UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
Marine Operations Center
439 W. York Street
Norfolk, VA 23510-1114

August 31, 2017

MEMORANDUM FOR: Commander Nicholas Chrobak, NOAA
Commanding Officer, NOAA Ship *Pisces*

FROM: Captain Scott M. Sirois, NOAA
Commanding Officer, NOAA Marine Operations Center-Atlantic

SUBJECT: Project Instruction for PC-17-05
Deep Water Atlantic Habitats II

Attached is the final Project Instruction for PC-17-05, Deep Water Atlantic Habitats II, which is scheduled aboard NOAA Ship *Pisces* during the period of September 10 – September 29, 2017. Of the 18 DAS scheduled for this project, 18 days are funded by a Line Office Allocation. The project is estimated to exhibit a Medium Operational Tempo. Acknowledge receipt of these instructions via e-mail to **OpsMgr.MOA@noaa.gov** at Marine Operations Center-Atlantic.

FINAL Project Instructions

Date Submitted: August 22, 2017

Platform: NOAA Ship *Pisces*

Project Number: PC-17-05 (OMAO), 2017-004-FA (USGS).

Project Title: *Deepwater Atlantic Habitats II:* Continued Atlantic Research and Exploration in Deepwater Ecosystems with Focus on Coral, Canyon, and Seep Communities

Project Dates: **September 10, 2017 to September 29, 2017**

Prepared by: AMANDA DEMOPOULOS (Digitally signed by AMANDA DEMOPOULOS, Date: 2017.08.24) Dated: ____________

Dr. Amanda W.J. Demopoulos
Chief Scientist
USGS-Wetland and Aquatic Research Center, 7920 NW 71st St., Gainesville, FL 32653

Approved by: MOWITT.WILLIAM.P.1241785161 (Digitally signed by MOWITT.WILLIAM.P.1241785161, Date: 2017.08.28 15:39:27 -04'00') Dated: ____________

CDR William Mowitt
Deputy Director
Office of Ocean Exploration & Research

Approved by: ____________ Dated: 9-1-17

Captain Scott M. Sirois, NOAA
Commanding Officer
Marine Operations Center - Atlantic

I. Overview

A. PC 17-05 *Deepwater Atlantic Habitats II:* Continued Atlantic Research and Exploration in Deepwater Ecosystems with Focus on Coral, Canyon, and Seep Communities, 10 September – 29 September, 2017.

This expedition is the first of three cruises for this project focused on exploring and characterizing seeps, corals, and canyon environments along the Atlantic margin. This project is a collaboration among three federal agencies: the Bureau of Ocean Energy Management (BOEM), NOAA Office of Ocean Exploration and Research (OER), and the U.S. Geological Survey (USGS). TDI Brooks with academic partners has been selected to serve as BOEM contractor for this study. Data gathered during this mission and future cruises for this project will help inform multiple management issues concerning this region. Details regarding daily operations and objectives can be found below.

B. Days at Sea (DAS)

Of the _18_ DAS scheduled for this project, _0_ DAS are funded by an OMAO allocation, _0_ DAS are funded by a Line Office Allocation, _18_ DAS are Program Funded, and _0_DAS are Other Agency funded. This project is estimated to exhibit a Medium Operational Tempo.

C. Operating Area (see figure 1)

The cruise will focus on several putative seep sites, canyons, and hard bottom features located <100 nm offshore, 36.8455°N, -74.5844°W to 31.7421°N, -79.0941°W (See Figure 1, Table 1).

D. Summary of Objectives

The goal of this expedition is to validate several seep targets (Fig. 1), image and map seeps, canyons (e.g., Keller, Pamlico, Hatteras, and unnamed canyons), and hard bottom features located between Virginia and Georgia. Specific objectives include:

1. Survey canyon, seep, and hard bottom features using AUV *Sentry* multibeam, subbottom profiling, digital still camera, and other sensors to characterize the seafloor in and around these benthic habitats.
2. Conduct CTD casts to collect sediment (monocore, see Appendix 2) and water samples (down to 2000 m).
3. Collect multibeam bathymetry with the ship's Simrad ME70 in areas lacking high resolution bathymetric data.
4. Conduct trawling operations a mid-water tucker trawl (see Appendix 3) net from the stern (preferred) or the starboard side J-frame (if needed).
5. Create a georeferenced database that incorporates MB bathymetry, the seafloor imagery, CTD data, and other environmental sensor data from *Sentry* with locations of benthic communities, including seep organisms and deep-sea corals and sponges.

E. Participating Institutions

1. US. Geological Survey

2. Woods Hole Oceanographic Institution

3. NOAA-OER

4. Stony Brook University

5. Nova Southeastern University

6. Temple University

F. Personnel/Science Party: name, title, gender, affiliation, and nationality

Name (Last, First)	Title	Date Aboard	Date Disembark	Gender	Affiliation	Nationality
Amanda Demopoulos	Chief-Scientist Research Ecologist	9/10/17	9/29/17	female	USGS	USA
Tracey Sutton	Ecologist	9/10/17	9/29/17	male	Nova	USA
Joe Warren	Contractor	9/10/17	9/29/17	male	Stony Brook	USA
Jason Chaytor	Research Geologist	9/10/17	9/29/17	male	USGS	USA
Brian Andrews	Geographer	9/10/17	9/29/17	male	USGS	USA
Sean Kelley	*Sentry* ex. lead	9/10/17	9/29/17	male	WHOI	USA
Mike Jakuba	*Sentry*	9/10/17	9/29/17	male	WHOI	USA
Ian Vaughn	*Sentry*	9/10/17	9/29/17	male	WHOI	USA
Andy Billings	*Sentry*	9/10/17	9/29/17	male	WHOI	USA
Jennifer Vaccaro	*Sentry*	9/10/17	9/29/17	female	WHOI	USA
Alanna Durkin	Contractor-Student	9/10/17	9/29/17	female	Temple	USA
Natalie Slayden	Contractor	9/10/17	9/29/17	female	Nova	USA
Nina Pruzinsky	Contractor-student	9/10/17	9/29/17	female	Nova	USA
Caitlin Adams	NOAA-OER	9/10/17	9/29/17	female	NOAA	USA
Jennifer McClain-Counts	Biologist Technician	9/10/17	9/29/17	female	USGS	USA
Sarah Cahill	Technician	9/10/17	9/29/17	female	USGS	USA

G. Administrative

1. Points of Contacts:

ademopoulos@usgs.gov	{Chief Scientist}
skelley@whoi.edu	{AUV *Sentry* lead}
CO.Pisces@noaa.gov	{Commanding Officer – PISCES}
XO.Pisces@noaa.gov	{Executive Officer – PISCES}
ops.Pisces@noaa.gov	{Operations Officer – PISCES}

2. Diplomatic Clearances

None Required.

3. Licenses and Permits

Letter of Agreement with SE Fisheries region is being processed.

II. Operations

The Chief Scientist is responsible for ensuring the scientific staff are trained in planned operations and are knowledgeable of project objectives and priorities. The Commanding Officer is responsible for ensuring all operations conform to the ship's accepted practices and procedures.

Key Changes and Points of Emphasis:

1. **Science watches will be on a flexible schedule to accommodate the *Sentry* schedule.**
2. **Mission will Depart from and Return to Morehead City, NC.**
3. ***Sentry* will begin mobilization 10 September 2017.**
4. **CTD rosette must be on board, calibrated, with new bottles mounted; sensors rated to at least 2000 m.**
5. **EK60 will require current calibration**
6. **Shore-side crane is needed to offload Sentry and additional containers. WHOI, with assistance from the ship, will make the arrangements.**
7. **Forklift needs to be on the dock and available for demobe**
8. **Demobe will start on 29 September**
9. **WHOI equipment will be placed on deck according to layout discussed during *Sentry* team's visit to the ship.**
10. **Mission requires transducer to be mounted on centerboard and associated cabling for USBL navigation prior to sailing.**

A. Project Itinerary:

This expedition will focus on seeps, canyons, and hard bottom coral features located between Virginia and Georgia (36.8455°N, -74.5844°W to 31.7421°N, -79.0941°W) (see Figure 1, Table 1). There are several seep targets, so some of the canyon sites may be dropped in order to optimize data collection and survey of potential seeps.

10 Sept: Begin mobilization of *Sentry* and scientific equipment.

11 Sept: Depart Morehead City, NC.
Transit to Hatteras Canyon, map/EK 60 upon arrival, depending on time

11/12 Sept: Conduct *Sentry* dive at Hatteras Canyon "seeps", following dive conduct CTD cast, potentially trawl depending on EK60 data, then transit to Avon B seep. If possible, collect ME70 data when *Sentry* is in the water.

