# CRUISE INSTRUCTIONS
NF-07-09-GRNMS

**CRUISE TITLE:** Gray's Reef National Marine Sanctuary and South Atlantic Fishery Management Council Regional Development and Assessment Cruise

**CRUISE NUMBER:** NF-07-09-GRNMS

**PERIOD OF CRUISE:** Cruise Leg I: May 31 – June 10, 2007; Cruise Leg II: June 12 - June 22, 2006

**AREA OF OPERATIONS:** Leg I: East Coast of Florida OCS
Leg II: Gray's Reef National Marine Sanctuary (GRNMS) and surrounding GA waters

**Chief Scientist:**
Mr. Greg McFall – Research Coordinator - GRNMS
NOAA / GRNMS
10 Ocean Science Circle
Savannah, GA 31411
Phone: 912-598-2416
Cell: 912-596-2464
Email: Greg.McFall@noaa.gov

**Principal Investigators:**
*Leg I*
Roger Pugliese – Senior Fishery Biologist
South Atlantic Fisheries Management Council
4055 Faber Place Drive, Suite 201
North Charleston, SC 29405
Phone: 843-571-4366
Email: roger.pugliese@safmc.net

John K. Reed - Senior Scientist
Harbor Branch Oceanographic Institution
5600 U.S. 1, North
Fort Pierce, FL 34946
Phone: 772-465-2400 x205
Fax: 772-461-2221
Email: jreed@hboi.edu

Lance Horn – AUV Mission Coordinator
National Undersea Research Center
University of North Carolina at Wilmington
5600 Marvin Moss Lane
Wilmington, NC 28409
Office: 910-962-2443

Cell: 910-512-0193
Email: hornl@uncw.edu

*Leg II*
Dr. Paul Gayes
Coastal Carolina University
Burroughs & Chapin Mar Wet Ct 105
Conway, SC 29528
Phone: 843-349-4015
Email: ptgayes@coastal.edu

Dr. Danny Gleason
Georgia Southern University
Department of Biology
P.O. Box 8042
Statesboro, GA 30460-8042
Phone: 912-681-5957
Email: dgleason@georgiasouthern.edu

## SCHEDULE OF OPERATIONS

**Cruise Leg I**

| | |
|---|---|
| Mobilization Date: May 31, 2007 | Location: Savannah, GA |
| Depart: June 1, 2007 | Location: Savannah, GA |
| Operations: June 1-June 9, 2007 | Location: Georgia and Florida offshore waters |
| Arrive: June 10, 2007 | Location: Savannah, GA |
| Demobilization: June 11, 2007 | Location: Savannah, GA |

**Cruise Leg II**

| | |
|---|---|
| Mobilization Date: June 11, 2007 | Location: Savannah, GA |
| Depart: June 12, 2007 | Location: Savannah, GA |
| Operations: June 12-21, 2007 | Location: GRNMS and surrounding areas |
| Arrive: June 21, 2007 | Location: Savannah, GA |
| Demobilization: June 21, 2007 | Location: Savannah, GA |

**Comments:** Sampling equipment and gear is to be loaded on board May 31st for Leg I and June 11th for Leg II. All scientists are to be onboard ship and ready to sail by 0700 June 1st for Leg I and by 0700 June 12th for Leg II. The ship is expected to depart Savannah on the morning of June 1st for Leg I and begin transit to the operating area and then return to Savannah, GA by approximately 1200 June 10th. Demobilization will occur by 1200 on June 11th. For Leg II the ship will transit to GRNMS the morning of June 12th and arrive back in Savannah by about 1200 June 21st. Scientists will remove all samples, equipment, and chemicals from the ship upon completion of the cruise.

## SURVEY JUSTIFICATION AND RATIONALE

The purpose of this survey (NOAA Ship NANCY FOSTER Cruise NF-07-09-GRNMS) is to provide surface platform support and diving support (through the use of tenders) necessary to

address scientific objectives and data requirements of Gray's Reef in accordance with its management plan responsibilities and to provide our partners access to key naturally-occurring live bottom sites in surrounding GA waters.

## SURVEY LOCATION AND DESCRIPTION

Leg I Sampling will be conducted on Florida mid-shelf and OCS waters. The first task and collect multi-beam and backscatter data for preparation of maps of three selected mid-shelf habitats (M1-M3) in depths between 30m and 40m offshore North Florida (Figure 1). The second task will be the Nancy Foster ship based mapping of benthic habitats in the South Atlantic Region including priority areas encompassed in proposed Deepwater Coral Habitat Areas of Particular Concern off the East Coast of Florida. Once the vessel moves off the shelf, ship-based mapping will be conducted to follow fathometer readings of potential deepwater coral pinnacles/habitat provided by John Reed (Figure 2). AUV mapping and characterization of F 12-22 presented on Figure 3 which occur in the proposed Deepwater Coral Habitat Areas of Particular Concern off the East Coast of Florida is the next priority. Mapping using the Nancy Fosters system will continue until map Areas A-E (Figure 4- Table 3) are reached. Map areas A, B and C will be mapped first with the Nancy Foster. The AUV will be deployed to map the central portion of the Map Area presented in Figure 5. The Nancy Foster's system will be used on Map Areas D and E in Figure 4. If time allows and if possible, the Nancy Foster on the return trip to Savannah, will follow just left of the track of Fathometer readings so it can be combined with the multi-beam track collected in the steam down from Savannah.

Leg II Sampling will be conducted within GRNMS and at sites outside its boundaries but no deeper than 130' fsw for diving operations. Exact locations of these sites will be determined while at sea based on an analysis of recent seafloor imagery and known areas of live bottom habitat and will be provided to the ship's navigation crew the night before a site is to be visited.

## NAVIGATION AND POSITIONING CONTROL

The ship's navigation equipment (differential GPS or GPS) will be used for station positioning. The accuracy of this equipment is sufficient to meet research objectives of the project; we will require at least two independent NMEA strings to be available in the Dry Lab and one in the Wet Lab.

## LEG I: SURVEY/SAMPLING METHODOLOGIES

*(For all activities, a Plan of the Day (POD) will be provided to the bridge nightly that details the specifics of the projects and timelines related to operations and logistics for the following day.*) Two activities are scheduled for Leg I, multibeam and AUV operations. These activities will not occur simultaneously. The AUV can operate for up to 30 hours, after which it requires 15 hours to charge the battery. Therefore the ship will conduct alternating periods of AUV operations and multibeam operations, the timing of which will depend on the size of target areas to be mapped. As a result, each day will be unique in terms of the schedule of activities (note: no personnel transfers or additional activities will occur during this leg). See Appendix A for AUV shipboard requirements, including launch and recovery procedures.

## PRIORITY OBJECTIVES: LEG I

Objective 1: Ship based mapping and characterization of benthic habitats in the South Atlantic region including priority areas encompassed in proposed Deepwater Coral Habitat Areas of Particular Concern off the East coast of Florida

Objective 2: AUV Mapping and Characterization of Benthic Habitats in the South Atlantic Region including priority areas encompassed in proposed Deepwater Coral Habitat Areas of Particular Concern off the East Coast of Florida

Objective 3: Shallow water testing of both mapping techniques along priority benthic habitats EFH and EFH-HAPCs in depths of 30m to 40m offshore East coast of Florida.

Objective 4: Promote public literacy through outreach and education activities

## PROJECTS: LEG I

Objective 1: Use multi-beam system aboard the Nancy Foster to collect acoustic and backscatter data for preparation of maps of deepwater coral habitats in Proposed Deepwater Coral Habitat Areas of Particular Concern.

Objective 2: Deploy AUV to collect multi-beam and backscatter data for preparation of maps of selected priority deepwater coral habitats in Proposed Deepwater Coral Habitat Areas of Particular Concern.

Objective 3: Collect multi-beam and backscatter data for preparation of maps of selected mid-shelf habitats in depths between 30m and 40m.

Objective 4: Outreach through products provided for enhancement of Habitat and Ecosystem website and IMS (e.g., Fledermaus 3D representations of the multibeam data collected and 3D "flythough" prepared by NURC).

**LEG I: SURVEY AREA**
***Multiplatform Sonar Mapping of Mid-Shelf and Deepwater Coral Habitats***

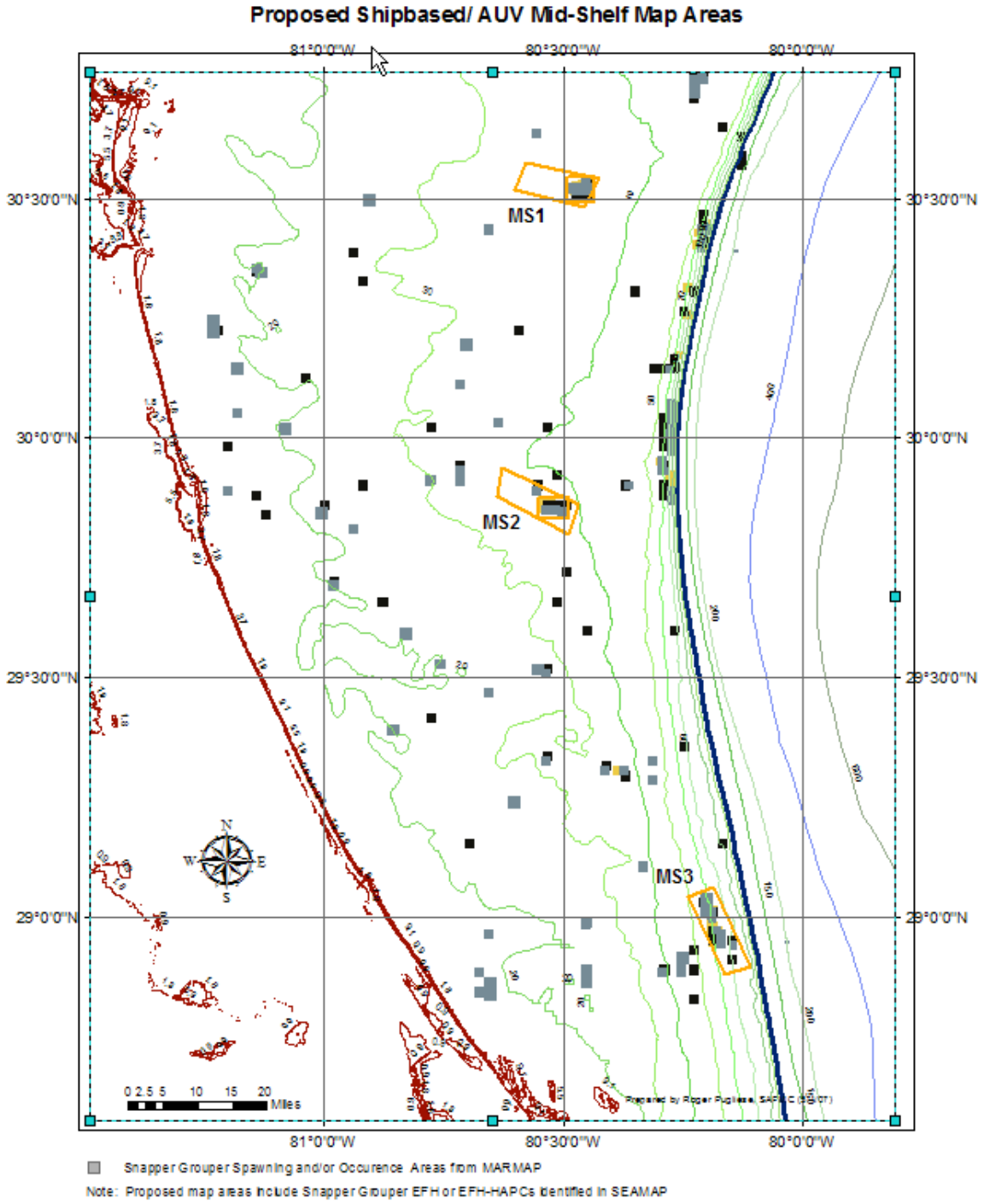


**Figure 1. Proposed map areas for mid-shelf habitats identified as Essential Fish Habitat or EFH-Habitat Areas of Particular Concern from fishery independent monitoring programs (MARMAP and SEAMAP)**

