Jacoby	University of Florida; zooplankton
Dr. Robert Ginsburg	University of Miami (RSMAS), Dept. of Geology; Leg 1 (May 31 to June 5)
Dr. Chris Langdon	University of Miami (RSMAS); reef ecology, coral feeding experiments; Leg 2 (June 5 to June 9)
Tina Udouj	Florida Fish and Wildlife Conservation Commission, Research Scientist; GIS specialist (May 31 to June 5)
Rachel Horak	Georgia Tech
Dr. Charles Messing	NOVA Southeastern University; deep reef ecology and zonation; Leg 1 (May 31 to June 5)
Thiago Correa	University of Miami (RSMAS), Dept. of Geology and Geophysics; student, GIS specialist, Leg 2 (June 5 to June 9)

University of Miami Technicians (2 berths)

Media:

Suzanne Wentley	Scripps Howard News reporter; Leg 2 (June 5 to June 9)
Sarah Grile	Scripps Howard News reporter; Leg 2 (June 5 to June 9)
Jeffrey Kofman	ABC Nightly News reporter and film team; (June 1)
Jeff Burnside	NBC News Miami reporter; (June 7)

METHODS AND MATERIALS

1) Collections-
   - *Johnson-Sea-Link* (JSL) submersible and support ship Research Vessel *Seward Johnson*- The JSL was equipped with a manipulator arm which includes clam-shell grab, jaws, and suction hose; 12-bin rotating carousel for benthic collections; two additional 12-bin carousels for zooplankton collections (critter gitter); color video camera with lasers for scale; digital still camera with lasers for scale; and CTD data recorder (time, depth, temperature, conductivity, and salinity). The JSL benthic sampling platform included 12 buckets and a large Plexiglas bio-box for collection of live fauna (primarily sponges, hard and soft corals, mollusks, echinoderms, crustaceans, and fish), and geological rock and sediment samples.
   - MOC Net Plankton Sampler- A set of 6 plankton nets (335 micron mesh) were deployed off the ship that allows discrete tows at depths from the surface to the bottom (1000 ft). Net tows were conducted between submersible dives.

- CTD/Water Rosette Sampler- This sampler was deployed from the ship to record surface to bottom parameters of conductivity, temperature, and salinity, as well as collect discrete water samples at various depths.
- Remote Observation Units- 'Eye-in-the-Sea' time-lapse camera system was deployed and recovered by the JSL to record the behavior of fishes and invertebrates associated with the coral community. An acoustic recorder unit was to be deployed to record fish sounds and behavior but was unavailable for the cruise.

2) Environmental Impact- Collections using the JSL submersible are highly selective and of minimal impact to the environment or species populations. Colonial animals (e.g., octocorals, corals, and sponges) were collected to leave the base intact for regrowth.

3) Permits- A permit was obtained prior to the cruise from the National Marine Fisheries Service authorizing general collections of deep-water organisms for research purposes.

4) Ship and Sample Positions- Collection site coordinates were determined with GPS navigation (Magnavox MX 200 Global Positioning System) which is accurate to <5 m. Plots of each submersible dive track and specific sample sites were made with the Integrated Mission Profiler (IMP), a software database developed by Florida Atlantic University that ties into the ship's GPS system. Submersible navigation and tracking may be accurate to 10-20 m depending on depth and conditions.

5) Acoustic Doppler Current Profiler (ADCP)- Prior to each submersible dive the ship board ADCP recorded surface to bottom current conditions to determine the best launch position for the submersible.

6) Site and Sample Documentation- Collection site descriptions, including latitude, longitude, habitat, depth, temperature, salinity, current, and weather conditions; along with sample descriptions, including morphology, color, abundance, taxonomy, and photographic reference for each sample were recorded in DBMR's proprietary ACCESS database which is archived at HBOI.