12 Sept: Conduct *Sentry* operations at Avon B;

13 Sept: Transit to and dive at Avon A; following dive conduct CTD cast, potentially trawl depending on EK60 data

14 Sept: Transit to Keller Canyon, *Sentry* Dive.

15 Sept: Continue dive at Keller Canyon; following dive conduct CTD cast, potentially trawl depending on EK60 data

16 Sept: *Sentry* dive at shallow seeps at the head of Keller Canyon;

17 Sept: transit to unnamed canyon north of Keller; conduct CTD cast, potentially trawl depending on EK60 data

18 Sept: *Sentry* dive at unnamed canyon

19 Sept: transit to Pea Island Seeps (A,B, or C)
20 Sept: *Sentry* dive at Pea Island Seeps
21 Sept: Transit to target south of Cape Lookout, *Sentry* dive
22 Sept: continue dive, conduct CTD cast, and potentially trawl depending on EK60 data
23 Sept: Transit to Savannah Banks, *Sentry* Dive
24 Sept: continue dive, conduct CTD cast, and potentially trawl depending on EK60 data
25 Sept: Transit to Stetson Banks, *Sentry* Dive
26 Sept: continue dive
27 Sept: finish survey, conduct CTD cast, potentially trawl depending on EK60 data, begin transit back to Morehead City
28 Sept: Arrive Morehead City, offload scientific collections and equipment; disembark scientific personnel.

29 Sept: Demob, including *Sentry*

B. Staging and Destaging:

Staging will begin 10 September 2017

Sentry and associated equipment/containers will already be on board

Destaging will begin on 28 September 2017

- Fork lift needs to be in place and available on 28/29 September
- Additional crane will be required to offload *Sentry* and associated containers
- Ship's personnel will be needed (e.g. Crane operator) to help offload scientific equipment on 28 and 29 Sept.

Offload Vehicle Van, Server Van, *Sentry*

Unspool spectra line

C. Operations to be Conducted:

Operational Plans: Detailed protocols for each of the operations will be provided to the vessel prior to mobilization. While there are several operations planned for this mission, some adjustments to the day to day operations and sampling locations may be necessary to ensure maximal use of *Sentry*.

The cruise operations are summarized as follows. The expedition will focus on suspected seep locations based on bubble plume locations obtained through previously collected multibeam data of the water column (Skarke et al. 2014), deep-sea canyons, and hard bottom coral and suspected deep-sea coral locations. Table 1 lists the lat/long/depth for these sites. AUV *Sentry* dives/surveys will be the primary "sampling" equipment used on this expedition (Figure 2). Multibeam sonar mapping using the ME70 (Pisces) will occur between dives and only in selected areas where data are incomplete or absent (150-440m). Time permitting, the following additional operations will be conducted to better characterize the oceanographic environment around the targeted features examined by *Sentry*. CTD casts with the monocore attached will be deployed at selected stations to be determined. Max depth for these operations will be 2000m. Water column backscatter data will be collected using the EK60 to locate deep-scattering layers (DSL). Midwater trawls will target identified DSL, pending time available.

While general targeted locations are identified in Table 1, specific locations for *Sentry* dives will be selected based on available multibeam depth data to plan deployments. These locations will be given to the ship before sailing. We request that the Pisces's Navigation Officer examine selected locations and identify any stations that may be a concern in terms of obstructions, depth, or other issues before deployment. If station-location problems are identified, then additional sampling locations will need to be selected prior to the dive operations during the cruise.

Sentry surveys will be conducted using the following methodology. Specific locations on the seafloor will be selected and transect lines between these "points" will be delineated. Depending on the spatial extent of the features of interest, 1-2 dives per feature will be planned. The first will use *Sentry*'s Reson 7125 to acquire high resolution multibeam data over the features of interest at an altitude of 60 MAB. These dives could last 6-8 hrs. Following *Sentry* recovery, multibeam depth data will be processed in order to plan a longer (possibly 24+hr) dive to collect georeferenced bottom photography for image transects to enable maximum image collection over habitat features of interest. Alternatively, if the *Sentry* data indicate there are no target areas of interest, then a new site will be selected for a *Sentry* survey, depending on the quality of the survey data. The remaining time will be used for recharging batteries and downloading data while conducting other operations.

Sentry will be programmed prior to each dive to conduct single or multiple passes over targets in order to yield the highest spatial coverage over features of interest. Transects over targets may include multiple features of interest including hard bottoms and unverified seeps, and/or move over varied terrain of different depth, slopes, and reflectivity.

Depending of the spatial extent of targeted areas, days at sea will be divided among sites with approximately 1-2 days in each area (Table 1 provides a list of prioritized areas). Transit between priority areas will occur when *Sentry* is on deck for battery charging and data downloads. Multiple *Sentry* deployments will be made in several, but not likely all, of the priority areas. Generalized launch and recovery protocols are provided in Appendix 1. When *Sentry* is on deck to download data and recharge batteries, ME70 operations, CTD/monocore casts, EK60 surveys, and/or mid-water trawling will be conducted. Monocore and trawling protocols are provided in Appendices 2 and 3, respectively.

<u>Scientific Computer System (SCS)</u>: *Pisces*' SCS system is a PC-based server, which continuously collects and distributes scientific data from various navigational, oceanographic, meteorological, and sampling sensors throughout the cruise. Date and time for data collections from computers, instrumentation, and log sheet recordings will be synchronized using the vessel's GPS master clock. The *Pisces'* Survey Tech is responsible for ensuring data collection.

The ship's Scientific Computer System (SCS) will be required for logging data on a routine basis and data requirements will be coordinated with the Commanding Officer and Electronics Technician at the beginning of the cruise. The bridge officers will be requested to execute "*Sentry* Events" using established software applications to capture SCS data streams during *Sentry* operations. Detailed information on data collection protocols will be supplied to the ship prior to sailing. Collection of ship sensor data through sampling events is a critical requirement to support this work. It is requested that the time server/time date be imbedded into the SCS files. Global Positioning System (DGPS or P-code GPS) provides data on vessel towing speed and direction to be recorded at a frequency of 1 Hz. A list of the requested SCS sensors is provided in Table 2. It is requested that the sensors be operational, calibrated and that logging capabilities be enabled.

<u>EK60 and ME70 Data Acquisition</u>: The Simrad EK60 echo sounder, (18-, 38-, 70-, 120-, and 200-kHz with split-beam transducers mounted on the retractable center-board) will acquire data continuously throughout the cruise, as long as its operation won't interfere with other sensor data collection. The EK60 will be interfaced to the SCS to record bottom depth and vessel log values. The EK60 will be interfaced to the POSMV motion sensor. When operational, the EK60 will be synchronized with the Simrad ME70 multibeam (operating within the frequency band 70–120 kHz), and the ship's ADCP. The EK60 is not synchronized with the other sounders and Doppler speed log on the vessel. To minimize acoustic and electrical interference, whenever possible we request deactivating other sounders on the vessel. The survey technicians will be responsible for EK60 and ME70 data acquisition and storage. The science party will provide survey plans to the bridge and survey tech (or appropriate designee) as soon as possible and in the required format prior to the survey start time.

In between dives, while *Sentry* is recharging batteries and downloading dive data, ship operations may include transiting to the next target location, ME70 data acquisition, EK60 data collection, CTD casts with monocore, and/or mid-water trawling. If *Sentry* expedition lead and *Pisces* CO approve, then CTD casts and/or trawling may occur while *Sentry* is in the water conducting surveys.

Further details on these additional operations are as follows:

1. Physical oceanographic parameters will be monitored through CTD casts, and the ship's flow-through thermosalinograph and fluorometer instruments.

2. Multibeam sonar mapping, using the ship's ME70 (operating within the frequency band 70–120 kHz) systems, will be conducted. Survey technicians with help from the science team will be responsible for multibeam operations. Data collected (.all files) will be saved and provided to the chief scientist. Science team will provide XBTs to sample the speed of sound for multibeam sonar calibration.

3. CTD casts will be conducted when *Sentry* is on deck and is non-operational or if the ship and Sentry ExLead determine it is safe to deploy while *Sentry* is in the water. The ship will supply SBE19+ and SBE911+, ECO Chlorophyll Fluorometer and Turbidity sensor (rated to at least 2000 m), and O_2 sensor (rated to at least 2000 m), and have these ready for use in support of the ship multibeam ops. CTD rosette will also collect discrete water samples. The survey technician, with help from the science team, will be responsible for CTD operations.

4. A monocore (Figure 3) will be securely attached to the CTD rosette at selected stations to collect discrete, quantitative bottom samples. The science team, with help from the survey tech and deck crew, will be responsible for CTD/monocore operations.

5. Mid-water trawling will be conducted to sample pelagic species from within deep-scattering layers identified in the EK60 data. The science team, with help from the survey tech and deck crew, will be responsible for trawling operations on the stern A-frame or starboard J-frame.

D. Dive Plan

Dives are not planned for this project.

E. Applicable Restrictions

Bad weather conditions, high sea states, equipment failure, safety concerns, and unforeseen circumstances can preclude normal operations. The ship's officers, chief scientist, and *Sentry* engineers will assess and address any concerns or issues affecting normal operations.