**Table 1. Coordinates for mid-shelf habitats identified as Essential Fish Habitat or EFH-Habitat Areas of Particular Concern from fishery independent monitoring programs (MARMAP and SEAMAP)**

| | Corner Point | | | | | | |
|---|---|---|---|---|---|---|---|
| MS1 NF | 1 | 80 | 36 | 11.27 | 30 | 31 | 11.05 |
| | 2 | 80 | 34 | 45.55 | 30 | 34 | 34.64 |
| | 3 | 80 | 27 | 26.22 | 30 | 29 | 1.12 |
| | 4 | 80 | 25 | 32.37 | 30 | 32 | 28.73 |
| MS1 (AUV) | 1 | 80 | 29 | 26.77 | 30 | 32 | 40.79 |
| | 2 | 80 | 26 | 15.23 | 30 | 32 | 40.79 |
| | 3 | 82 | 29 | 26.77 | 30 | 29 | 34.61 |
| | 4 | 80 | 26 | 15.23 | 30 | 29 | 37.29 |
| MS2 NF | 1 | 80 | 38 | 14.6 | 29 | 52 | 42.36 |
| | 2 | 80 | 37 | 41.95 | 29 | 56 | 13.4 |
| | 3 | 80 | 29 | 21.76 | 80 | 28 | 8.3 |
| | 4 | 80 | 28 | 8.3 | 29 | 51 | 41.73 |
| MS2 (AUV) | 1 | 80 | 33 | 6.79 | 29 | 52 | 33.03 |
| | 2 | 80 | 29 | 25.25 | 29 | 52 | 33.03 |
| | 3 | 80 | 33 | 6.79 | 29 | 49 | 57.96 |
| | 4 | 80 | 29 | 25.25 | 29 | 49 | 57.96 |
| MS3 NF | 1 | 80 | 14 | 30.43 | 29 | 2 | 32.64 |
| | 2 | 80 | 11 | 19.59 | 29 | 3 | 40.63 |
| | 3 | 80 | 9 | 51.32 | 28 | 52 | 44.61 |
| | 4 | 80 | 6 | 44.06 | 28 | 53 | 51.41 |

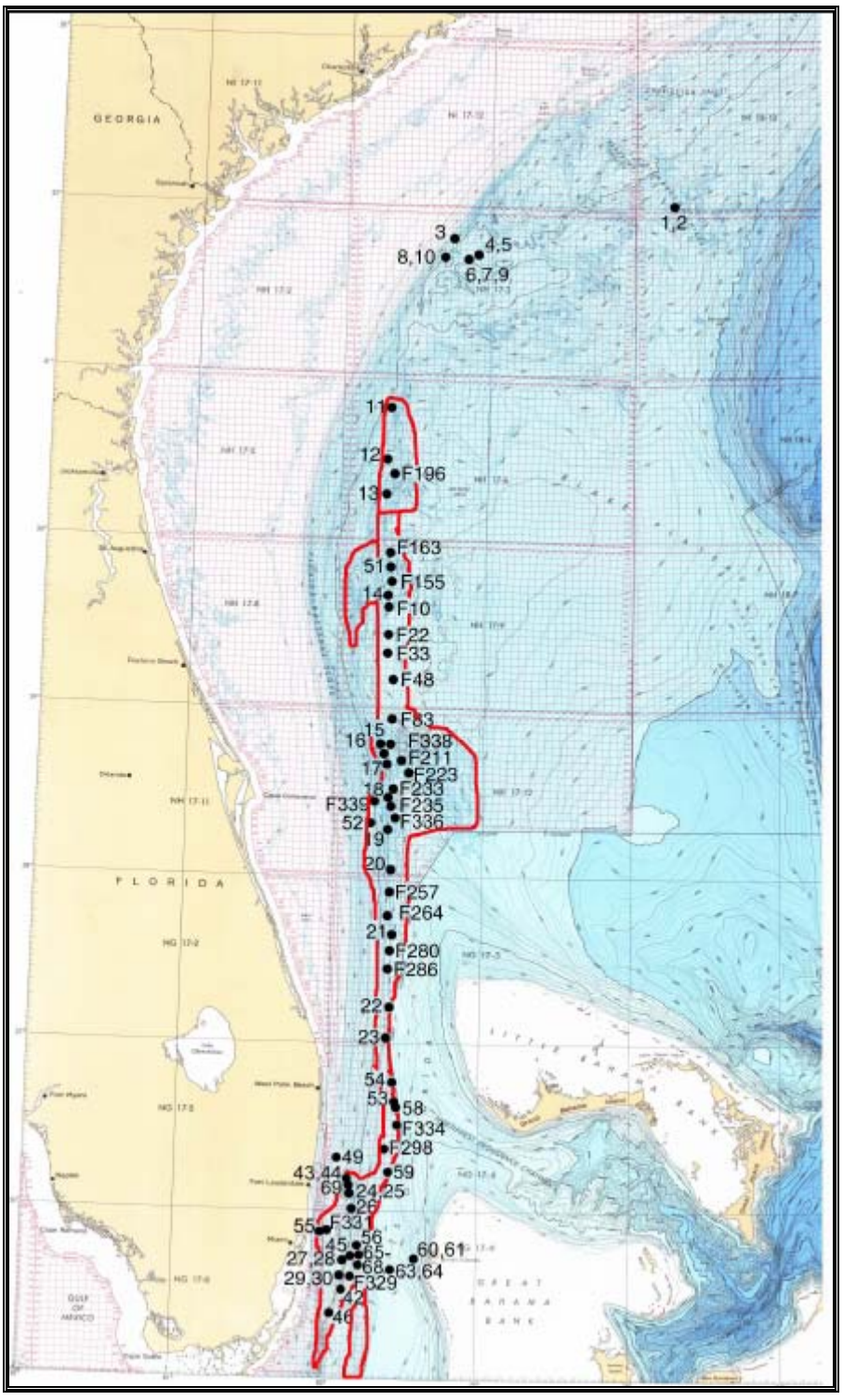


**Figure 2. Map of East Florida *Lophelia* Reefs including ground-truthed numbered sites and fathometer profiles indicating probable high relief hard-bottom or deepwater coral bottom (Reed 2004, 2006).**

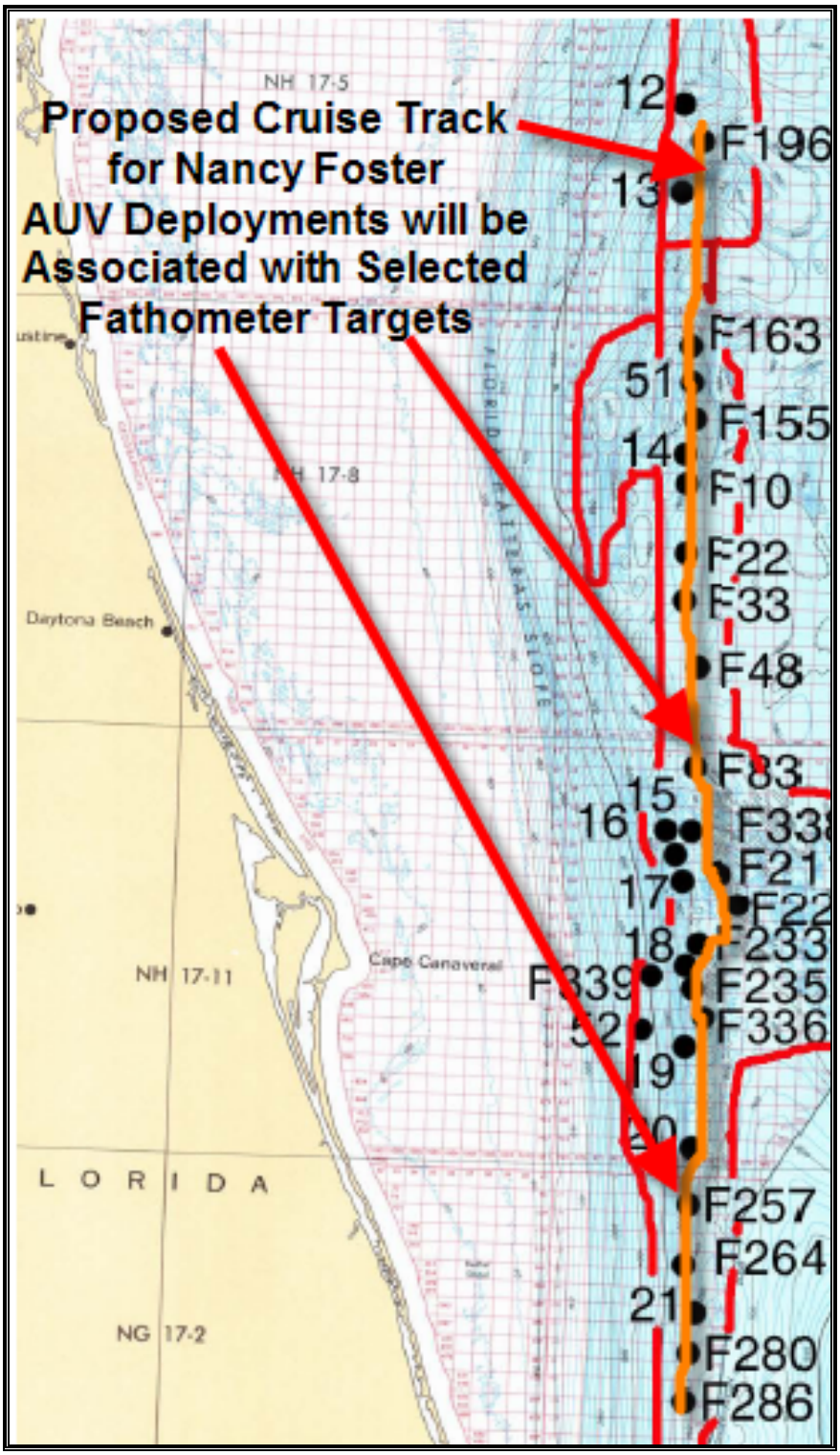


**Figure 3. Recommended cruise track to cover fathometer profiles indicating probable high relief hard-bottom or deepwater coral bottom (Reed 2004, 2006).**

**Table 2. Coordinates for proposed cruise track for multibeam mapping using NANCY FOSTER and AUV.**

| Pinnacle# | Long. | Lat. |
|---|---|---|
| 157 | 79 39.474 | 30 30.119 |
| 196 | 79 39.114 | 30 23.355 |
| 187 | 79 38.949 | 30 18.403 |
| 186 | 79 38.980 | 30 16.774 |
| 184 | 79 38. 187 | 30 15.312 |
| 165 | 79 38.199 | 29 57.686 |
| 163 | 79 38.107 | 29 55.281 |
| 160 | 79 37.976 | 29 51.125 |
| 156 | 79 37.903 | 29 45.710 |
| 155 | 79 37.981 | 29 45.457 |
| 3 | 79 38.067 | 29 40.243 |
| 10 | 79 37.897 | 29 35.442 |
| 22 | 79 37.396 | 29 25.713 |
| 23 | 79 37.364 | 29 25.113 |
| 33 | 79 37.055 | 29 19.049 |
| 48 | 79 36.479 | 29 09.913 |
| 51 | 79 36.325 | 29 7.749 |
| 83 | 79 35.941 | 28 55.987 |
| 88 | 79 35.964 | 28 53.811 |
| 96 | 79 36.005 | 28 51.750 |
| 113 | 79 37.585 | 28 47.625 |
| 116 | 79 37.159 | 28 46.329 |
| 129 | 79 37.675 | 28 39.819 |
| 134 | 79 38.280 | 28 38.104 |
| 135 | 79 38.010 | 28 28.336 |
| 137 | 79 38.003 | 28 27.791 |
| 151 | 79 36.830 | 28 17.061 |
| 251 | 79 36.891 | 28 10.188 |
| 252 | 79 36.911 | 28 2.426 |
| 257 | 79 36.632 | 27 54.289 |
| 264 | 79 36.407 | 27 46.020 |
| 266 | 79 36.196 | 27 43.857 |
| 267 | 79 36.081 | 27 42.706 |
| 269 | 79 35.904 | 27 40.828 |
| 270 | 79 35.782 | 27 39.498 |
| 280 | 79 35.658 | 27 32.711 |
| 286 | 79 35.749 | 27 27.109 |
| 291 | 79 35.674 | 27 17.590 |
| 292 | 79 35.599 | 27 12.569 |
| 293 | 79 35.392 | 27 1.226 |
| 211 | 79 32.136 | 28 40.728 |
| 215 | 79 30.021 | 28 40.122 |
| 219 | 79 30.006 | 28 37.530 |
| 223 | 79 29.997 | 28 35.244 |

| | | |
|---|---|---|
| 224 | 79 30.059 | 28 35.189 |
| 229 | 79 31.825 | 28 33.572 |
| 233 | 79 34.515 | 28 31.140 |