7) Photography/Video- Samples were photographed *in-situ* with the submersible using Canon Power Shot G2 digital camera, 2272 x 1704 pixels high resolution images (4.1 million pixels) which has two laser dots (8 cm apart) for scale. Color videotapes (digital Mini DV) were recorded with the JSL's pan and tilt videocamera (Sony DX2 3000A with Canon J8X6B KRS lens, 6-48 mm zoom, and 0.3 m minimum focus) which has two laser dots (25 cm apart) for scale. Each sample was photographed in the ship's laboratory with a ruler and sample number against a gray background using digital media (Nikon Coolpix 990 with Nikon SB-22S strobe and stored on CD ROM).

8) Photographic/Video Archives-. Original insitu and laboratory digital images, and insitu JSL videotapes are archived in DBMR's Photographic Library at HBOI.

9) Museum Specimens- Museum voucher specimens were subsampled from most samples and stored in 20 dram scintillation vials for small vouchers and in 2-16 oz glass jars for large vouchers. Museum specimens are stored in DBMR's Reference Museum at HBOI.

10) Taxonomy- Taxonomic identifications will be made by Shirley Pomponi (sponges), John Reed (Cnidaria, miscellaneous invertebrates), M. Youngbluth (zooplankton), T. Frank (crustaceans), and T. Sutton (fishes). Some specimens may be shipped to other taxonomic specialists for verification or further work up, as necessary.

11) Biomedical Research- Small sub-samples (5-10g) were extracted in ethanol for subsequent biological testing. The remainder of the samples were stored at -15^0 Celsius in a portable freezer on board the ship and are stored in DBMR's freezers at HBOI. Extracts of these organisms will be tested in DBMR's laboratories as well as in the laboratories of scientific collaborators for chemistry and biological activities.

12) Education and Outreach- HBOI's At Sea Web Site (www.at-sea.org) and HBOI's media lab provided coverage (pre-cruise, throughout the mission, and post cruise) with essays, photographs, and videos. The media lab also provided access to various local and national newspapers and network news.

OBLIGATION TO HOST COUNTRY AND PERMITS

For collections within the U.S. EEZ, a Letter of Acknowledgement (LOA) was requested and received from the U.S. National Marine Fisheries Service in accordance with 50 CFR 600.745 of the Federal Register (Permit #SER06-037; May 19, 2006). All provisions of this LOA have been fulfilled which include this final cruise report.

RESULTS

Itinerary

Areas of operation included the east coast of Florida within US EEZ-
Miami Terrace escarpment, depths 900 to 1100 ft, ~15 nm off Fort Lauderdale (~26°05'N, 79°50'W; 2 sites- Reed Site # BU4 and BU4a)

May 31 (Weds.)	Finish loading gear on ship; secure gear; depart ~12 noon (high tide - 12:11 pm); transit to Miami Terrace site (~90 nm); conduct test JSL dive during transit
June 1-8	JSL submersible, MOC net, and Rosette/CTD operations
June 9	Transit to HBOI; arrive ~9:00 am; offload gear and personnel

Personnel Changeout

June 1	Transfer media (ABC Nightime News) on board for day of filming
June 5	Depart ship via small boat at NOVA dock, 8:00 am; Robert Ginsburg, Tina Udouj, Charles Messing
June 5	Pickup at NOVA dock via small boat, 8:00 am; Chris Langdon, Thiago Correa, 2 media (Scripps Newspapers)

June 7	Depart ship via small boat at NOVA dock, 8:00 am; John Reed
June 7	Pickup at NOVA dock via small boat, 8:00 am; pickup media (NBC) for day

Cruise Track

Figures 1 and 2 show the general location of the dive sites and cruise track.

Collection Sites

Areas of operation included two sites on the Miami Terrace escarpment (BU4 and BU4a) within US waters, ~15 nm off Fort Lauderdale, Florida at depths of 900 to 1100 ft.

Collections resulted in 17 submersible dives, seven MOC net trawls, and two water rosette/CTD casts. Appendix 1 summarizes the collection sites data and lists the site number, latitude, longitude**,** JSL dive number, depth range, and number of samples. Appendix 2 details the site descriptions, including location, habitat, bottom environmental conditions including bottom temperature, salinity, visibility, and current. The database for the submersible tracks are stored on CD ROM in DBMR's Collection Archives at HBOI.