III. Equipment

A. Equipment and Capabilities provided by the ship (itemized)
CTD rosette with sufficient weight to conduct CTD casts down to 2000m
CTD sensors required: transmissometer, DO, temperature, conductivity, depth

EK60
ME70
ADCP
Dynamic Positioning
Oxygen sensor rated to at least 2000m
ECO Chlorophyll Fluorometer and Turbidity sensor rated to at least 2000m
Working winches
Working cranes
Freezers—80 and walk-in freezer
Seawater available on deck

B. Equipment and Capabilities provided by the scientists (itemized)

Sentry AUV 1. WHOI AUV *Sentry*: *Sentry* (Figure 2), (http://www.whoi.edu/main/sentry), operated through the WHOI-Deep Submergence Facility, is an internally recording, 6000 m rated, AUV with these basic specifications:

Depth capability	6,000 meters
Dimensions: Length:	2.9m (9.7ft)
Width	2.2m (7.2ft)
Height	2m (6.5ft)
Weight:	1,451 kg (3,200 lb) without extra science gear
Operating range	70-100 km, (38-54 mile) depending on speed, terrain and payload
Operating speed	0-1.2 m/s (0-2.3 knots)
Propulsion	:4 brushless DC electric thrusters on pivoting wings
Energy	Lithium Ion batteries; 13 kWh
Bus power	48-52 Volts DC.
Endurance	18-40 hours depending on mission type
Recharge time	10 hours, 16 hour full turnaround from surface to release
Descent/Ascent speed	40m/min for both descent and ascent, 2400m/hr.
Navigation	USBL Navigation with real-time Acoustic Communications and/or Long Baseline (LBL) using acoustic transponders, Doppler Velocity Log (DVL), and Inertial Navigation System (INS)

These sensors are standard to Sentry's configuration:

Sensor	Model
Sonardyne Ranger 2 w/ Avtrack2	Ranger 2
WHOI LBL	Custom
INS	IXSEA PHINS 1 INS
DVL	RDI 300kHz
Pressure Depth Sensor	Paroscientific 8B7000
CTD	SBE FastCAT 49
Dissolved Oxygen	Aanderaa Optode w/ fast foil
Turbidity	Seapoint Optical Back Scatter (OBS)
Side Scan Sonar	Edgetech 2200-M 120/410kHz
Sub Bottom Profiler	Edgetech 2200-M 4-24kHz
Magnetometers Camera	3x APS1520 3 axis Prosilica GC-1380C Digital Still Camera
Multibeam	Reson 7125 MBES 400kHz with 7216 receiver

Sentry operations requirements: Protocols for *Sentry* operations will be discussed during a meeting of WHOI *Sentry* team lead Sean Kelley, Chief Scientist A. Demopoulos and *Pisces* crew during a pre-cruise meeting. Launch and recovery protocols are provided in Appendix 1.

Monocore (Fig. 3): The monocore will be suspended under the CTD rosette by a 10 m line. The monocore weighs about 33 lbs. The CTD will be lowered to as near bottom as possible. The monocore will collect a sample of the bottom sediments. Refer to Appendix 2 for sampling protocol.

Mid-water trawl: Two rectangular mid-water trawls ("Tucker trawls") will be supplied by the science crew. The larger trawl (the "Mother Tucker") will be used if stern deployments are feasible. The smaller trawl ("Baby Tucker") will be used if side deployments are necessary. Both trawls can be physically handled during deployment and retrieval by the science party. Both trawls are single-warp and can be deployed on non-conducting hydrowire, though conducting cable would be preferred if possible (for real-time depth determination). Both trawls weigh less than a CTD rosette. Detailed specs are given in Appendix 3.

IV. Hazardous Materials

A. Policy and Compliance

The Chief Scientist is responsible for complying with FEC 07 Hazardous Materials and Hazardous Waste Management Requirements for Visiting Scientific Parties (or the OMAO procedure that supersedes it). 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 quantity, MSDS, appropriate spill cleanup materials (neutralizing agents, buffers, or absorbents) in amounts adequate to address spills of a size equal to the amount of chemical brought aboard, and chemical safety and spill response procedures. Documentation regarding those requirements will be provided by the Chief of Operations, Marine Operations Center, upon request.

Per OMAO procedure, the scientific party will include with their project instructions and provide to the CO of the respective ship 30 days before departure:

- List of chemicals by name with anticipated quantity
- List of spill response materials, including neutralizing agents, buffers, and absorbents
- Chemical safety and spill response procedures, such as excerpts of the program's Chemical Hygiene Plan or SOPs relevant for shipboard laboratories
- For bulk quantities of chemicals in excess of 50 gallons total or in containers larger than 10 gallons each, notify ship's Operations Officer regarding quantity, packaging and chemical to verify safe stowage is available as soon as chemical quantities are known.

Upon embarkation and prior to loading hazardous materials aboard the vessel, the scientific party will provide to the CO or their designee:

- An inventory list showing actual amount of hazardous material brought aboard
- An MSDS for each material
- Confirmation that neutralizing agents and spill equipment were brought aboard sufficient to contain and cleanup all of the hazardous material brought aboard by the program
- Confirmation that chemical safety and spill response procedures were brought aboard

Upon departure from the ship, scientific parties will provide the CO or their designee an inventory showing that all chemicals were removed from the vessel. The CO's designee will maintain a log to track scientific party hazardous materials. MSDS will be made available to the ship's complement, in compliance with Hazard Communication Laws.

Scientific parties are expected to manage and respond to spills of scientific hazardous materials. Overboard discharge of hazardous materials is not permitted aboard NOAA ships.

B. Inventory

Common Name of Material	**Qty**	**Notes**	**Trained Individual**	**Spill control**
Formalin	14 liters	Stored in ship chem. locker	A. Demopoulos	F
95% Ethyl Alcohol (ethanol)	1 liter	Alkalinity, stored in ship chem. locker	A. Demopoulos	E
99% non-denatured ethanol	1 liter	Stored in ship chem. locker	A. Demopoulos	E
Mercuric	500 ml	Very toxic, corrosive.	A. Demopoulos	M

Chloride		Stored in ship chem. locker		
Borate buffer (Borax)	1 kg	Stored in ship chem. locker	A. Demopoulos	NA - powder

C. Chemical safety and spill response procedures

F: Formalin/Formaldehyde

- Ventilate area of leak or spill. Remove all sources of ignition.
- Wear appropriate personal protective equipment.
- Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible.
- Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container.
- Do not use combustible materials, such as saw dust.

E: Ethanol

- Ventilate area of leak or spill. Remove all sources of ignition.
- Wear appropriate personal protective equipment.
- Stop the flow of material. Dike the spilled material.
- Carefully cover the area with spill absorbent material.
- Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy duty plastic bags). Store for disposal as hazardous waste.
- Mop the affected area using detergent and water.

M: Mercuric chloride

- Ventilate area of leak or spill.
- Wear appropriate personal protective equipment (impervious material).
- Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover material when possible.
- Use non-metal tools and equipment. Collect material in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place all materials in contact with chemical in a chemical waste container.
- Avoid any transfer into the environment

D. Radioactive Materials

No Radioactive Isotopes are planned for this project.

E. Inventory (itemized) of Radioactive Materials

Not applicable

V. Additional Projects

A. Supplementary ("Piggyback") Projects

No Supplementary Projects are planned.

B. NOAA Fleet Ancillary Projects

No NOAA Fleet Ancillary Projects are planned.

VI. Disposition of Data and Reports

Disposition of data gathered aboard NOAA ships will conform to NAO 216-101 *Ocean Data Acquisitions* and NAO 212-15 *Management of Environmental Data and Information.* To guide the implementation of these NAOs, NOAA's Environmental Data Management Committee (EDMC) provides the *NOAA Data Documentation Procedural Directive* (data documentation) and *NOAA Data Management Planning Procedural Directive* (preparation of Data Management Plans). OMAO is developing procedures and allocating resources to manage OMAO data and Programs are encouraged to do the same for their Project data.

A. Data Classifications: *Under Development*

a. OMAO Data

b. Program Data

B. Responsibilities: *Under Development*

VII. Meetings, Vessel Familiarization, and Project Evaluations

A. Pre-Project Meeting: The Chief Scientist and Commanding Officer will conduct a meeting of pertinent members of the scientific party and ship's crew to discuss required equipment, planned operations, concerns, and establish mitigation strategies for all concerns. This meeting shall be conducted before the beginning of the project with sufficient time to allow for preparation of the ship and project personnel. The ship's Operations Officer usually is delegated to assist the Chief Scientist in arranging this meeting.

B. Vessel Familiarization Meeting: The Commanding Officer is responsible for ensuring scientific personnel are familiarized with applicable sections of the standing orders and vessel protocols, e.g., meals, watches, etiquette, drills, etc. A vessel familiarization meeting shall be conducted in the first 24 hours of the project's start and is normally presented by the ship's Operations Officer.

C. Post-Project Meeting: The Commanding Officer is responsible for conducted a meeting no earlier than 24 hrs before or 7 days after the completion of a project to discuss the overall success and shortcomings of the project. Concerns regarding safety, efficiency, and suggestions for future improvements shall be discussed and mitigations for future projects will be documented for future use. This meeting shall be attended by the ship's officers, applicable crew, the Chief Scientist, and members of the scientific party and is normally arranged by the Operations Officer and Chief Scientist.