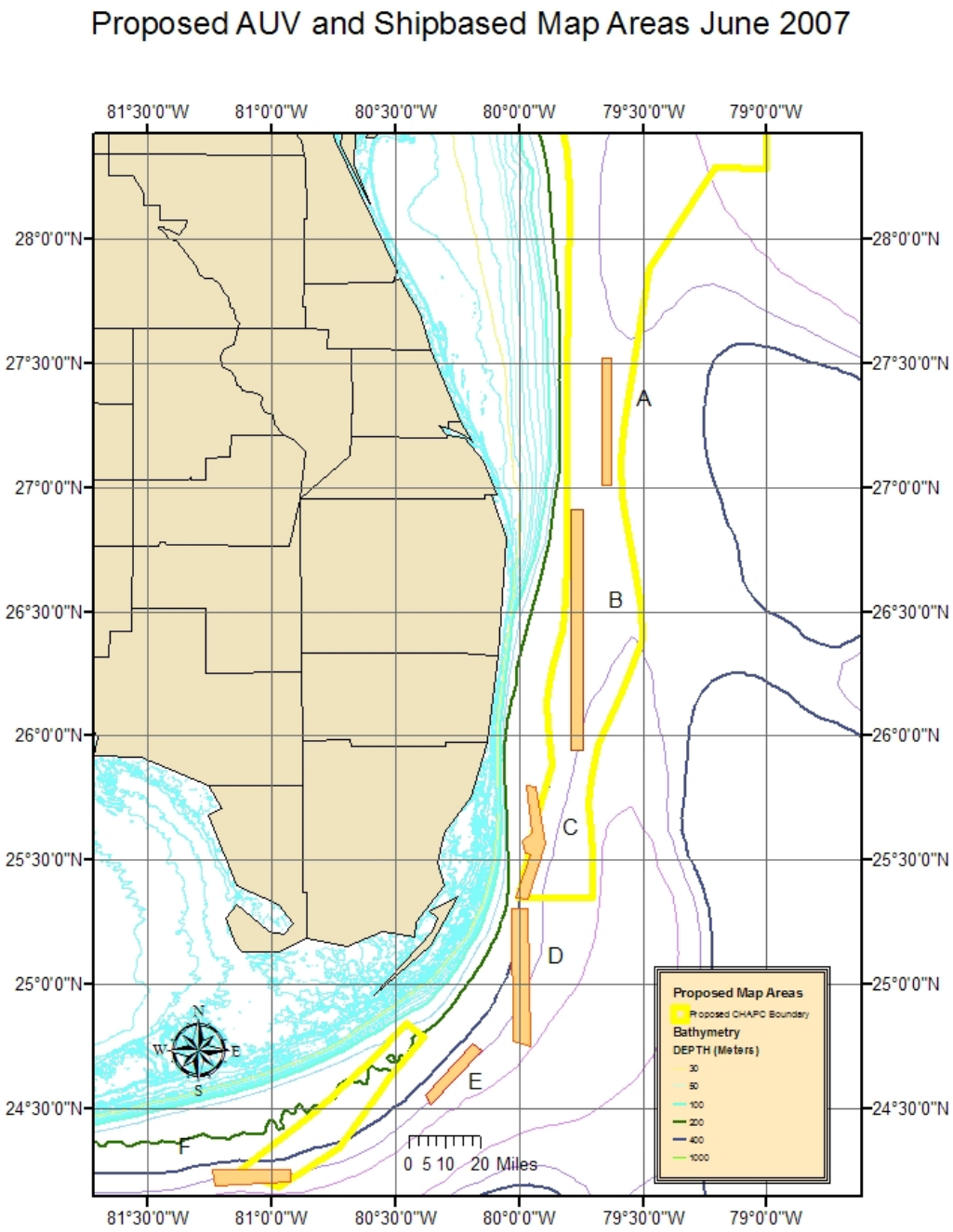


**Figure 4. Proposed Map Areas A-E covering deepwater coral habitat possible golden crab fishing areas associated with the Proposed Deepwater Coral HAPCs.**

**Table 3. Coordinates for proposed Map Areas A-E covering deepwater coral habitat possible golden crab fishing areas associated with the Proposed Deepwater Coral HAPCs.**

| | | |
|---|---|---|
| A | -79.664857 | 27.52352 |
| | -79.626856 | 27.52352 |
| | -79.66408 | 27.009355 |
| | -79.625305 | 27.009355 |
| B | -79.793203 | 26.913043 |
| | -79.743168 | 26.913043 |
| | -79.793203 | 25.94182 |
| | -79.743168 | 25.94182 |
| C | -79.664857 | 25.80319 |
| | -79.929545 | 25.80319 |
| | -80.012262 | 25.348244 |
| | -79.963518 | 25.3448244 |
| D | -80.03677 | 25.314139 |
| | -79.963983 | 25.314139 |
| | -80.027006 | 24.772609 |
| | -79.954646 | 24.758604 |
| E | -80.35313 | 24.515283 |
| | -80.153753 | 24.732126 |
| | -80.379245 | 24.554205 |
| | -80.183396 | 24.760938 |

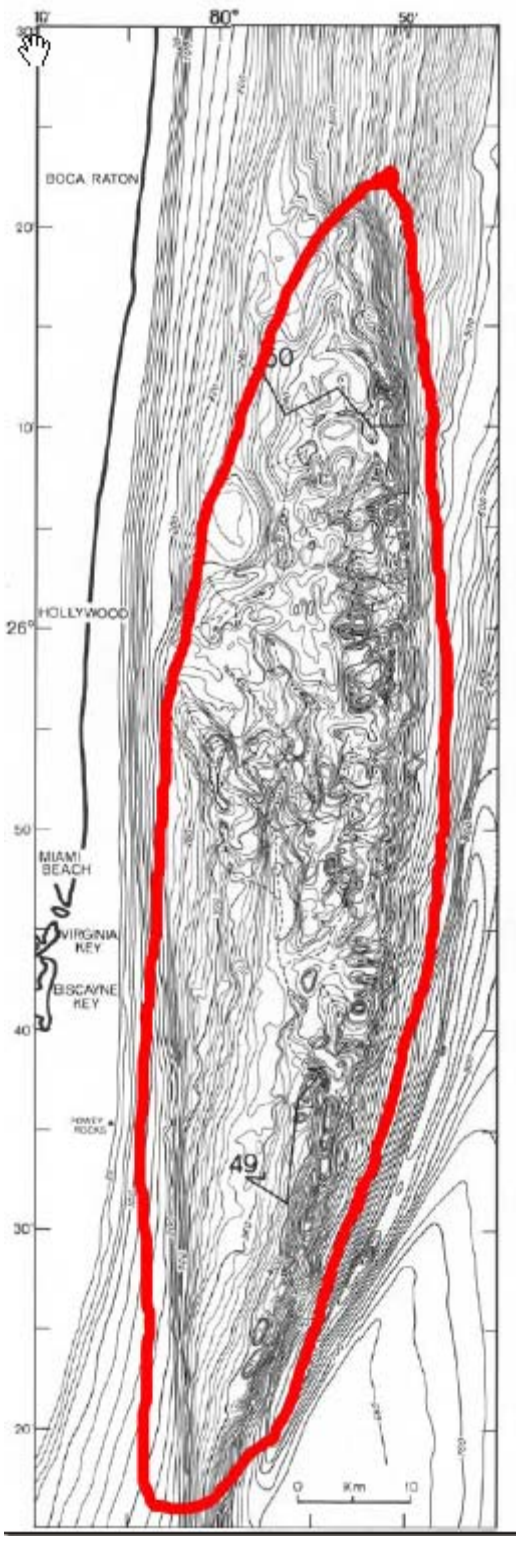


**Figure 5. Bathymetry of area encompassing proposed priority Map Area for AUV operations associated with the Miami Terrace and the Proposed Deepwater Coral HAPC .**

BACKGROUND

Deep-Water Coral Reefs (from Reed, 2004)

Deep-water reefs are sometimes defined as bioherms, coral banks, or lithoherms (Teichert, 1958; Stetson et al., 1962; Neumann et al., 1977; Wilson, 1979; Reed, 1980; Freiwald et al. 1997; Fosså et al. 2000; Paull et al., 2000). Some deep-water reefs consist of caps of living coral on mounds of unconsolidated mud and coral debris, such as some Oculina and Lophelia coral reefs (Reed 2002a,b; Reed et al. 2005, 2006), whereas deep-water lithoherms are defined as high-relief, lithified carbonate limestone mounds rather than unconsolidated mud mounds (Neumann et al., 1977). Rogers (1999) has suggested that deep-water coral bioherms fall within the definition of a coral reef based on their physical and biological characteristics. Various types of deep-water, high-relief bioherms are common off the southeastern United States, along the base of the Florida- Hatteras Slope, on the Blake Plateau, in the Straits of Florida, and eastern Gulf of Mexico (Reed et al., 2005, 2006). Only a small percentage of deep-water reefs have had their benthic and fish resources characterized.

Recovery, Interpretation, Integration and Distribution of Deepwater Bottom Habitat Information for the South Atlantic Bight (200 - 2,000 m)

The Deepwater mapping project is in the process of documenting deep-water, hard-bottom habitat from existing data throughout the South Atlantic Bight and Straits of Florida (Arendt et al., 2003). The SEAMAP bottom mapping workgroup has defined deep-water, hard-bottom habitat as including the following subcategories of habitat types: coral, rock rubble, coral rubble, exposed hard pavement, thinly covered hard substrate, and artificial structures. In addition, a category of 'Special Habitats' includes the subcategories of canyons, tilefish burrows, consolidated mud, methane seeps, sinkholes, and coral banks. Deep-water corals are defined as including Scleractinia (hard corals), Octocorallia (soft corals), Hydrocoral (hydro corals and stylasterine corals), and Antipatharia (black corals).

Florida DSCE (from Reed, 2006)

Deep sea coral ecosystems (DSCE) in U.S. EEZ waters exist along the eastern and southwest Florida shelf slope (in addition to the Oculina Marine Protected Area and deep shelf-edge reefs with hermatypic coral). These include a variety of high-relief, hard-bottom, live-bottom habitats at numerous sites along the base of the Florida-Hatteras Slope off northeastern and central eastern Florida, the Straits of Florida, the Miami Terrace and Pourtales Terrace off southeastern Florida, and the southwestern Florida shelf slope. The predominate coral on these reefs are the azooxanthellate, colonial scleractinian corals, Lophelia pertusa, Madrepora oculata, and Enallopsammia profunda; various species of hydrocorals of the family Stylasteridae, and species of the bamboo octocoral of the family Isididae. Various types of high-relief, live-bottom habitat have been discovered in the area: Lophelia mud mounds, lithoherms, sinkholes, ancient Miocene escarpments and karst topographic features (Reed 2002b; Reed et al., 2004a,b, 2005, 2006). These all provide hard-bottom substrate and habitat for sessile macrofauna including deep-water corals, octocorals (gorgonians), black coral, and sponges, which in turn provide habitat and living space for a relatively unknown but biologically rich and diverse community of associated fish, crustaceans, mollusks, echinoderms, polychaete and sipunculan worms, and other macrofauna, many of which are undoubtedly undescribed species.