Physical Parameters

Data for temperature and salinity profiles from submersible dives (temperature, salinity, and depth recorded every second) were recorded and are stored on CD ROM in DBMR's Collection Archives at HBOI.

Taxonomy and Biodiversity Inventory

The expedition resulted in the collection of 70 samples of macroinvertebrates and fish including 21 sponges, 30 cnidaria, and various other taxa (11 decapod crustaceans, 5 echinoderms, 1 mollusk, and 2 fish). In addition, 22 sediment samples (rock, coral rubble, sediment) were collected with the submersible for geological analyses. Appendix 3 lists the current taxonomic identification for each sample collected at each site, and also includes sample number and depth of collection.

Specimen Documentation

Complete documentation of each specimen includes sample notes, site notes, *in-situ* photographs, laboratory photographs, videotapes, museum voucher specimens, and subsamples used for microbial isolation, cell culture, chemistry, and molecular research (Appendix 4). These are archived in an ACCESS database in DBMR's Collection Archives at HBOI.

Museum Vouchers

Deep-water specimens are archived as taxonomic museum specimens in DBMR's Reference Museum at HBOI. One set of small museum specimens (20 ml jars) and a duplicate set of large museum specimens (2-16 oz jars) were subsampled for these archives. Some duplicate samples of the same species were not subsampled. Sediment/rock samples are archived at University of Miami, RSMAS (R. Ginsburg).

Photographic Documentation

Digital photographs (*in-situ* and laboratory) were taken of each specimen when possible. A total of 1089 insitu and 81 laboratory digital images are archived in DBMR's Photographic Library at HBOI.

Submersible Videotapes

Mini-DV digital videotapes (35 sixty-minute tapes) from the *Johnson-Sea-Link* submersible dives document the deep-water specimens in their natural habitat. Original videotapes are archived in DBMR's Photographic Library at HBOI.

Collections and Dive Summary

A. JSL Submersible Dives- Two or three dives were conducted each day. Benthic and water column objectives were conducted on alternate days. Dive operations were conducted from noon to midnight each day.

1. Submersible video/photographic benthic surveys and habitat characterization- John Reed, component leader; Charles Messing. Completed 4 JSL dives for surveys and collections.
    a. Initial surveys were used to select the best site for the monitoring studies and to ground-truth available maps.
    b. Conduct quantitative video/photographic surveys of selected sites to compare high and low biodiversity habitats.
    c. Collect benthic specimens to describe biodiversity of reef comminity and to verify identifications from videotapes.

2. Zooplankton suction sampling– Marsh Youngbluth, component leader; Charles Jacoby. Completed 4 JSL dives- day and night sampling. The primary goals for this sampling program were to determine species composition and abundance of zooplankton (the prey field for planktivorous reef fishes and ahermatypic corals) as a function of three variables:
    a. Proximity to the reef structure (3 treatments: in coral outcrops; above coral outcrops; and away from coral outcrops)
    b. Time of day (2 treatments – daytime and nighttime)
    c. Size (2 treatments – 64-µ mesh and 333-µm mesh buckets)

3. Visual fish censusing– Tracey Sutton, component leader. Completed 6 JSL dives- day vs night.

    Much of the visual fish censusing will be done ship-board and ashore via analysis of JSL video taken during dives with other mission objectives. At least one dive was needed to score fish composition/abundance *in situ* to compare with the score from the same dive generated by video analysis. It is likely that large species of potential commercial importance (e.g., tilefish, grouper, sharks, carangids) will be undersampled by a smaller field-of-view video camera.

4. Visual macrocrustacean censusing – Tammy Frank, component leader. Completed 1 JSL dive and additional collections were made during survey dives.

Used the same methods as visual fish and benthic censusing. Specimens were collected on various dives so that correct identifications were made prior to video censusing.