D. Project Evaluation Report

Within seven days of the completion of the project, a Customer Satisfaction Survey is to be completed by the Chief Scientist. The form is available at https://sites.google.com/a/noaa.gov/omao-intranet-dev/operations/marine/customer-satisfaction-survey and provides a "Submit" button at the end of the form. It is also located at https://docs.google.com/a/noaa.gov/forms/d/1a5hCCkgIwaSII4DmrHPudAehQ9HqhRqY3J_FXqbJp9g/viewform. Submitted form data is deposited into a spreadsheet used by OMAO management to analyze the information. Though the complete form is not shared with the ships, specific concerns and praises are followed up on while not divulging the identity of the evaluator.

VIII. Miscellaneous

A. Meals and Berthing

The ship will provide meals for the scientists listed above. Meals will be served 3 times daily beginning one hour before scheduled departure, extending throughout the project, and ending two hours after the termination of the 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 project.

Berthing requirements, including number and gender of the scientific party, 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 makeup of the ship's complement. The Chief Scientist is responsible for ensuring the scientific berthing spaces are left in the condition in which they were received; for stripping bedding and linen return; and for the return of any room keys which were issued. The Chief Scientist is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the project and at its conclusion prior to departing the ship.

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.

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy dated May 17, 2000 which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels.

B. Medical Forms and Emergency Contacts

The NOAA Health Services Questionnaire (NHSQ, NF 57-10-01 (3-14)) must be completed in advance by each participating scientist. The NHSQ can be obtained from the Chief Scientist or the NOAA website http://www.corporateservices.noaa.gov/noaaforms/eforms/nf57-10-01.pdf.

All NHSQs submitted after March 1, 2014 must be accompanied by NOAA Form (NF) 57-10-02 - Tuberculosis Screening Document in compliance with OMAO Policy 1008 (Tuberculosis Protection Program).

The completed forms should be sent to the Regional Director of Health Services at the applicable Marine Operations Center. The NHSQ and Tuberculosis Screening Document should reach the Health Services Office no later than 4 weeks prior to the start of the project to allow time for the participant to obtain and submit additional information should health services require it, before clearance to sail can be granted. Please contact MOC Health Services with any questions regarding eligibility or completion of either form. Ensure to fully complete each form and indicate the ship or ships the participant will be sailing on. The participant will receive an email notice when medically cleared to sail if a legible email address is provided on the NHSQ.

The participant can mail, fax, or email the forms to the contact information below. Participants should take precautions to protect their Personally Identifiable Information (PII) and medical information and ensure all correspondence adheres to DOC guidance (http://ocio.os.doc.gov/ITPolicyandPrograms/IT_Privacy/PROD01_008240).

The only secure email process approved by NOAA is Accellion Secure File Transfer which requires the sender to setup an account. Accellion's Web Users Guide is a valuable aid in using this service, however to reduce cost the DOC contract doesn't provide for automatically issuing full functioning accounts. To receive access to a "Send Tab", after your Accellion account has been established send an email from the associated email account to accellionAlerts@doc.gov requesting access to the "Send Tab" function. They will notify you via email usually within 1 business day of your approval. The 'Send Tab" function will be accessible for 30 days.

Contact information:.

Regional Director of Health Services
Marine Operations Center – Atlantic
439 W. York Street
Norfolk, VA 23510
Telephone 757-441-6320
Fax 757-441-3760

Email MOA.Health.Services@noaa.gov

Prior to departure, the Chief Scientist must provide an electronic listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: contact name, address, relationship to member, and telephone number.

C. Shipboard Safety

Hard hats are required when working with suspended loads. Work vests are required when working near open railings and during small boat launch and recovery operations. Hard hats and work vests will be provided by the ship when required.

Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. At the discretion of the ship CO, safety shoes (i.e. steel or composite toe protection) may be required to participate in any work dealing with suspended loads, including CTD deployment and recovery. The ship does not provide safety-toed shoes/boots. The ship's Operations Officer should be consulted by the Chief Scientist to ensure members of the scientific party report aboard with the proper attire.

D. 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 means of communications, the ship can usually accommodate the Chief Scientist. Special radio voice communications requirements should be listed in the project instructions. The ship's primary means of communication with the Marine Operations Center is via email and the Very Small Aperture Terminal (VSAT) link. Standard VSAT bandwidth at 128kbs is shared by all vessels staff and the science team at no charge. Increased bandwidth in 30 day increments is available on the VSAT systems at increased cost to the scientific party. If increased bandwidth is being considered, program accounting is required and it must be arranged through the ship's Commanding Officer at least 30 days in advance.

E. IT Security

Any computer that will be hooked into the ship's network must comply with the *OMAO Fleet IT Security Policy* 1.1 (November 4, 2005) prior to establishing a direct connection to the NOAA WAN. Requirements include, but are not limited to:

(1) Installation of the latest virus definition (.DAT) file on all systems and performance of a virus scan on each system.
(2) Installation of the latest critical operating system security patches.
(3) No external public Internet Service Provider (ISP) connections.

Completion of the above requirements prior to boarding the ship is required.

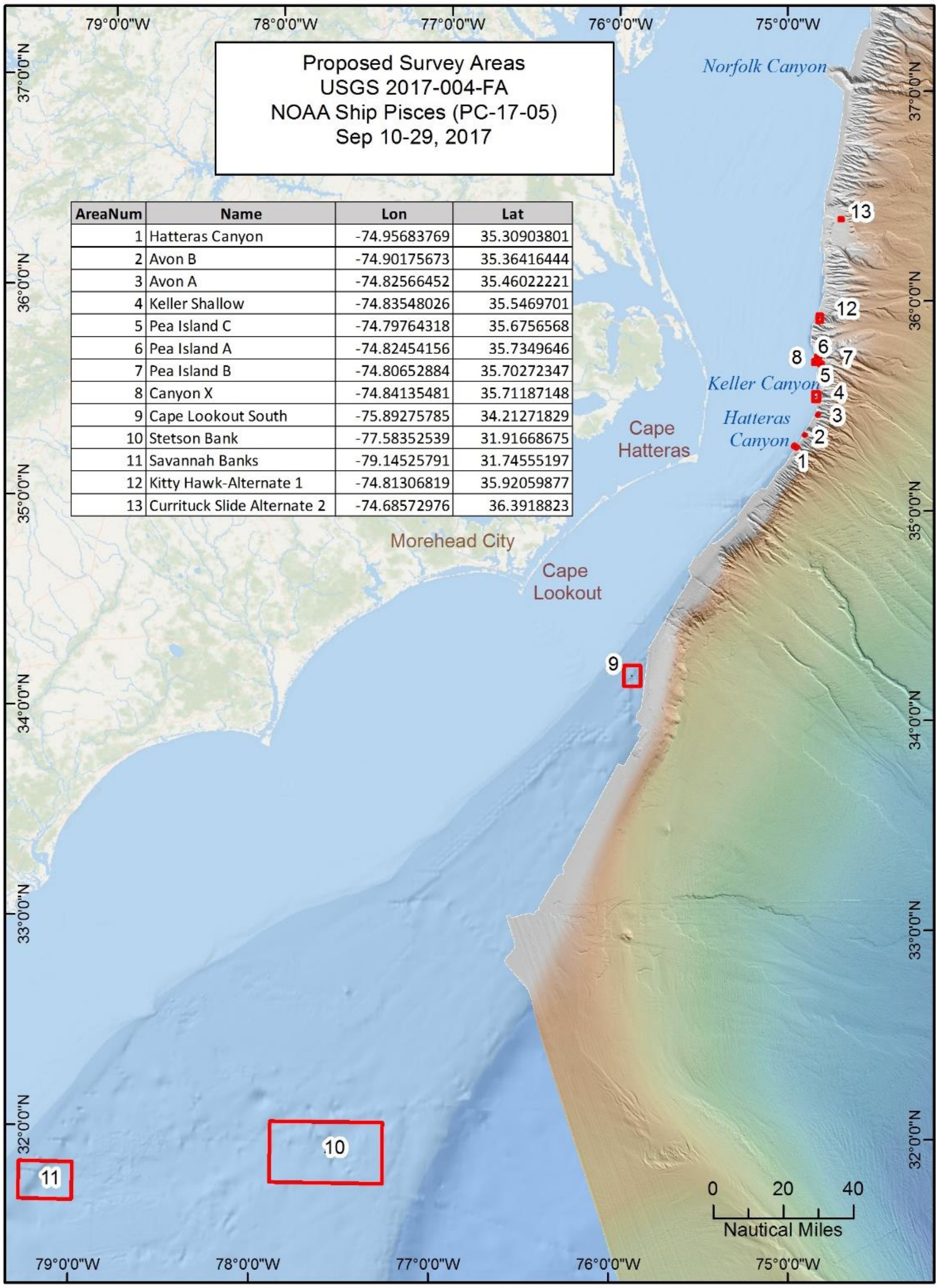
Non-NOAA personnel using the ship's computers or connecting their own computers to the ship's network must complete NOAA's IT Security Awareness Course within 3 days of embarking.