Recent research expeditions by Principal Investigator (PI), J. Reed, Harbor Branch Oceanographic Institution (HBOI), using HOVs (human occupied vehicle) and ROVs (remotely operated vehicle) along with previous research by the PI in the 1990s and 1980s, have compiled new information on the status, distribution, habitat, and biodiversity of some of these relatively unknown and newly discovered deep reef ecosystems. In 2004, during a State of Florida funded mission with the Johnson-Sea-Link (JSL) Submersible, the PI discovered nearly 300 potential targets during echosounder transects that may be newly discovered deep-water reefs off the east coast of Florida, some of which are up to 168 m (550 feet) in height at depths of 732 m (2400 feet) (Reed and Wright, 2004; Reed et al., 2004b, 2005, 2006). Expeditions in 2002 and 2003 for biomedical research by the PI and funded by the National Oceanic and Atmospheric Administration's Office of Ocean Exploration (NOAA OE) enabled preliminary exploration of additional deep-water reef sites in the western Atlantic (Blake Plateau) and eastern Gulf of Mexico on southwest Florida shelf slope (Reed, 2003, 2004; Reed and Pomponi, 2002b; Reed et al., 2002, 2003, 2004d, 2006). These were the first HOV and ROV dives ever to document the habitat and benthic biodiversity of some of these relatively unknown deep-water reefs.

Justification for High Priority Deepwater Coral Mapping Need:
Excerpt from: "Draft Deepwater Coral Research and Monitoring Plan for the South Atlantic Region" (SAFMC 2007)

Background and Need to Support Management
The SAFMC manages coral, coral reefs and live/hard bottom habitat, including deepwater corals, through the South Atlantic Coral Fishery Management Plan. Mechanisms exist in the FMP as amended to further protect deepwater coral and live/hard bottom habitats. The SAFMC Habitat and Environmental Protection Advisory Panel and Coral Advisory Panel have supported proactive efforts to identify and protect deepwater coral ecosystems in the South Atlantic region. The Council has endorsed the Panels' recommendation for designation of new deepwater Coral Habitat Areas of Particular Concern under the Federal Coral FMP. New deepwater coral HAPCs will be designated through the Fishery Ecosystem Plan Comprehensive Amendment.

Scope
The Deepwater Coral Research and Monitoring Plan for the South Atlantic Region constitutes the regional research component of the implementation plan that will be a part of the NOAA Deep-Sea Coral and Sponge Conservation and Management Strategy. The purpose of the plan is to guide deepwater coral ecosystem research and monitoring efforts conducted by NOAA and partners through grants and contracts in the South Atlantic region. Additional components will address needs to expand partnerships, identify funding needs and implement deliverables.

In developing this plan, the South Atlantic Fishery Management Council is responding to recent amendments to the Magnuson-Stevens Act and NOAA's determination that an agency strategy is needed to effectively and efficiently address deepwater coral ecosystems issues. The primary goal of this Research and Monitoring Plan is to support conservation and management of deepwater coral ecosystems in the South Atlantic region while addressing NOAA's strategy to balance long-term uses of the marine ecosystem with maintenance of biodiversity. The Plan will also assist in meeting the new mandates of the Magnuson-Stevens Act.

This plan incorporates recommendations and needs developed through the Deep-Sea Corals Collaboration meeting held in Tampa, Florida in 2002 and the Deep Sea Corals workshop report (McDonough and Puglise 2003). This will allow the Council to build on the expertise and insight of the international deepwater coral research community. To focus the needs to the South Atlantic region, the Council has engaged regional experts to serve as the primary contributors of this Research and Monitoring Plan.

This Research and Monitoring Plan responds directly to mandates included in the 2006 reauthorization of the Magnuson-Stevens Act:

''SEC. 408. DEEP SEA CORAL RESEARCH AND TECHNOLOGY PROGRAM.
(a) IN GENERAL.—The Secretary, in consultation with appropriate regional fishery management councils and in coordination with other federal agencies and educational institutions, shall, subject to the availability of appropriations, establish a program—
(1) to identify existing research on, and known locations of, deep sea corals and submit such information to the appropriate Councils;
(2) to locate and map locations of deep sea corals and submit such information to the Councils;
(3) to monitor activity in locations where deep sea corals are known or likely to occur, based on best scientific information available, including through underwater or remote sensing technologies and submit such information to the appropriate Councils;
(4) to conduct research, including cooperative research with fishing industry participants, on deep sea corals and related species, and on survey methods;
(5) to develop technologies or methods designed to assist fishing industry participants in reducing interactions between fishing gear and deep sea corals; and
(6) to prioritize program activities in areas where deep sea corals are known to occur, and in areas where scientific modeling or other methods predict deep sea corals are likely to be present.
(b) REPORTING.—Beginning 1 year after the date of enactment of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, the Secretary, in consultation with the Councils, shall submit biennial reports to Congress and the public on steps taken by the Secretary to identify, monitor, and protect deep sea coral areas, including summaries of the results of mapping, research, and data collection performed under the program.''

The president signed the reauthorized Magnuson-Stevens Act on January 12, 2007. Therefore, the first report is due to Congress on or before January 12, 2008. It is the Council's intent to review the report at the December 2008 Council meeting.

For purposes of this plan, Deepwater Coral Ecosystems (DWCE) are defined as:
Deepwater coral, coral reefs, and live/hard bottom habitat in waters extending from 200 m to the seaward boundary of the EEZ.

Goal
To protect deepwater corals by:
A. Refining existing (proposed) and designating new deepwater Coral HAPCs.
B. Increasing our understanding of DWCEs' ecological role and function in the South Atlantic region to guide future management actions.

Phase I: Map and describe known and expected deepwater coral ecosystems in the South Atlantic region.

Phase II: Determine the ecological role of deepwater coral ecosystems in the South Atlantic region, especially the role of deepwater coral habitats as Essential Fish Habitat, and expand the understanding of structure-forming species' biology and ecology.

PHASE I: MAP AND describe KNOWN AND EXPECTED DEEPWATER CORAL ECOSYSTEMS in the south atlantic region

Justification/Background
Deepwater coral ecosystems (DWCEs) are herein defined as deepwater coral, coral reefs, and live/hard bottom habitat in waters extending from 200 m to the seaward boundary of the EEZ. Azooxanthellate cnidarians include branching stony corals (Scleractinia), gorgonians and soft corals (Octocorallia), black corals (Antipatharia) and lace corals (Stylasteridae). These DWCEs therefore include the constructional habitats generated chiefly by colonial scleractinians as well as the non-constructional "gardens" dominated chiefly by other anthozoans and sponges. DWCEs are common within the Exclusive Economic Zone (EEZ) off the southeastern U.S. and 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 to the eastern Gulf of Mexico. Despite a series of exploratory expeditions during the last decade, only a few DWCEs in this region have been mapped in any detail, observed directly or have had their benthic and fish assemblages examined. The limited number of direct observations via submersible or Remotely Operated Vehicle (ROV) indicate that they provide hard substrates and habitat for a relatively unknown but biologically rich and diverse community of associated fishes and invertebrates, including commercial species such as wreckfish (Polyprion americanus), Warsaw grouper (Epinephelus nigritus), deepwater snappers and golden crab (Chaceon fenneri).

Two potential threats—fossil fuel development and bottom fishing—create a time-sensitive need to map and characterize these habitats. A moratorium on oil/gas exploration in Florida waters has long prevented impact from fossil fuel extraction; however, recent U.S. legislation directed at expanding energy production in the Gulf of Mexico, coupled with exploration by Cuba in waters adjacent to the Florida Keys, has expanded this threat. Liquefied natural gas re-gassification facilities and several proposed natural gas pipelines and offshore facilities could also directly impact local DWCEs. With respect to fishing, DWCEs worldwide have been seriously impacted by bottom trawls (Fosså et al. 2002, Freiwald et al. 2004). In Florida waters, unprotected portions of the Oculina Bank off the central east coast (75-100 m depth) have been severely affected both by overfishing and bottom trawling (Koenig et al. 2000, 2005; Reed et al. 2005b, Reed et al. in review).

Increasing our understanding of the distribution and composition of these assemblages; the physical, trophic and biochemical interactions of their components; and the environmental forcing factors that control distribution and composition across regional to local scales will enable effective ecosystem management. Such information will also provide the requisite baseline for examining ecosystem response to potential stressors and for investigating all aspects

of component organism biology, including population dynamics, physiology, genetics and biopharmacology.

Objective 1: Map the distribution of DWCEs in the Southeastern U.S. EEZ.
1A. Determine the extent of known DWCEs in the South Atlantic region.
DWCEs occur along the southeastern coast of the United States from North Carolina to the southwestern Gulf of Mexico. Areas where DWCEs have been identified include: 1) North Carolina Lophelia mounds—three mound systems represent the northernmost DWCEs in the South Atlantic Bight; 2) Stetson Reefs—hundreds of pinnacles up to 152 m tall at depths of 640 to 900 m on the eastern Blake Plateau off South Carolina; 3) Savannah Lithoherms—numerous lithoherms at depths of 490 to 550 m with up to 60 m vertical relief; 4) East Florida Lophelia Reefs—hundreds of 15-152m tall coral bioherms and lithoherms at depths of 600 to 870 m along the shelf margin from southern Georgia to the Straits of Florida; 5-6) Miami and Pourtalès Terraces—relict phosphoritic limestone bank-margin hardgrounds and escarpments extending from Boca Raton to Key West at depths of 200 to 600 m; and 7) Southwest Florida Lithoherms—dozens of 15m tall Lophelia lithoherms at 500 m in the eastern Gulf of Mexico (Reed et al. 2004, 2005a, 2006). Only a small percentage of these sites has been investigated beyond fathometer transects; each new exploratory expedition discovers new sites. Many more coral sites are likely, and the full extent of topographic features on the Blake Plateau remains unknown. Similarly, the distribution of possible DWCEs along the southern margin of the Florida peninsula south of Miami and along the Florida shelf margin in the Gulf of Mexico are largely uninvestigated.

Increasingly sophisticated mapping technology, such as ship- and Autonomous Underwater Vehicle (AUV)-mounted multibeam sonar systems with backscatter data, side-scan sonar systems, and sub-bottom seismic profilers can be used to provide detailed bottom imagery with resolution to 1-3 m. A simple light-weight digital camera system can also be lowered during fathometer or AUV transects of topographic features to provide first-order ground-truthing (i.e., to determine presence/absence of corals) (see Grasmueck et al. 2006, in review). Geographic Information Systems (GIS) can be used to integrate mapping data with other geo-spatial information (e.g., fishing pressure, management areas, biological, geological, physicochemical observations, geophysical structure, hydrodynamics) to generate detailed and precise maps and datasets and foundation for robust system analyses, predictions, and management protocols. Only a small portion of this region has been mapped using ship based multibeam sonar (S. W. Ross et al. 2006, unpubl. data); maps from the North Carolina coral mounds and a portion of the Stetson Banks revealed numerous new features, suggesting that the coral habitat is much more extensive than previously thought. Only a few days of multibeam mapping (Ross et al. 2006 cruise) provided more bottom type data than had been accumulated in 6 years of previous cruises.

TASK 3: Conduct acoustic seabed mapping, and ground-truth with visual surveys within proposed CHAPCs and priority areas outside CHAPCs . Begin with low-resolution over wide areas followed by high-resolution mapping of targeted area (e.g., multibeam echo sounder, sidescan sonar) and ground-truthing (e.g., ROVs, AUVs, towed cameras, cores, samples) based on SAFMC recommendations.

1B. Map human activities that may impact DWCEs.
As noted in the Justification/Background section above, fossil fuel development and bottom fishing represent the primary potential near-term threats to local DWCEs. The continuing depletion of coastal fisheries may expand fishing efforts into deeper habitats in search of valuable commercial species such as royal red shrimp (Hymenopenaeus robustus), other shrimps and crabs, wreckfish, and other fish species (some not yet exploited). One of these, the Warsaw grouper, is a candidate for designation as a threatened or endangered species.