5. Biomedical research- John Reed, component leader; Jill Roberts, Tara Pitts. Collections made during survey dives.
   Benthic invertebrates and sediment samples were collected for biomedical research.
   a. Small sub-samples (5-10 g) of selected benthic invertebrates were collected and extracted in ethanol for subsequent biological testing.
   b. Heterotrophic microorganisms were collected from various samples of macroinvertebrate and sediments. Samples will be cultured on differential, selective media and/or stored frozen in 40% glycerol-seawater solution for subsequent biological testing.
   c. Living specimens of sponges and octocorals were collected for research on sustainable use of marine natural resources, including microbial fermentation, aquaculture, cell culture, and molecular biology.

6. Deep-water coral samples– Marsh Youngbluth, component leader, Charles Jacoby (dietary studies); Chris Langdon (feeding experiments and live coral aquarium); Sandra Brooke (reproductive studies). Collections were made during surveys.
   a. Dietary analyses- *Lophelia* coral samples were collected, dissected, frozen or preserved for microscopical and/or biochemical trophic analyses (Youngbluth/Jacoby).
   b. Live *Lophelia* coral collected for feeding and acidification studies at UM RSMAS cold water aquarium system (C. Langdon).
   c. Reproduction studies- *Lophelia* coral samples preserved for sectioning and analyses of reproductive organs.

7. Geological samples- Robert Ginsburg, component leader. Collections were made during surveys.
   Sediment, coral rubble and rock samples were collected for geological analyses.

B. <u>Remote Observation Units</u>-

1. Time-lapse video camera – Erika Raymond, component leader. Two deployments completed.
   "Eye-in-the-Sea" time-lapse videocamera system was deployed and recovered with the JSL for periods of ~24-h to record the activities of fishes and invertebrates associated with the coral habitat. The primary objective will be the observation of community shifts between diurnal and nocturnal fish assemblages. These data are lacking in previous deep reef fish censuses, and this information is vital for ecological assessments of deep coral communities. Large crustaceans may also show diel differences in behavior (Tammy Frank to provide this assessment). The EITS contains a hydrophone array, which can be used to assess diel shifts in sound production by fishes and crustaceans.
2. Passive Acoustic Monitoring system– Grant Gilmore, component leader.
   This project was not completed since Dr. Gilmore was unable to participate.

C. MOC Net Plankton Samples- Net tows were conducted between submersible dives (between midnight and noon). Seven deployments were made.

1. To distinguish the "background" (i.e., water column) zooplankton field against which the JSL suction sampling results can be compared; i.e., do "benthic hotspots" in any way correlate with "pelagic hotspots"? It's unlikely, due to strong currents in the area, but this has never been examined. Tammy Frank, component leader.
2. To sample fish larvae to determine potential self-recruitment processes around deep-water coral structures (i.e., do these structures meet the criteria of essential fish habitat?). Tracey Sutton, component leader.

D. CTD/Water Rosette samples- CTD and water casts were conducted between submersible dives; Marsh Youngbluth, component leader. Two deployments were made.

APPENDIX 1

Collection Site Summary

(Site Number = day + month + year + site)

APPENDIX 2

Collection Site Descriptions

(Collection Site = day + month + year + site; temperature, salinity, visibility, and current refer to conditions at the maximum depth of the dive)

APPENDIX 3

Species List of Samples Collected with the JOHNSON-SEA-LINK II Research Submersible and Snorkel
(Sample Number = day + month + year + site + sample)

POR= Porifera, CNI= Cnidaria, ART= Arthropoda, MOL= Mollusca, ECH= Echinodermata, CHO= Chordata (fish), SED= Sediment or rock, ENV= Environmental (Water)

APPENDIX 4

Checklist of *In-situ* and Laboratory Photographs, Taxonomic Museum Specimens, Type of Preservative for Museum Specimens, Microorganism Isolates, Cell Culture Subsamples, and High Performance Liquid Chromatography (HPLC) Subsamples

(Photographs- Y= yes, N= no; Museum Specimen, Large- Y= deposited at HBOI or RSMAS, Small- Y= deposited at HBOI, N= no museum voucher;
Preservative- 70ET= 70% ethanol, 5FO= 5% formalin)