F. Foreign National Guests Access to OMAO Facilities and Platforms

Foreign National access to the NOAA ship or Federal Facilities is not required for this project.

VIII. Appendices

Figure 1. Map of target areas to be surveyed during the PC-17-05 *Deepwater Atlantic Habitats II:* Continued Atlantic Research and Exploration in Deepwater Ecosystems with Focus on Coral, Canyon, and Seep Communities 10-29 Sept. 2017, including seep targets.



AreaNum	Name	Lon	Lat
1	Hatteras Canyon	-74.95683769	35.30903801
2	Avon B	-74.90175673	35.36416444
3	Avon A	-74.82566452	35.46022221
4	Keller Shallow	-74.83548026	35.5469701
5	Pea Island C	-74.79764318	35.6756568
6	Pea Island A	-74.82454156	35.7349646
7	Pea Island B	-74.80652884	35.70272347
8	Canyon X	-74.84135481	35.71187148
9	Cape Lookout South	-75.89275785	34.21271829
10	Stetson Bank	-77.58352539	31.91668675
11	Savannah Banks	-79.14525791	31.74555197
12	Kitty Hawk-Alternate 1	-74.81306819	35.92059877
13	Currituck Slide Alternate 2	-74.68572976	36.3918823

BDA, USGS, 7 Aug 17

Figure 2. AUV *Sentry*

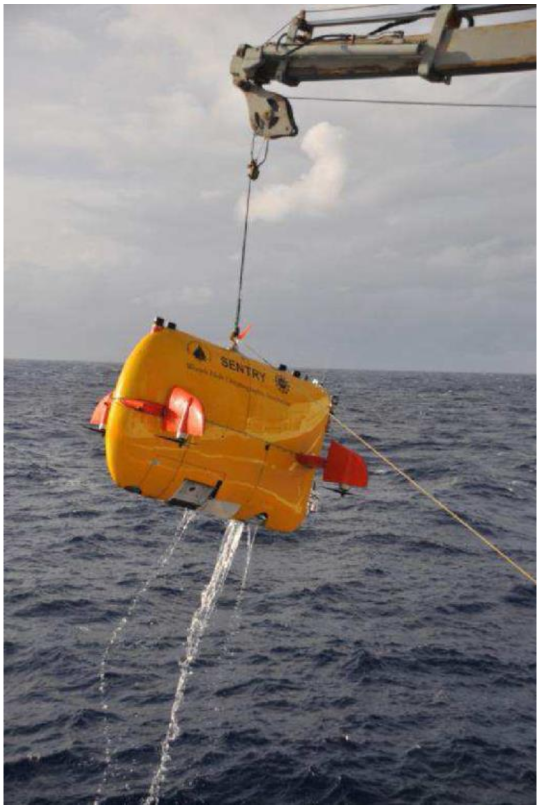


Figure 3. NIOZ monocore will be suspended under the CTD rosette by a 10 m line. The monocore weighs about 33 lbs.

Table 1. Station locations (Priority Areas) within the Area of Operations.

Location	Longitude	Latitude	Depth (m)
Hatteras Canyon	-74.95683769	35.30903801	TBD-<2000
Avon B	-74.90175673	35.36416444	250-400
Avon A	-74.82566452	35.46022221	200-300
Keller Shallow	-74.83548026	35.5469701	50-100
Pea Island C	-74.79764318	35.6756568	180-350
Pea Island A	-74.82454156	35.7349646	300-350
Pea Island B	-74.80652884	35.70272347	400-600
Canyon X	-74.84135481	35.71187148	TBD-<2000
Cape Lookout South	-75.89275785	34.21271829	400-450
Stetson Bank	-77.58352539	31.91668675	600
Savannah Banks	-79.14525791	31.74555197	500-800
Kitty Hawk-Alternate 1	-74.81306819	35.92059877	200-500
Currituck Slide Alternate 2	-74.68572976	36.3918823	1000

Table 2. Scientific Computer Sensors, and logging rates of those sensors, required during NOAA ship *Pisces* PC-17-05, *Deepwater Atlantic Habitats II:* Continued Atlantic Research and Exploration in Deepwater Ecosystems with Focus on Coral, Canyon, and Seep Communities, 10-29 Sept 2017.

Sensor Name	**Units**	**Log Rate (secs)**
ADCP-Depth	(Meters)	1
ADCP-F/A-GroundSpeed	(Knots)	1
ADCP-F/A-WaterSpeed	(Knots)	1
ADCP-P/S-GroundSpeed	(Knots)	1
ADCP-P/S-WaterSpeed	(Knots)	1
Air-Temp	(Degrees C)	1
Baro-Press	(Millibars)	1
CenterBoardPos-Value	(Position)	1
Date	(Date)	1
Doppler-Depth	(Meters)	1
Doppler-KeelOffset	(Meters)	1
Doppler-P/S-BottomSpeed	(Knots)	1
Doppler-P/S-WaterSpeed	(Knots)	1
EK60-18kHz-Depth	(Meters)	1
EK60-38kHz-Depth	(Meters)	1
ES60-200hz-Depth	(Meters)	1
ES60-50hz-Depth	(Meters)	1

GYRO	(Degrees)	1
ME70-Depth	(Meters)	1
Mid-SeaTemp-C	(Degrees C)	1
MX420-COG	(Degrees)	1
MX420-Lat	(DEGMIN)	1
MX420-Lon	(DEGMIN)	1
MX420-SOG	(Knots)	1
MX420-Time	(Time)	1
PASHR-Hdg-Qual	(Value)	1
PASHR-Hdg-True	(Degrees)	1
PASHR-Heave	(Centimeters)	1
PASHR-Pitch	(Degrees)	1
PASHR-Pitch-Qual	(Value)	1
PASHR-Roll	(Degrees)	1
PASHR-Roll-Qual	(Value)	1
PASHR-Time	(Time)	1
PI32-DEPTH300-VAL	(Meters)	1
PI32-DS-VAL	(Meters)	1
PI32-HR-VAL	(Meters)	1
PI32-WS-VAL	(Meters)	1
PORTTrawlWinchLineOut	(Meters)	1
PORTTrawlWinchLinespeed	(Meters/sec)	1
PORTTrawlWinchTension	(Kilos)	1
POSMV-COG	(Degrees)	1
POSMV-Elevation	(Value)	1
POSMV-hdops	(Value)	1
POSMV-Heading	(Degrees)	1
POSMV-Lat	(DEGMIN)	1
POSMV-Lon	(DEGMIN)	1
POSMV-Quality	(Value)	1
POSMV-Sats	(Value)	1
POSMV-SOG	(Knots)	1
POSMV-Time	(Time)	1
SAMOS-AirTemp-Value	(Degrees C)	1
SAMOS-TRUE-WIND-DIR-Value	(Degrees)	1
SAMOS-TRUE-WIND-Spd-Value	(Knots)	1
Shaft-RPM-Value	(Value)	1
STBDTrawlWinchLineOut	(Meters)	1
STBDTrawlWinchLinespeed	(Meters/sec)	1
STBDTrawlWinchTension	(Kilos)	1
YOUNG-TWIND-Direction	(Degrees)	1
YOUNG-TWIND-Speed	(Knots)	1

Appendix 1. Launch and Recovery Procedures for AUV *Sentry*. (Excerpt from WHOI document "A Scientists Guide to *Sentry* Cruise Planning and Proposal)

Launch and recovery of *Sentry* is similar to launch and recovery of many forms of science gear free of the ship that are launched and recovered by research vessels around the world. *Sentry* sets itself apart from a lot of deployed science gear by the various sensors, sonars, and tracking equipment that are on the outside of the vehicle. This equipment is exposed and vulnerable on launches and recoveries and particular attention should be paid to avoid damaging this equipment. *Sentry* also has a unique capability that allows an operator to drive *Sentry* to the ship. This allows the vessel to comfortably hold the ship on station while the vehicle drives to the recovery location.

Figure 4 is a picture of *Sentry* on the DECK of R/V Knorr. This picture has the *Sentry* umbilical and charge cables attached as well as the cooling lines.

Figure 4

4.1 LAUNCH AND RECOVERY PREPARATION

4.1.1 General Safety Awareness

Personnel safety is the number one concern for *Sentry* Operations. *Sentry* Operations combines the Vessels Safety Guidelines, WHOI's Safety Guidelines as well as UNOLS RVOC Safety Guidelines to provide safest operations environment possible.

4.1.2 On Deck Personnel

Sentry Launches and Recoveries require the following deck support

- Deck Boss/Launch Coordinator (typically BOS'N or *Sentry* crew)
- Crane Operator (Ship Personnel)
- Line Handlers - Minimum 3 Persons (Filled by Deck Crew/*Sentry* Crew)
- Pull Pin Handler (*Sentry* crew, only required for Launch)

4.1.3 Personal Protective Equipment

Sentry Operations requires at a minimum the following PPE (Personal Protective Equipment) during Launch and Recovery Operations.