**PRIORITY TARGET SITES OFF FLORIDA**
Reed (2004, 2006a) and Reed et al. (2005, 2006) provide the most detailed data of the deepwater, live bottom habitats off eastern Florida. The following sites are suggested for priority targets for multibeam sonar mapping of the bottom:

1) East Florida Lophelia Reefs (Fig. 1: 06 East Florida Deep Sites.tif): This map shows most of the deep water sites that Reed et al. (2006) have ground-truthed with visual observations (numbers to left of dot) and also shows fathometer profiles (yet to be surveyed) which indicate high-relief bottom and probable hard or coral bottom (F#'s to right of dots). The red outline is the general region that I suggest is top priority for multibeam mapping.
The fathometer sites (F#) on the map only indicate a few of the nearly 300 high-relief features (>15 ft relief) that were mapped by Reed et al. (2006) with single beam echosounder (fathometer) along the ~2600 ft contour from Jacksonville to about Jupiter, Florida. The PI has the original fathometer files which show latitude, longitude, depth for each feature. Of these sites listed above, the primary sites are those reported in Reed et al. (2006). Site 12 (Pinnacle 204B) is the northern most feature of the East Florida Lophelia Reef zone 30o30'N) and one of the largest features. It appeared from the echosounder to be nearly 3 nm N-S, 0.8 nm E-W, with 157 m relief. Other high-relief features include Reed Reef Sites #13-22. In addition, newly surveyed sites not include Reed Reef #52 (nearly 100% live Lophelia reef) and surveys for proposed natural gas pipelines off Palm Beach (Reed, 2006b) and Fort Lauderdale (Messing et al., 2006). Also the TopSpot bathymetry chart of eastern Florida has the best bathymetry that I have seen to date (Fig. 2: TopSpot Chart- Canaveral Lophelia bathy.tif). This clearly shows high relief features which could be targeted from north of Cape Canaveral ($28^0$50'N) to West Palm ($26^0$40'N). It appears to be quite accurate according to the sub dives I have made on specific features that I selected from this map.

2) Miami Terrace escarpment: This Miocene-age terrace off southeastern Florida has high-relief, hard-bottom habitats and rich benthic communites depths of 300-600 m that ranges from south of Boca Raton to southern Biscayne Bay (Fig. 3: Miami Terrace bathy with outline HAPC.jpg; Reed et al., 2006).

3) Pourtalès Terrace: This is a continuation of Miami Terrace off the Florida Keys (depth 200-460 m) of which habitat and fauna were described in detail by Reed et al. (2005) including high relief bioherms and deepwater sinkholes (Fig. 4: 04 Lophelia MS- Fig 12- Pourtales Sites.tif).

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## LEG II: SURVEY/SAMPLING METHODOLOGIES

*(For all activities, a Plan of the Day (POD) will be provided to the bridge nightly that details the specifics of the projects and timelines related to operations and logistics for the following day.)* Daytime operations during Leg II of the GRNMS cruise will involve SCUBA operations (no deeper than 130 fsw), opportunistic multibeam mapping, and benthic sampling (June 18-22 only). At night, scientists will deploy a subbottom profiler and sidescan sonar, and may occasionally conduct sediment grab operations. In addition, we also intend to utilize the ship's multibeam system. Below is a proposed timeline of activities to be conducted. This is meant only to be a general guide for how these activities could occur and is not intended to be a binding daily schedule.

0730 – Divers load launches (2)
0800 – Launches deploy for two dives
0830 – Ship transits to grab location to conduct grab sampling *or* multibeam

1115 – Launches return to FOSTER
1130 - Recover launches
1130 - Lunch
1230 – Load launches
1245– Launches redeploy for two dives
1330 - Ship transits to grab location to conduct grab sampling *or* multibeam
1600 – Launches return to FOSTER
1615 – Recover launches
1700 – Secure from diving operations (unless a night dive is required)
1800 – Commence transects for sub-bottom profiling and multibeam
0600 – Complete sub-bottom profiling and multibeam

*Special Activities in addition to above (all contingent on weather):*
June 14th: R/V Savannah in area to conduct ROV operations (requires two divers from R/V Nancy Foster to board R/V Joe Ferguson to support ROV operations); Media invited to observe operations
June 18th: personnel transfer; Media also invited to observe operations (GRNMS vessel for transport)
June 19th: Sanctuary Advisory Council invited to observe operations (GRNMS vessel for transport). Up to twenty visitors for 2-3 hours.

## PRIORITY OBJECTIVES: LEG II

Objective 1: Sub-bottom profiling in Gray's Reef National Marine Sanctuary.

Objective 2: Studies of benthic invertebrate populations and population dynamics on hard bottom reefs of the South Atlantic Bight.

Objective 3: Paleontological and geologic structure survey.

Objective 4: Contribute to Southeastern Regional Taxonomic Center's benthic invertebrate collection

## PROJECTS: LEG II

### Objective 1: Sub-bottom profiling in Grays' Reef National Marine Sanctuary
*Dr. Paul Gayes*

A high resolution geophysical survey is planned to advance the understanding of the regional framework of the continental shelf in the vicinity of the marine sanctuary. The survey will consist of towing an Edgetech 512i CHIRP subbottom profiler and a Klien 3000 side scanning sonar. The tracklines of the survey will form a regional grid with regularly spaced shore-parallel and shore perpendicular lines of survey. This regular grid may be modified to provide additional resolution of features in key areas and sites where previous work has identified specific questions or if significant structures are identified during the survey.

A listing of specific waypoints will be provided to the bridge. Navigation for all lines of survey will be provided to the bridge via HYPACK hydrographic survey software display from the Science Lab. Individual lines may be added, deleted or shifted as necessary to accomplish project objectives.

Geophysical Surveys

Chirp and Side scan Surveys will consist of running high-resolution CHIRP sub-bottom profiling and side scan sonar. Both systems have been regularly used on the Foster and are towed simultaneously.

The CMWS Chirp system can be towed at the surface within a small catamaran sled or as a deeper towed towfish. Both configurations have been routinely used on the Foster in the past. The configuration providing the best data quality for the conditions and water depths operating in will determine which configuration is used for the cruise.

The chirp sled is towed by a cable behind the ship and held outboard of the ships wake as much as possible. As a result it should be towed from a block set well off the center line of the A-Frame. The ship's trawl wire should be rigged through this block and connected to either the sled or towfish. A second electrical/data cable can be hand deployed and adjusted as the towfish is deployed and retrieved by the ship's trawl winch/A-Frame. The load of the towfish (~200-300 lbs) is carried by the ship's trawl winch and A-Frame.

The geophysical survey is weather dependant and usually limited by the presence of white-capping waves or large, short period swell. To limit excessive force on data cable extra care is requested when turning to tracklines and general maneuvering while towing geophysical gear. Turns should be broad and gentle and completed at survey speed (4-5 knots) to safeguard against undue strain on or crossing of chips and side scan cables being towed from the ship.

The CMWS Side Scan Sonar is also towed from the fantail. The fish is hand deployable and the tow cable is typically run through a large diameter block on a davit well off the centerline of the A-Frame but on the opposite side from the Chirp Sled. Typically the CHIRP system is deployed first followed by the side scan.

Shipek Surficial Sediment Grab

If weather conditions do not allow for geophysical surveys or if significant features are identified during the survey, a series of Shipek bottom grabs may be requested. CMWS will bring a Shipek grab for this purpose and specific grab locations will be identified from the geophysical imagery during the cruise and provided as target location via Hypack to a monitor on the bridge. This will show the ship's position relative to the target and distance/heading to the grab site. Normally, station tolerance is set for 20 meters/50 feet but this positioning requirement may be relaxed or tightened depending on conditions and objectives.

The Shipek grab is normally operated from the port A-Frame using the ship's trawl winch. The grab weighs around 100 lbs. Operation requires the grab to be lifted off the deck and held while personnel prep and cock the grab, then the grab is lowered over the side to the bottom. Once at the bottom the grab will trigger and can be immediately returned to deck. Once on deck, the grab

is again supported around 2-3 feet off the deck while personnel remove the sample. This is a secondary operation and most likely to be requested to ground truth geophysical survey lines in the event of weather conditions beyond tolerance for geophysical survey.

**Objective 2: Studies of benthic invertebrate populations and population dynamics on hard bottom reefs of the South Atlantic Bight.**
*Dr. Daniel Gleason*

Our goal on this cruise is to make substantial progress on the following three projects being conducted currently by our group:

*1) An Interactive Web-based Guide to the Benthic Invertebrates and Cryptic Fishes of Gray's Reef*
We will continue our stepwise approach to identifying the benthic invertebrates and cryptic fishes of Gray's Reef and surrounding hard bottom areas. This approach includes identifying potential exotics, providing literature associated with these species, and building a database of phenological events and physical conditions on the reef. During this cruise we will carry out the following activities in pursuit of this goal:

- We will continue to fill in as many gaps as possible by targeting species where we lack either photographs or specimens.
- We will continue collection and in situ photography of conspicuous benthic macroinvertebrates that are not presently represented in our collection to expand the breadth of the web-based guide.
- We will continue meiofaunal sampling in hard bottom areas by suspending buffer pads slightly above the reef substrate.
- We will collect and redeploy PVC traps for assessments of cryptic fish and invertebrate fauna. We have 10 traps on 3 different reefs that we collect at periodic intervals.
- We will explore at least one new site, looking for new benthic organisms for the collection.

Approximate number of dives needed: 6 at various reefs

*2) Dispersal and recruitment of benthic marine invertebrates at Gray's Reef National Marine Sanctuary*
The specific goals of this project are to follow recruitment of benthic marine invertebrates to newly established patches of bare reef substrata off the coast of Georgia and document changes in patch community structure over time and to determine if recruitment of benthic marine invertebrates to hard bottom sites off the coast of Georgia is primarily the end product of local or long distance dispersal of larvae. This project has practical implications for management of the GRNMS because it will provide baseline information that can be used to assess what short and long-term impacts might result from user-induced damage to the benthos. This project was initiated during the May 22-30, 2004, Nancy Foster cruise on J-Reef and has been expanded to a site within the boundaries of Gray's Reef National Marine Sanctuary. Activities conducted for this project will consist of the following:

- At J-Reef we will continue photographic monitoring of the 20 natural plots (30x30 cm each) established and 10 pieces of artificial substrate deployed in summer 2004.

- We will use a small chain to document topographic complexity in the natural plots and on the artificial substrate.
- At the GRNMS monitoring site we will re-establish treatment plots originally set up on the 2005 Nancy Foster Cruise by again scraping clean 30 x 30 cm sections of substrate on the top of the ledge using a chisel and hammer. There will be a total of 10 haphazardly selected replicate plots that will be scraped clean and 10 unmanipulated controls.
- At J-Reef, we will stain with alizarin red-S colonies of *Oculina arbuscula* that have settled on paving tiles deployed in 2005. The purpose of this staining will be to provide a mark on the skeleton that can be used for future measures of coral growth.
- We will use the multi-beam capabilities of the Nancy Foster to map hard bottom areas at the following sites: Gray's Reef National Marine Sanctuary Monitoring Site (31º 23.815 N, 80º 53.461 W) and Patch Reef #1 (31° 24.340 N, 80° 51.983 W), J Reef (31º 36.056 N, 80º 47.431 W), the R2 Tower hard bottom (31º 24.305 N, 80º 35.490 W), and Ledge #6 (31º 37.688 N, 80º 34.662 W).

Approximate number of dives needed: 4 at J reef and 6 at GRNMS

*3) Dynamics of benthic marine invertebrate communities on temperate offshore reefs of Georgia*

The goal of this project is to determine if established communities of sessile benthic invertebrates on individual subtidal hard bottom reefs vary both spatially and temporally and to determine if sediment is a major factor structuring these communities. Preliminary observations indicate that sessile benthic invertebrate populations on SAB reefs vary over small spatial scales (i.e., a few meters) on individual outcrops and temporally on scales that range from seasonal to annual. Thus, monitoring of benthic invertebrate populations in this system must be conducted over temporal scales that allow seasonal variation to be differentiated from longer term patterns or stochastic events. In the absence of such monitoring, our ability to predict trends and to manage the system is compromised. This is a new research direction and will be initiated during the cruise as follows:

- Monitoring of sessile benthic invertebrates will be initiated by quantifying populations in 0.5 x 0.5 m (0.25 $m^2$) quadrats placed adjacent to a 30 m long transect line. A total of 3 transect lines will be established at each of 2 sites (J-Reef and GRNMS Monitoring Site): one following the ledge immediately adjacent to the scarp, one placed 2 m away from the scarp on the sandy ledge, and one placed 5 m away from the scarp on the sandy ledge. Transect lines will be placed in these positions to take into account gradations in community composition that appear to occur on these ledges.
- Sediment traps will be deployed along the same transect lines used to monitor temporal and spatial variation in the benthic invertebrate communities. These traps will consist of 5 cm diameter x 30 cm length polyvinyl chloride pipe capped at one end. A total of 30 traps, 10 replicates along each of the 3 transect lines at each site, will be attached with plastic cable ties to the stainless rods that mark the transect line positions. This will ensure that sedimentation rates are quantified within close proximity to the monitoring of benthic cover. All traps along a single transect line will be separated by a horizontal distance of no less than 2 m.

Approximate number of dives needed: 12 at J reef and 12 at GRNMS

**Objective 3: The University of Georgia Center for Applied Isotope Studies - Paleontological and geologic structure survey**
*Dr. Scott Noakes*

In the summer of 2006 numerous dives were completed on J-Reef in search of fossilized bone fragments often found at the reef. Near the end of the diving season, a large mammalian (cetacean) bone section was discovered under an outcrop at J-Reef. Due to the size and shape of the bone, it is thought to be a whale jaw bone. Scallops from the overlying outcrop has been previously dated to approximately 40,000 years old. Approximately 1.5 m of the bone was excavated last fall before the end of the diving season. This summer, dives need to be made at J-reef to assess the condition of the bone and continue excavation. Additional time needs to be spent on the area around the bone to determine if any other related bones exist under the ledge.

A second priority for the cruise is to inspect, photograph, and measure the scallop outcrop identified at both sections of the USS Daniel (located near J-Reef). Upon completion of the Daniel dives, a location selected between the Daniel and J-Reef will be selected and sand will be removed from the bottom in an attempt to identify the depth of the scallop bed. This will help determine if the scallop bed is continuous from J-Reef to the Daniel and at what depth (~1/2 m expected).

Continued dives on Gray's Reef and surrounding live-bottom areas will be completed as a general reconnaissance for fossils and artifacts. Last year some of the dives on the live-bottom areas identified fossilized scallops (GR-12) and bone fragments.

**Objective 4: Southeastern Regional Taxonomic Center – South Carolina Department of Natural Resources (June 18-22)**
*Dr. Betty Wenner*

The SERTC is building a curated collection of invertebrates from the South Atlantic Bight (Cape Hatteras to Cape Canaveral). The collection serves as a tissue repository for genetic research and provides voucher specimens for development of taxonomic guides and digital images of specimens to document features that are not available in traditionally preserved material. Since funding began, the SERTC has developed a substantial regional invertebrate collection. In 2006, SERTC scientists collected macro-invertebrates during the GRNMS cruise that significantly augmented our collection with specimens from the Sanctuary and the surrounding area, where we have been unable to sample. Many of the specimens we collected were photographed while alive, to provide high quality images for our taxonomic guides, educational posters and our popular website. Images from that 2006 cruise on the R/V Nancy Foster were supplied to staff at GRNMS for their use.

On the 2007 cruise, we plan to collect infaunal specimens from the GRNMS. We are especially interested in peracarid crustaceans and polychaetes. Specimens retained during the cruise will be preserved, curated and cataloged for use by SCDNR, other researchers, graduate students, academic institutions, museums, and various educational programs.

The specific goals for this cruise are:

1) To obtain high-quality digital images of infaunal invertebrates for future guides and publications;
2) To obtain amphipod, isopod and polychaete specimens that are under-represented in our voucher collection;
3) To obtain high-quality images of other invertebrates for our digital image library and for use in educational materials, website and public donations. Because we will be sorting material that is collected, we will be able to photograph those taxa that may lose diagnostic characteristics like pigmentation, or contract to the extent that they are difficult to examine;
5) To expand our existing specimen collection with invertebrates from the GRNMS and surrounding waters (5 miles from boundaries); and
6) To target one or two species of octocorals (small branching gorgoniids and plexaurids) for the SERTC collections.

Methods:
1) SCUBA -*In situ* photography and hand collection of specimens will be done within the sanctuary. Collection will be made with a hammer, chisel, and scissors.
2) A Smith-McIntyre grab will be deployed just outside the sanctuary. "Live rock" collected will be washed to obtain invertebrates and returned to the bottom. The sample will be elutriated and sieved to obtain macroinvertebrates.

Needs:
The following assistance from the ship's crew and other participating scientists will be needed to achieve our goals on this cruise:
1) Profiling and bottom typing - This data will help us chose collection sites outside the sanctuary.
2) Gear deployment - Deployment of the grab that require mechanical equipment, such as winches, will require assistance from the ship's crew.
3) Sorting - We will request the assistance of other available scientists and students to help handle gear, sort and sieve samples, and perform other tasks that may arise.
4) Space - We will need laboratory space for a photographic copy stand, microscope and light source, laptop computer, and counter space for preserving and sorting. We will need deck space for rough sorting samples and for gear storage. We may need freezer space for some specimens and storage space for equipment, containers, preserved specimens, etc.

**EQUIPMENT AND SUPPLIES**

Vessel Provided

- A trained technician / crew member to mix gas and fill tanks
- 24 NITROX scuba tanks and means of refilling tanks at sea to support dive operations
- 1 small boat for deployment of up to 6 divers with operator
- 2 small boats for deployment of up to 3 divers with operator
- One operator for each of the small boats which will be provided by the ship
- Winch with stainless wire
- A-frame for deployment/recovery of equipment
- J-frame for deployment/recovery of equipment

- Freezer space for at least 80cuft
- Refrigerator (2-3 cu. Ft.)
- Electronic feed into dry and wet labs of ship's GPS and fathometer
- CTD
- Crane and operator for mobilizing and demobilizing equipment and gear and for launching boats
- Clean 110v power from the wet lab

Project Provided

- See Appendix A for list of AUV equipment
- 12 NITROX Tanks; urface operated sampling gear to include seismic gear and grab samplers
- Sample containers and miscellaneous sampling supplies
- Various redundant diving equipment
- Various lab supplies and equipment
- HAZMAT spill kit
- CMWS Klien 3000 and Klien 595 Side Scan Sonar with Isis acquisition (CMWS)
- CMWS Edgetech 512i Chirp Sub bottom profiler ( Power requirements for these are standard 110v outlets available in OCEA Lab).
- Shipek Bottom Sediment Grab.

## HAZARDOUS MATERIALS

All scientific operations will be conducted in compliance with general requirements for the handling of hazardous materials as outlined in the NMAO "Environmental Compliance and Guidance Manual." The Co-Chief Scientists will be directly responsible for the handling, both administrative and physical, of all hazardous wastes by the scientific party.

The Chief Scientist shall be responsible for complying with MOCDOC 15, Fleet Environmental Compliance #07, Hazardous Material and Hazardous Waste Management Requirements for Visiting Scientists, released July 2002. Details regarding those requirements will be provided by the Chief of Operations, Marine Operations Center – Atlantic upon request and may be reached at 757-441-6842

By Federal regulations and NOAA Marine and Aviation Operations policy, the ship may not sail without a complete inventory of all hazardous materials by name and the anticipated quantity brought aboard, MSDS and appropriate neutralizing agents, buffers, and/or absorbents in amounts adequate to address spills of a size equal to the amount of chemicals brought aboard and a chemical hygiene plan. The amount of hazardous material arriving and leaving the vessel shall be accounted for by the Chief Scientist.

The following is the list of hazardous materials and anticipated quantities to be brought aboard for NOAA Ship NANCY FOSTER Cruise NF-05-12-GRNMS:

**A. From Invited Participants**:

| Chemical Name | Quantity | Characteristics |
|---|---|---|
| • 70% Ethanol | 40 L | Flammable |
| • 95% Ethanol | 30 gal | Flammable |
| • Magnesium Chloride | 500 g | Irritant |
| • Formalin (10%) | 4 L | Caustic |
| • Methanol | 1 L | Flammable |
| • Acetone | 1 L | Flammable |
| • 100% Formalin | 1 L | Caustic |
| • Diethyl ether | 100 mL | Flammable |
| • Methylene Chloride (dichloromethane) | 4 L | Flammable |
| • Methanol | 4 L | Flammable |
| • Butanol | 4 L | Toxic |
| • Hexane | 4 L | Toxic |
| • Carrageenan | 100 g | Non caustic |
| • Sodium alginate | 100 g | Non caustic |
| • Calcium chloride solution | 500 mL | Alkaline |
| • Agar | 100 g | Non caustic |
| • Liquid Nitrogen | 35 L dewar | Freeze burns |
| • Bleach | 1 L | Non caustic |

An updated inventory of all hazardous materials and quantities that will be brought aboard, along with a "Material Safety Data Sheet" for each specific hazardous material (i.e., formalin, ethyl alcohol), will be provided to the Commanding Officer before the ship's departure. Upon completion of the cruise, the Principal Investigators will provide to the Commanding Officer a final inventory of hazardous materials showing that all such materials brought aboard have been properly used up or removed in suitable waste containers.

While on the ship, hazardous materials not in use will be stored in suitable containers that meet DOT regulations for the transport and storage of such materials. The dewar of liquid nitrogen will be secured outside on deck. Smaller volumes of flammable materials that are in use on a regular basis (e.g., small containers of ethyl alcohol) will be kept in a flammable liquid storage cabinet inside the ship's lab.

The scientific party will provide all required neutralizing agents, buffers, and absorbents in amounts adequate to address potential spills of sizes up to the amounts of hazardous materials indicated above. For Cruise NF-05-12-GRNMS the list of spill-response equipment will include the following:

HAZMAT Spill-Response Equipment List

- Inert absorbent pads approved for use with formalin and solvent spills;
- Official HAZMAT spill response kit;
- Protective gear (gloves, eyeglasses, respirators) for spill-response personnel.

No liquid wastes will be introduced into the ship's drainage system. No solid waste material will be placed in the ship's garbage. All such wastes will be removed from the ship and disposed of using suitable procedures for hazardous materials.

All scientific operations will be conducted in compliance with general requirements under a Chemical Hygiene Plan for Chemical Labs aboard NOAA ships. As part of this plan, precautions will be taken to avoid harmful levels of hazardous materials due to:

- Inhalation (e.g., work with solvents and formalin in fresh air or in areas with good ventilation to avoid exposure; in case of exposure, move to unexposed area with fresh air immediately; if not breathing, give artificial respiration or, if breathing is with difficulty, then give oxygen; follow up with medical attention).
- Skin contact (e.g., wear gloves and protective clothing when working with solvents and formalin to avoid contact; in case of contact, flush skin immediately with water for at least 15 minutes and wash all contaminated clothing; follow up with medical attention).
- Eye contact (e.g., wear protective goggles when working with solvents and formalin to avoid eye contact; in case of contact, flush eyes immediately with water for at least 15 minutes and follow up with medical attention).
- Ingestion (e.g., avoid using solvent and formalin around food and drink; in case of ingestion, induce vomiting immediately; seek medical attention)
- Exposure that may aggravate existing medical conditions (e.g., persons with pre-existing skin disorders, eye problems, or impaired liver, kidney or respiratory function, should avoid working directly with solvents or formalin and let other scientific personnel perform these activities).

Additional information on precautions for avoiding exposure problems, and for appropriate first-aid treatment in the event of exposure, will be provided in the Material Safety Data Sheets (MSDS) for each individual HAZMAT brought onboard.

No radioactive materials will be brought onboard by the scientific party during this cruise.

## SCIENTIFIC PARTY

Chief Scientist Authority: The Chief Scientist has the authority to revise or alter the technical portions of these instructions provided that, after consultation with the Commanding Officer, it is ascertained that the proposed changes will not: (1) jeopardize the safety of the personnel or the ship; (2) exceed the time allotted for the project; (3) result in undue additional expense; or (4) alter the general intent of the Project Instructions.

Principal Investigator Authority: In the absence of the Chief Scientist, the Principal Investigators will be appointed to assume the duties and responsibilities of the Chief Scientist.