- Hard Hat
- Coast Guard Approved Work Vest
- Closed toed shoes (preferably steel toes)
- Gloves (Optional)
- Safety Glasses (Optional)

4.2 NORMAL OPERATING CONDITIONS

4.2.1 Vessel Setup

Vessel setup is a key component to *Sentry* launch and recovery operations.

- During launch the critical consideration is that the vehicle not pass under the ship. To this end, the ship will need to set up into the seas to minimize roll, but with the side of the ship where launch will occur as down current as possible.
- During recovery, the key issue is not to impact the vehicle. Since *Sentry* can drive towards the vessel, it is better to set the vessel up downwind of *Sentry* so that it is blown away from *Sentry*. It may be necessary to move the ship's bow a little after the lift line is hooked up and before the crane lifts *Sentry* from the water as the prime consideration then becomes minimizing roll.

4.2.2 *Sentry* Launch

Sentry is ready to be launched after the *Sentry* crew conducts a successful deck test of the vehicle. The *Sentry* launch coordinator crew will coordinate launch time and position with the necessary Vessel crew. The following is the general flow of launch operations for *Sentry*. Some of these actions will happen simultaneously.

- Notify Deck personnel of Launch time and ensure all necessary jobs are filled.
- Secure tag lines to *Sentry* fore and aft
- Rig air tugger line to crane hook
- Rig lifting sling with pull pin and crane hook

- Radio Beacon on and tested, Strobe on and Tested
- Charge and umbilical cable are removed from Sentry
- Secure all panels on *Sentry*
- Cooling lines are removed

NOTE: On launch Tag Line handlers shall pay particular attention to entanglement of the lines, particularly when slipping the lines. The unique design of *Sentry* creates various hazards for tag lines to get caught and create damage to the vehicle. Tag lines need to stay clear of the Vehicle fins, thrusters, and sensors on the top of the vehicle. In particular, tag lines must be slipped gently and not allowed to swing freely. The recommended procedure is to slack the line and slip it until the free end is in one hand. This can then be dropped into the water to arrest line swing and gently pulled hand over hand by the other end.

Sentry launch will commence with lifting the vehicle several inches

- The poles used to hold *Sentry* up will be removed
- The fore and aft catches will be removed
- *Sentry* shall then be lifted out of the cradle up to a height that will allow *Sentry* to clear the Vessels railing
- *Sentry* should then be moved outboard to position it above the water and a safe distance from the ship.
- Slip the bow tag line as the vehicle goes over the rail. Recover as much of stern tag line as possible in preparation for slipping it.
- Orient the vehicle pointed away from the ship (*Sentry* may glide forward as it descends).
- Start lowering the vehicle into the water AND slip the stern line. Ideally, the stern tag line is free of *Sentry* when it just touches the water but err on the side of clearing the tag line.
- Pull the release (as soon as weight is off lift sling) and lift crane hook up and away.
- If necessary slide ship away from vehicle as it descends clear of the ship. Then slowly move ship clear of *Sentry* by several hundred meters in case it should surface prematurely. Typically the *Sentry* launch coordinator will provide direction over the radio.
- Secure crane and all launch equipment.
- Have ship remain within tracking distance until *Sentry* is following mission profile adequately

4.2.3 *Sentry* Recovery

Provide bridge with expected time and location for *Sentry* to be on the surface. Ship should typically be positioned about 400 meters down-wind of *Sentry* as it approaches the surface. It is critical to be tracking *Sentry* as it leaves the bottom since tracking is poor as it gets near the surface and hard to pinpoint its location.

There are two recovery scenarios:
Sentry is able to be driven on the surface towards the ship using radio control.
Sentry is “dead boat” and the ship must maneuver along-side of *Sentry*

- Ensure all required personnel are present and notify bridge that the deck personnel are ready for recovery of the vehicle.
- Ship should approach *Sentry* to within 50 – 100m meters off the rail of the ship near the recovery location. *Sentry* personnel will attempt radio control with remote control box. If radio control is

obtained, ship should come to a stop and hold position and heading that they feel is best. When bridge has ship in position and is ready they should notify the deck to have *Sentry* driven to the ship.

If *Sentry* is NOT radio controlled then the ship should carefully approach *Sentry* trying to keep it off about 10-15 ft until alongside and within pole reach.

- When *Sentry* is alongside the ship in the area for recovery, a long pole attaches the lift line loop to the lift hook on *Sentry*. The lift line is pulled free of the pole and the loop at the other end is QUICKLY attached to the crane. Under some circumstances the lift line may already be attached to the crane. A tagline running directly inboard to an air tugger will typically already be attached. IT IS IMPORTANT THAT THE PEOPLE ON THE STABILIZING TAG LINES KEEP THE LIFT LINE FROM TANGLING ON *Sentry*. This can be done by keeping some tension on the lines thus lifting the lift line up and clear of the vehicle.
- As soon as the lift line is attached the crane should swing outboard to keep *Sentry* from hitting the hull. Note that if the crane pulls *Sentry* sideways it may slip forward or aft (direction of least resistance) through the water, and thus impact the hull. The pole can be used to push *Sentry* away if necessary.
- As *Sentry* comes out of the water the crane should bring it inboard enough to attach tag lines. These lines attach to the **appropriate** "D" rings welded to the struts between the upper & lower hulls.
- Continue to bring *Sentry* onboard and lower until just above the cradle
- Capture *Sentry* with fore and aft constraints
- Replace outboard leg of cradle and insert poles
- Lower *Sentry* into the cradle
- Secure the vehicle with cargo straps and disconnect all lines so the crane can be secured.

4.3 Launch and Recovery Pictures and Sequence

4.3.1 Launch

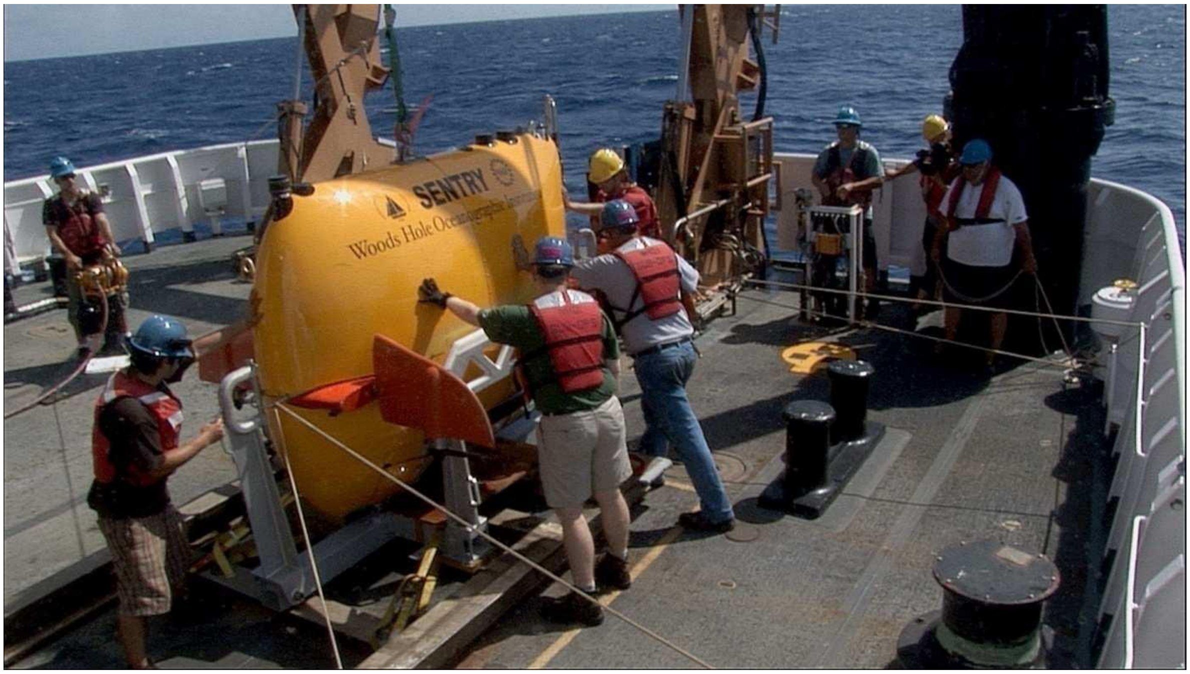


Figure 5 - *Sentry* is in the cradle and lifted approximately 1-2 inches

Figure 6 - The outboard side of the cradle is removed and the pipes through the center of the vehicle are removed.