Scientific Personnel List:

**Cruise Leg I**

| Name | Affiliation | Status |
|---|---|---|
| Greg McFall | NOS/NMS | M-USA |

| | | |
|---|---|---|
| Sarah Fangman | NOS/NMS | F-USA |
| Betty Wenner | SCDNR/SAFMC | F-USA |
| Jocelyn Karazsia | NOAA Fish Hab/SAFMC | F-USA |
| Andrew Kennedy | College of Charleston | M-USA |
| Lance Horn | NOAA/NURC | M-USA |
| Jeff Williams | NOAA/NURC | M-USA |
| Vernon Asper | NOAA/NURC | M-USA |
| Glenn Taylor | NOAA/NURC | M-USA |
| Steve Brodet | NOAA/NURC | M-USA |
| Rob Downs | NOAA/NURC | M-USA |
| Paul Higgens or Scott Sharpe | NOAA/NURC | M-USA |
| Craig Harmak | FWRI | M-USA |
| Tim Battista | NOAA/NCCOS | M-USA |
| Josh Mode | College of Charleston | M-USA |

*Total gender count:* *F-3 M-12*

| | |
|---|---|
| Roger Pugliese** | SAFMC |
| John Reed** | HBOI |
| Tina Udouj** | FWRI |

** Note: Indicates members involved in cruise planning and follow-up

**Cruise Leg II**

| Name | Affiliation | Status |
|---|---|---|
| Greg McFall* | NOS/NMS | M-USA |
| Sarah Fangman* | NOS/NMS | F-USA |
| Danny Gleason* | Georgia Southern | M-USA |
| Hampton Harbin* | Georgia Southern | M-USA |
| Stephanie Schopmeyer* | Georgia Southern | F-USA |
| Leslie Bates* (June 12-18) | Georgia Southern | F-USA |
| Rob Ruzicka* | Georgia Southern | M-USA |
| Scott Noakes* (June 12-18) | University of Georgia | M-USA |
| David Grenda* | REEF | M-USA |
| Betty Wenner (June 18-22) | SCDNR | F-USA |
| Paul Gayes | Coastal Carolina | M-USA |
| Erin Scher | Coastal Carolina | F-USA |
| Jamie Phillips (June 12-18) | Coastal Carolina | M-USA |
| Monica Price | Coastal Carolina | F-USA |
| Jeff Marshall (June 12-18) | Coastal Carolina | M-USA |
| Clark Alexander (June 18-22) | Skidaway Institute | M-USA |
| Mike Robinson (June 18-22) | Georgia Southern | M-USA |

Note: *Indicates staff members who will/may function as divers during cruise.

*Total gender count:* *F:5 M:9*

Medical History Reports: Participants will forward completed copies of the "NOAA Health Services Questionnaire" and proof of TB testing or course of treatment to the NOAA Health Safety Officer prior to the ship's departure for review and approval.
NOAA Fleet Medical Policy requires all personnel embarking on NOAA vessels to furnish a completed copy of the NOAA Health Services Questionnaire (NHSQ) to the Health Services Office of the Marine Operations Center. This form should be submitted 30 days in advance of sailing, but no later than 7 days in advance of sailing. The Chief Scientist is responsible for the timely submission of NHSQs for scientific personnel to the Health Services Office.

Meals and Berthing: Meals and berthing are required for up to 7 scientists. Meals will be served 3 times daily beginning one hour before scheduled departure, extending throughout the cruise, and ending two hours after the termination of the cruise. Berthing requirements, including number and gender of the science crew, will be provided to the ship by the Chief Scientist. The Chief Scientist and Commanding Officer will work together on a detailed berthing plan to accommodate the gender mix of the scientific party taking into consideration the current make-up of the ship's complement.

All NOAA Scientists will have proper travel orders when assigned to any NOAA ship. The Chief Scientist will ensure that all non NOAA or non Federal scientists aboard also have proper orders. It is the responsibility of the Chief Scientist to ensure that the entire scientific party has a mechanism in place to provide lodging and food and to be reimbursed for these costs in the event that the ship becomes uninhabitable and/or the galley is closed during any part of the scheduled project.

Since the watch schedule is split between day and night, the night watch may often miss daytime meals and will require adequate food and beverages (for example a variety of sandwich items, cheeses, fruit, milk, juices) during what are not typically meal hours. Special dietary requirements for scientific participants will be made available to the ship's command at least seven days prior to the survey.

Communications: A progress report on operations prepared by the Chief Scientist may be relayed to the program office. Sometimes it is necessary for the Chief Scientist to communicate with another vessel, aircraft or shore facility. Through various modes of communication, the ship is able to maintain contact with the Marine Operations Center on an as needed basis. These methods will be made available to the Chief Scientist upon request, in order to conduct official business. Due to a new directive from Marine Operations Center, the science party must reimburse the ship for all calls made using INMARSAT, Sky Cell and cellular communications. The Chief Scientist will be required to keep a log of all calls made by the science party. Charges will be assessed against the program after the ship receives the bill. There is generally a three-month delay receiving the bill for review.

FOREIGN NATIONAL ACCESS AND DEEMED EXPORT CONTROLS: All foreign national access to the vessel shall be in accordance with NAO 207-12 and RADM De Bow's March 16, 2006 memo (http://deemedexports.noaa.gov). The foreign national's sponsor is responsible for obtaining clearances and export licenses required and for providing for required escorts by the

NAO. Programs sponsoring foreign nationals should consult with their designated line office personnel to assist with the process (http://deemedexports.noaa.gov/contacts.html).

The following are basic requirements. Full compliance with NAO 207-12 is required.

**Responsibilities of the Chief Scientist:**

Ensure the following is provided to the Commanding Officer before any foreign national will be allowed on board for any reason:

1. Written notification identifying the NOAA Program individual who is responsible for ensuring compliance with NOAA and export regulations for the foreign national (see Foreign National Sponsor responsibilities below).
2. A copy of the DOC/OSY clearance authorization for access by the foreign national.
3. A copy of Appendix B of NAO 207-12 with NOAA Chief Administrative Officer concurrence endorsement.
4. Written notification that the foreign national has been cleared against the State, Commerce and Treasury departments' Lists to Check. http://www.bis.doc.gov/ComplianceAndEnforcement/ListsToCheck.htm
5. Provide the NOAA Foreign National List spreadsheet for each foreign national in the scientific party.

Escorts – The Chief Scientist is responsible to provide escorts to comply with NAO 207-12 Section 5.10, or as required by the vessel's DOC/OSY Regional Security Officer.

Ensure all non-foreign national members of the scientific party receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the servicing Regional Security Officer.

Export Control - The Chief Scientist is responsible for complying with NAO 207-12 and the development of Technology Access Control Plans for items they bring aboard. The Chief Scientist must notify the Commanding Officer of any export controlled items they bring aboard and any access restrictions associated with these items.

The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

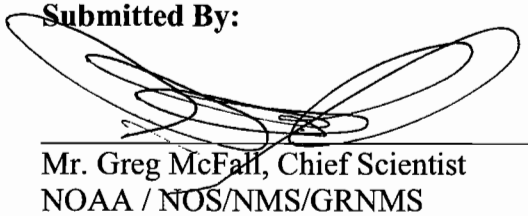
**DIVING OPERATIONS**

Diving operations will be conducted as required to support the collection of invertebrates, benthic samples, and conduct fish surveys, recovery of lost gear and for ship's husbandry as required. Individuals who will function as divers are identified in Section 14 above in the list of scientific crew. Greg McFall will serve as the divemaster for all dive operations on this cruise. A minimum of two divers will work together on all dives. Dives may be conducted in teams of two, three or four people. Each team will dive twice and sometimes four times daily as allowed

under "No Decompression" limits of 36% NITROX. A "lay-day" may be scheduled in the middle of the cruises for the purposes of "offgassing." Night dives may be conducted during the cruise as need, time and logistics allow. The presence and use of a qualified technician or crewmember to mix NITROX and fill tanks is respectfully requested.

**CRUISE INSTRUCTION APPROVALS**

**Submitted By:**



Mr. Greg McFall, Chief Scientist
NOAA / NOS/NMS/GRNMS
10 Ocean Science Circle
Savannah, GA 31411
912-598-2416

**Approved By:**

CAPT. Emily Christman, Commanding Officer
Marine Operations Center, Atlantic
NOAA

## Appendix A. AUV Shipboard Requirements

**Overview -** The Eagle Ray is an Explorer-class Autonomous Underwater Vehicle built by International Submarine Engineering Ltd. (www.ise.bc.ca). It has a torpedo shaped body constructed of detachable sections of glass reinforced plastic (GRP) composite and aluminum alloy. There are two horizontal control planes forward, four control planes aft in an "X" configuration, and an exposed, two-bladed propeller. Various antennae protrude upward from the aft section and can be raised on a telescoping mast. Various scientific and navigation sensors are exposed in the forward and aft sections. Two strong lift points are provided fore and aft on top, and each lifting point can bear the full weight of the vehicle.

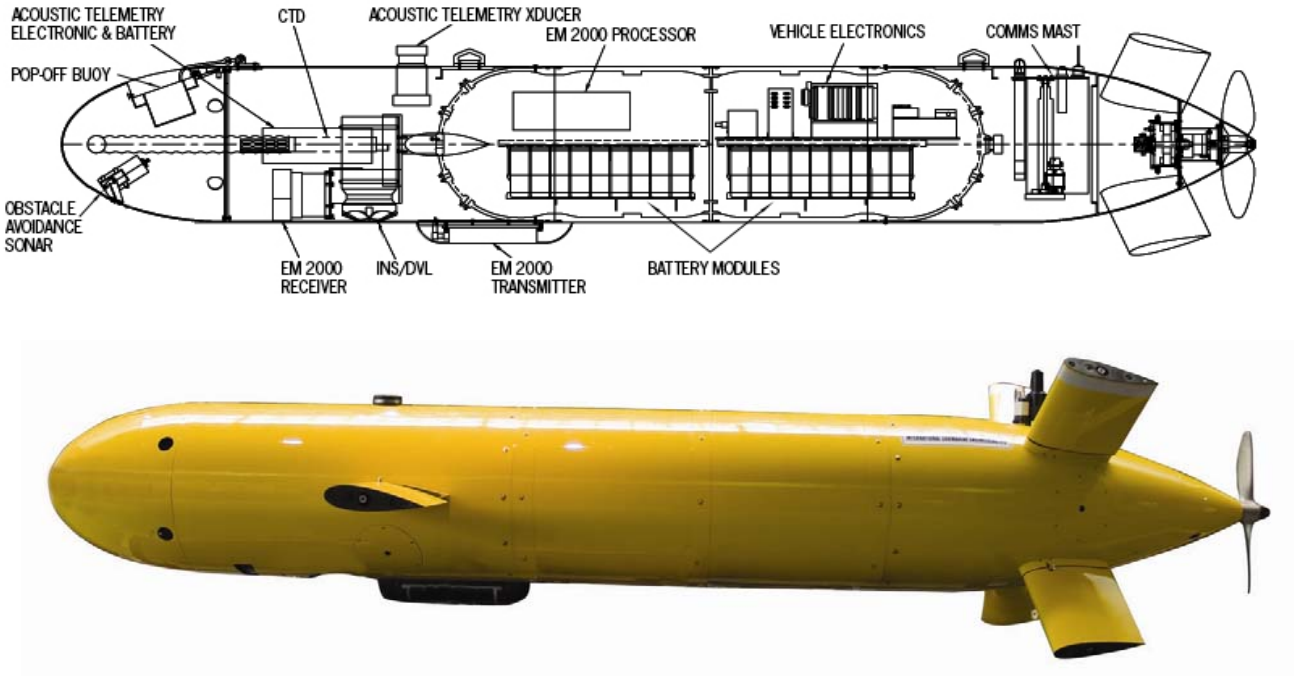



**Figure 2: Schematic drawing above picture of Eagle Ray AUV with streamlined nose cone.**

| | | |
|---|---|---|
| Length overall | 5.03 m | 16.5 ft |
| Hull diameter | 0.69 m | 2.3 ft |
| Weight | 903.6 kg | 2008 lb |
| Width at fore planes | 1.49 m | 4.9 ft |
| Height at aft planes | 1.13 m | 3.7 ft |
| Height with mast extended | 1.89 m | 6.2 ft |

**Table 1: Eagle Ray dimensions**

**Eagle Ray Scientific Support Van -** The Eagle Ray AUV and its support equipment are safely housed and shipped in its Scientific Support Van (Figure 2), a standard 8'x 20' ISO shipping container equipped to maintain the vehicle in a climate-controlled environment. The van is

designed to hold all of the components required to operate the vehicle including enclosed shelves for technical manuals and reference material, battery chargers, bins for equipment and parts storage, and wall hanging devices for antennas and cables. An overhead extendable boom, a rolling trolley with manual hoist, and a vehicle cradle on casters enable two people to move the vehicle into and out of the van. The fully packed container with vehicle weighs a total of 17,000 pounds. The van can be chained to the deck of the ship or twist lock tie downs will be provided that can be welded to the deck which allows the container to be locked down on all four ISO corner fittings (See Figure 3 for dimensions).