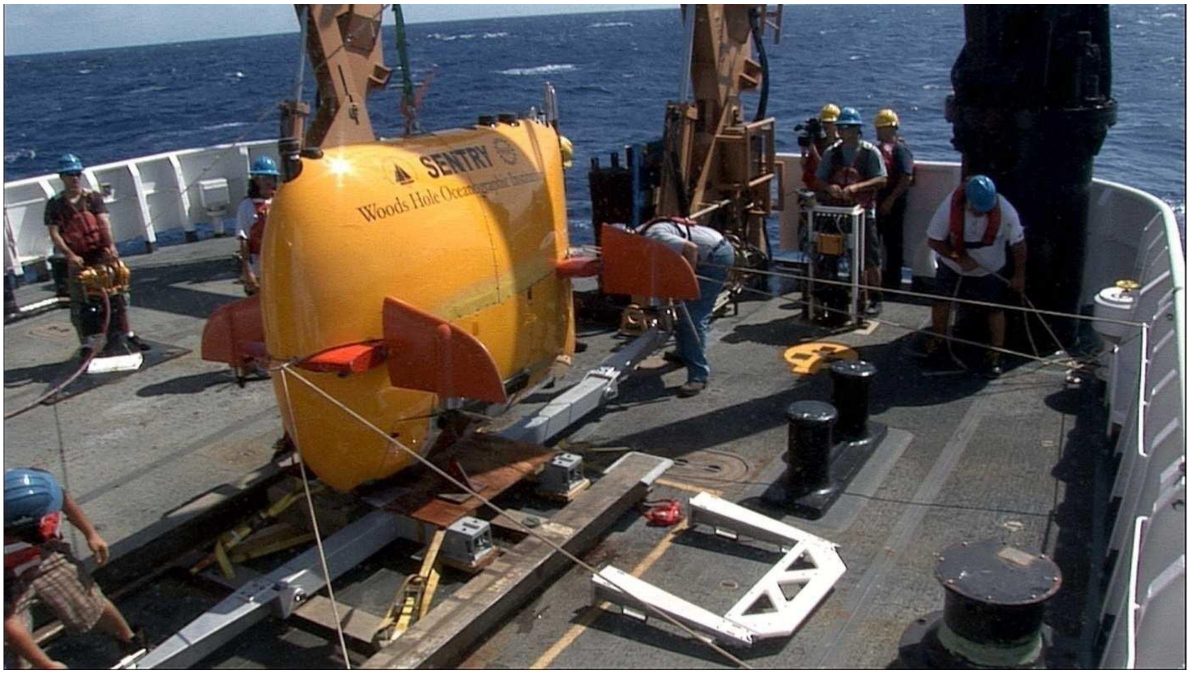


Figure 7 - The fore and aft catches are released leaving the vehicle stabilized by the tagline to the air tugger (left) and the fore and aft taglines (right)

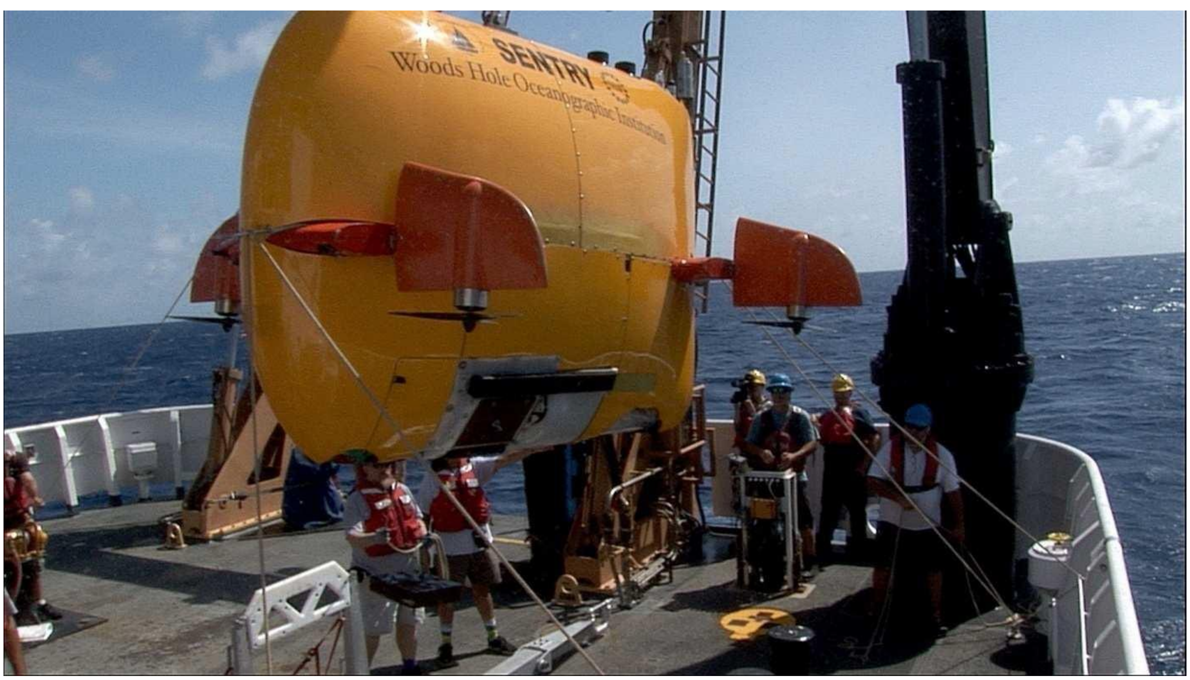


Figure 8 - *Sentry* is lifted up from the cradle and out towards the rail.

Figure 9 - As *Sentry* moves over the rail, the forward tagline is slacked and slipped.

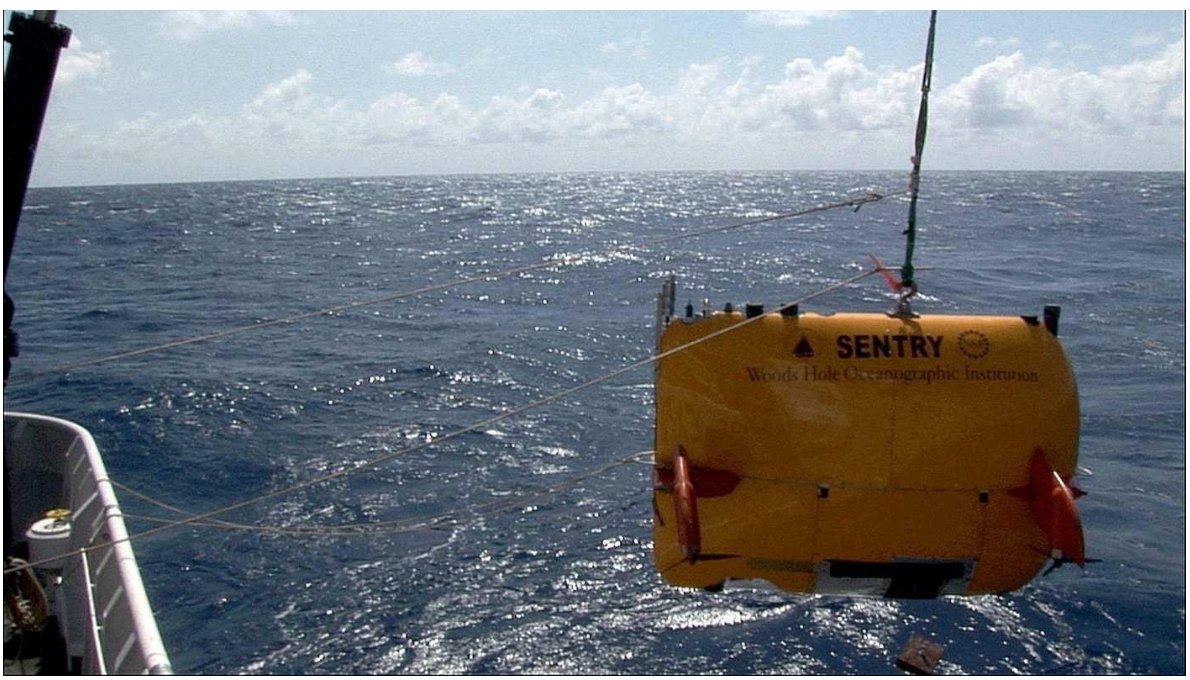


Figure 10 - *Sentry* continues to move outboard, the aft tagline is used to point the vehicle away from the vessel, then is slipped right before the vehicle enters the water. As soon as the pin is unloaded, it is pulled and the vehicle descends freely.

Figure 11 - As the vehicle drives towards the stationary vessel, the lift line for the crane is attached using a carbon fiber pole. The vehicle immediately drives full reverse and the pole is potentially used to fend the vehicle while the lift line is tensioned.

Figure 12 - As the lift line is tensioned and the vehicle lifted partially out of the water, fore and aft tag lines are attached using carbon poles and hooks. The tagline to the airtugger is already attached to the lifting bridle.

Figure 13 - The vehicle is slewed back into the cradle and the fore and aft catches are secured first. The side is reattached and the poles reinserted before the vehicle is set into the cradle.

Appendix 2. Description of the monocore deployment procedures.

1. Attach line (scientist provided rope) with a bowline knot to the bottom of the CTD rosette and to the top of the monocore (See Appendix 2 Figure 1). Length of line will equate to the safe working distance between the bottom of the rosette and seafloor (e.g., 10 m), determined by ship operations.

2. Deploy CTD rosette over side of ship, and allow the monocore to hang below the rosette before lowering CTD to the seafloor. Remove black clip while the core is under tension; this is necessary so that the core can properly sink into the mud once the core has reached the seafloor.