**Figure 2: AUV Support Van fully loaded. Note that extendable boom is offset to the right of center.**

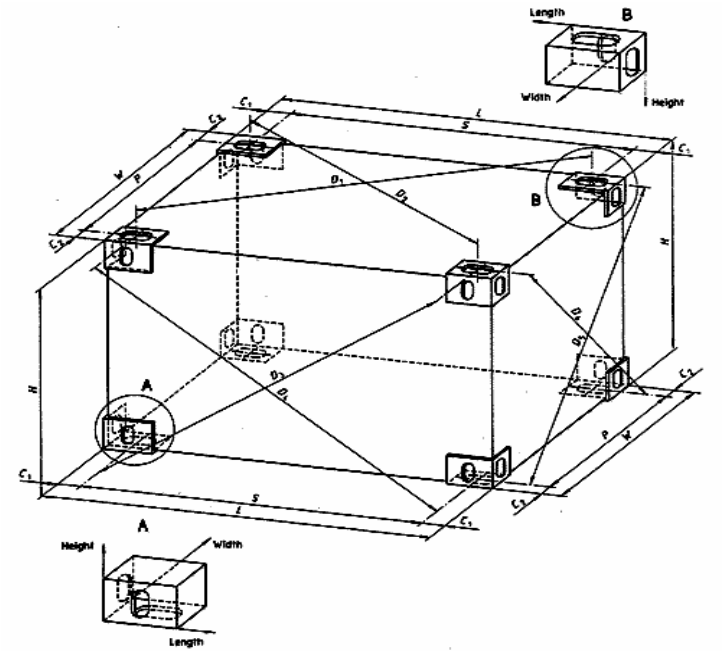



**Figure 3: Support Van Dimensions**

| | |
|---|---|
| L | 19’ 10-1/2” |
| W | 8’ |
| H | 8’ |
| P | 7’ 4-31/32” |
| S | 19’ 2-7/16” |

**Eagle Ray Scientific Support Van Power Requirements –** The scientific support van contains a transformer that can take a variety of ship power and convert it to the power required for the van. A 50 foot deck whip is supplied to connect the van to 208, 240, or 460 VAC single phase

ship's power. The deck whip has three (two power and one ground) #6AWG wires (black, white, and green) that hook up inside a panel on the support ship and a plug that mates to the van.

The internal batteries of the AUV are recharged in place without requiring the hull to be opened. Two custom power supplies convert ship's power to appropriate charging voltage and amperage levels. The power supplies are normally located in the AUV Support Van, however, if the van is not taken aboard the support ship, then the power supplies must be placed in an environmentally controlled space in the support ship that is protected from rain and sea spray. The power supplies must be located within 50 feet of the aft end of the AUV for charging purposes. Each power supply has a Hubble brand HBL2621 plug that fits the corresponding HBL2620 receptacle, and requires 220 VAC, 30 amps, 60 Hz single phase power.

**Launch and Recovery System (LARS) Requirements -** The Launch and Recovery System is designed to be mounted on ships of opportunity in order to facilitate the launch and recovery of the AUV using deck cranes or A-frame/winch assemblies (Figures 4 and 5). Cranes or A-frame/winch assemblies used to deploy the AUV must be capable of handling a minimum of 6,000 pounds lift and be capable of reaching at least 10 feet from the stern of the support vessel. The LARS rests on an ISO frame base (with exactly the same footprint dimensions as the scientific support van) and weighs approximately 4000 pounds. It is designed to be either welded directly to the deck of the support vessel or locked into place using ISO twist lock tie downs which are welded to the deck.

**Figure 4: AUV on LARS and ready for deployment by shipboard crane.**

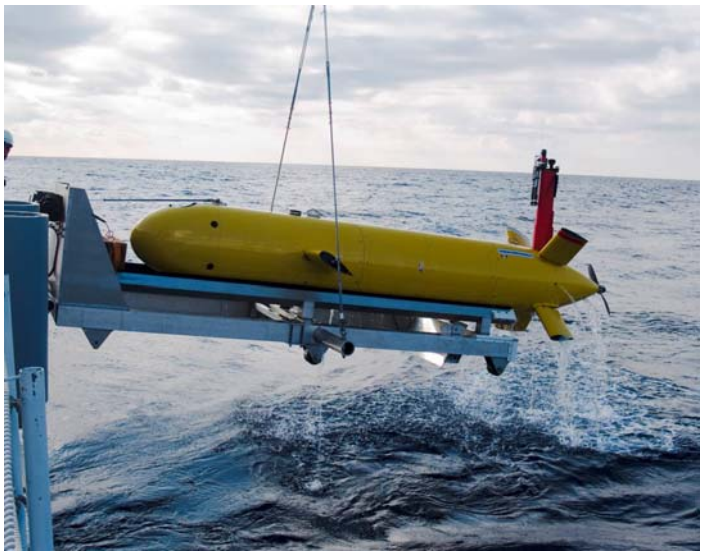


**Figure 5: AUV being recovered with the LARS**

AUV staff will provide the operations supervisor and one LARS operator. Ship's crew required for LARS operations include a crane operator and two line handlers. Adequate deck lighting is required for night operations. During deployment, the support vessel is asked to maintain

heading at approximately three knots while the crane or A-frame operator moves the ramp and truck portion of the LARS out over the water. The ramp is lowered until the AUV just begins to slide down the ramp and pulls the restraining line tight. The LARS is lowered approximately four more inches to ensure that the AUV will slide down the ramp into the water once the restraining line is cut. During recovery, the AUV is maneuvered so that the nose is pointing with the seas. The support vessel is maneuvered, backing down into the seas, close to the AUV. Ideally, the bridge will have aft controls and direct line of sight to the stern of the vessel. The AUV deck supervisor will be directing the bridge on distances and direction to the AUV during recovery. On command, the AUV will release a pop-up buoy from a recessed space in the nose to aid in recovery. The buoy is attached to the forward lift point with 60 feet of 3/8" floating line of 3600 pound working strength. If necessary, the AUV can be driven astern to pay out the recovery line. This line is recovered and attached to the winch on the LARS. The support vessel is asked to take a heading and maintain approximately three knot speed through the water as the AUV is winched onto the LARS ramp and lifted out of the water.

The NAUV may also be launched and recovered using special lifting lines, quick-release or snatch-hooks, and tag lines, which will be provided by the AUV staff. Adequate cleats for guiding and snubbing the tag lines are required. Numerous deck attachment points for installing recovery hardware would be ideal. For unusual or difficult recovery operations, a small boat with two crew or divers may be required to aid in recovery efforts.

**Dry Lab Space Requirements -** The AUV surface support electronics are packaged in a portable shock mount rack case. The electronics must be secured in a protected environment. Six feet of counter space must be provided for the electronics rack, uninterruptible power supply, two computer consoles (LCD screen, keyboard, mouse), and one laptop computer with adequate tie down points to secure the electronic equipment. Additional dry lab space requirements include:

- Dry storage (typically 40 square feet) required for numerous spare parts and consumables storage bins.
- A through-hull bulkhead penetrator (4" typical) is required to pass various cables (antennae, acoustic modem, vehicle telemetry, etc.) from the dry lab area to the outside deck.
- Radio communications with the bridge and deck must be possible. The AUV staff provides standard VHF handheld radios for dry lab and deck use.
- Dedicated 110 VAC, 30 amp, 60 Hz single phase power to operate the AUV electronics.
- Depth data is desired. Data should be provided to the AUV support electronics in the dry lab area in NMEA compatible serial format (RS-232).

**Bridge Mission Repeater -** Mission workstation details such as vehicle tracking, planned AUV route, current AUV location, and support ship location relative to the AUV will be made available on the bridge. This information is vitally important to bridge personnel to safely maneuver the support vessel near the AUV. A flat screen monitor, 100 foot video cable, and video splitter/amplifier will be provided by the AUV staff. Video or network (IP) feeds may be used.

**Acoustic Transponder Mounting Requirements –** Two acoustic hydrophone transducers that extend below keel depth are required to enable tracking and communications with the AUV.

Typically, these hydrophones are mounted to a custom hydrophone pole (provided by the AUV crew) that bolts to the side of the support vessel (Figure 6). The pole contains a swivel that allows the hydrophone to be raised while the support vessel is underway, and lowered and stabilized with forward and aft guy wires when conducting AUV operations. It is imperative that the support vessel maintain less than 6 knots speed through the water when the hydrophone pole is in the lowered position, and that the support vessel be dead in the water when the hydrophone pole is being deployed or recovered. The hydrophone must be mounted within 100 feet of the dry lab area. After mounting, the installation must be precisely surveyed for alignment calibration by the AUV staff.


**Figure 6: Preparing to deploy hydrophone pole.**

**Mobilization/Demobilization Requirements –** The AUV scientific support van and the LARS will arrive at the support vessel location on a 40 foot, air-cushioned ride, flat bed truck. A crane is required to lift the van and the LARS from the truck and place them onto the support vessel. The crane will typically be arranged by the AUV staff unless the support vessel has easy access to a crane with sufficient lifting capacity. **It is the responsibility of the support vessel's Captain to ensure that the van and LARS are securely fastened to the deck, that they do not block vital access points, and that all welding is conducted safely.**

## Shipboard Requirements Summary

| | Science Support Van | LARS | AUV | Control Console |
|---|---|---|---|---|
| Dimensions (LxWxH) | 19.8’ x 8’ x 8’ | 19.8’ x 8’ x 5’ | 16.5’ x 4.9’ x 3.7’<br>Cradle length = 18’ | With Covers = 27.5”x29”x33”<br>W/O Covers = 27.5”x 22”x33” |
| ISO Corners Center to center | 7’ 4-31/32” x 19’ 2-7/16” | 7’ 4-31/32” x 19’ 2-7/16” | N/A | N/A |
| Weight (pounds) | 17,000 (fully loaded) | 4,000 | 2,008 | 73 |
| Components/ Contents | See AUV Load List | Truck<br>Ramp<br>ISO Platform<br>I-beam Rail System | See Figure 1 | SCC, MPW, ATC<br>power supplies, Ethernet hub, wireless, sat comm., DGPS Antennae connections |
| Power Requirements | 208, 240, 460 VAC / 60 A single phase, 60 Hz | 110VAC / 15 A<br>60 Hz<br>Runs on batteries, charged from Science Support Van with extension cord | 54.4 VDC / 28 A<br>Supplied by battery chargers in science support van | 110 VAC / 30 A<br>60 Hz<br>Ship dry lab power to UPS system to console. |
| Power Connector(s) | Van end of deck cable:<br>Shore = Hubble 460C12W<br>Ship = Hubble 360C7W<br><br>Ship’s end of deck cable:<br>Three 6-AWG wire pigtail (Blk, Wht, Grn) | Standard 110AC Plug | Ethernet = MCIL8M<br>Charge = IL3F<br>(Subconn) | HBL26CM11<br>Adaptor to standard wall<br>Receptacle socket provided |
| Critical Distances | To Dry Lab = 100’<br>To Power hookup = 50’ | From Support van for cradle footprint = 22’ | From open end of Support Van for charging batteries = 40’ | To support vessel bridge = 100’<br>To Hydrophone pole = 80’ |
| Hydrophone Mount: Swivel plate is bolted to gunnel with 3/8” hardware (provided), bolts fore and aft on 4” centers. Need cleats fore and aft of where plate is bolted to gunnel for guy lines. | | | | |

Contact Information: Lance Horn
National Undersea Research Center
University of North Carolina at Wilmington
5600 Marvin Moss Lane
Wilmington, NC 28409
Office: (910) 962-2443
Cell: (910) 512-0193
Email: hornl@uncw.edu