3. When the rosette is approximately 50 m above bottom, lower winch speed to 30 m/min.

4. Lower CTD to 10 m above bottom or safe working distance used by the ship.

5. Raise the CTD rosette slowly, 30m/min until 50 m above bottom, then continue recovering the CTD at speed determined by ship operations.

6. Once the CTD is at the surface, recover the monocore.

7. Place black clip on top of monocore to ensure the core sample is secured.

8. Place monocore in stand (See Appendix 2 Figure 2).

Figure Appendix 2.1 Monocore deployment schematic.

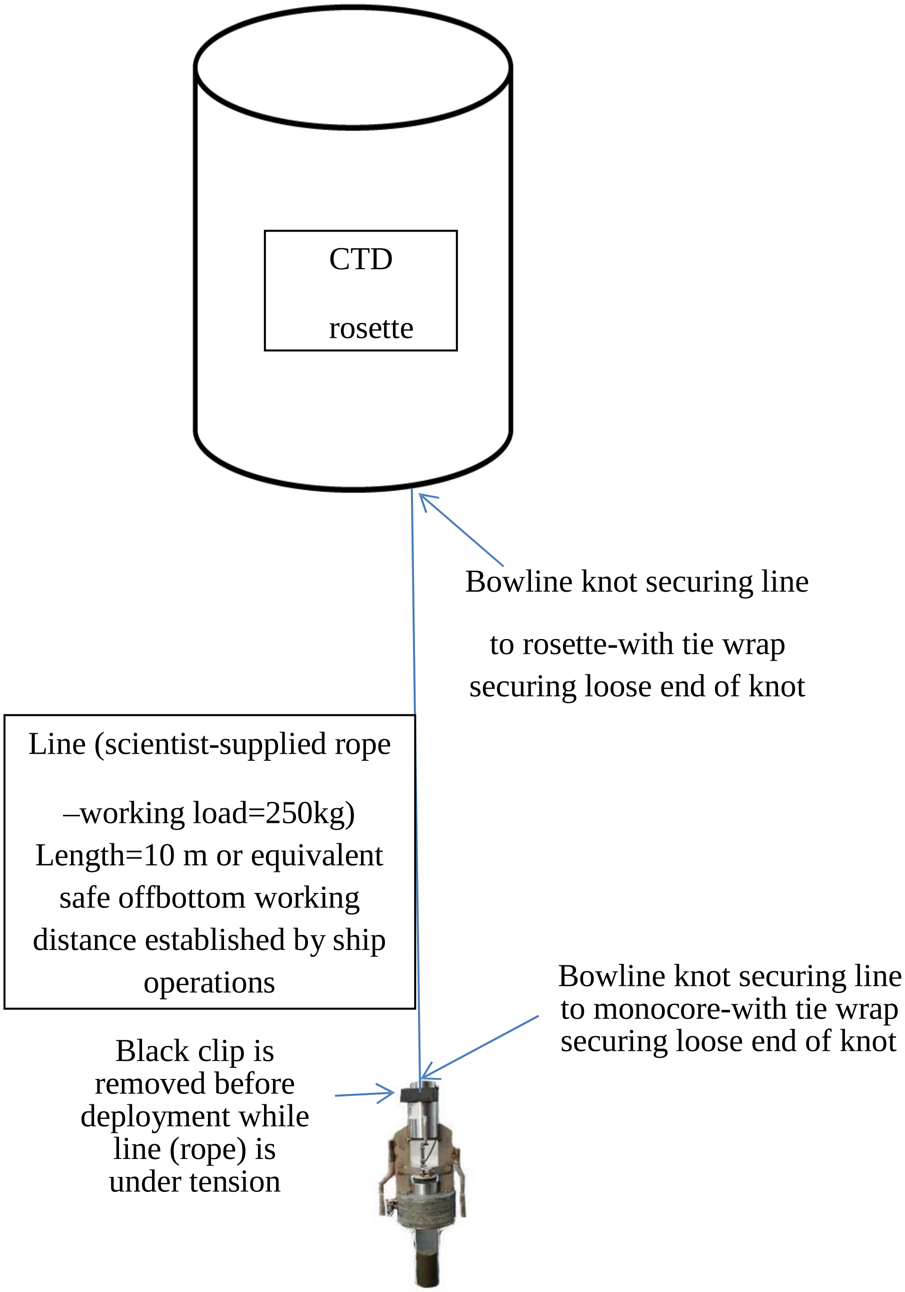


Figure Appendix 2.2 Monocore secured on deck on stand. The monocore weighs about 33 lbs.

Appendix 3.

A Tucker trawl will be used to collect midwater organisms for community and biogeochemical analyses (Fig. Appendix 3.1 a-c). Two net sizes will be brought for use, depending on deployment location. If stern-deployed (preferred), the larger “Mother Tucker” trawl will be used. This trawl is ~10’ wide and 15’ tall, with a net length of ~60’. If side deployment is necessary, the smaller “Baby Tucker” will be used. This trawl is ~6’ wide and 11’ tall, with a net length of 45’. Both trawls have a single cod-end that can be retrieved by hand once the trawl bars are secured. The trawls have stainless rope as their side bridles, and are thus collapsible. The primary weight element of the trawls is the lowest bar, which bears lead weights. Securing this bar is the primary launch and recovery consideration. If possible, electromechanical cable is the preferred warp, with connection to a mini-CTD or time-depth recorder whose data can be viewed on deck in real time. Ideally three net deployments will be conducted during station occupation: a tow above the deep-scattering layer (DSL), one within the DSL, and one below the DSL. This will allow quantification of the fauna within the DSL. The depths of the DSL are time-dependent. EK60 surveys over target locations will be used to detect the DSL. will be Nighttime depths are generally within the top 200 m, while daytime depths are generally between 400-600 m. In most cases the wire-out/net depth scope is ~1.7:1, so the maximum wire out needed is estimated to be 1020 m.

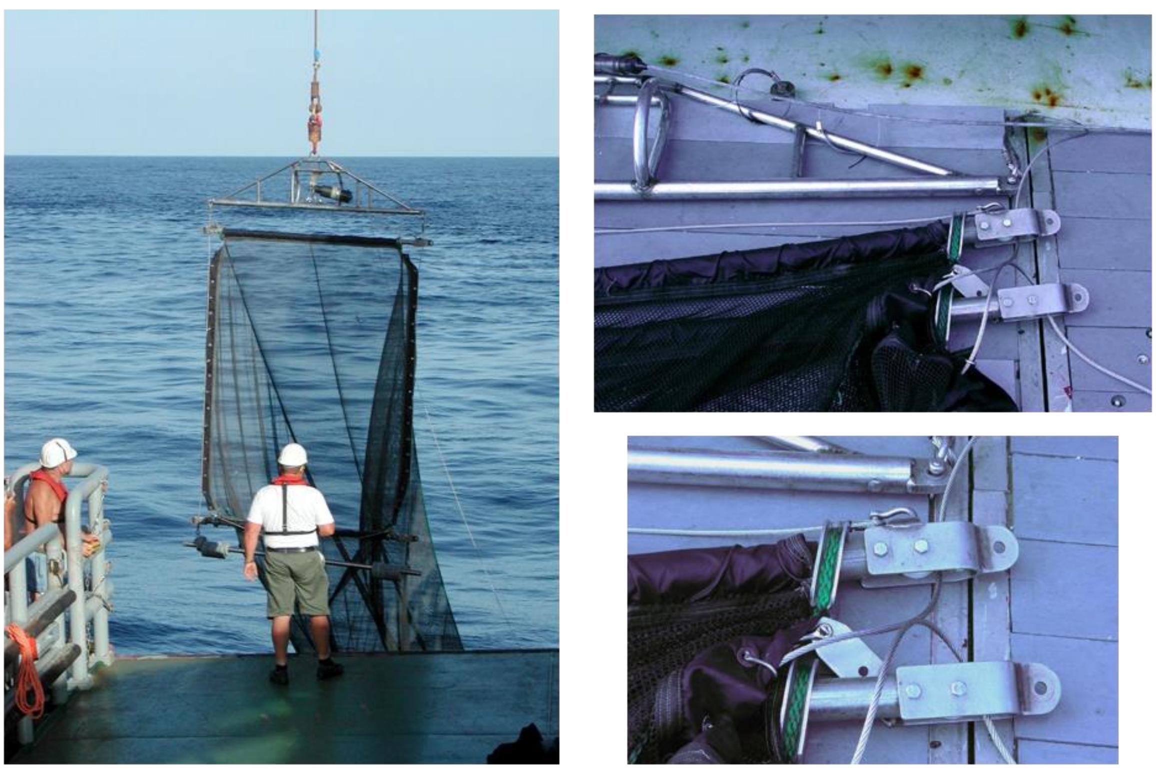


Figure Appendix 3.1. Opening-closing Tucker trawl. A) “Baby tucker” being deployed; B) top frame with net bars in closed position; C) close-up view of side bridle configuration (stainless steel rope).