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

MEMORANDUM FOR: Captain Mark Wetzler, NOAA
Commanding Officer, NOAA Ship *Okeanos Explorer*

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

SUBJECT: Project Instruction for EX-16-09
Main Hawaiian Island Shakedown (Mapping)

Attached is the final Project Instruction for EX-16-09, Main Hawaiian Island Shakedown (Mapping), which is scheduled aboard NOAA Ship *Okeanos Explorer* during the period of December 10 – December 16, 2016. Of the 7 DAS scheduled for this project, 7 DAS are funded by a Line Office Allocation. This project is estimated to exhibit a Medium Operational Tempo. Acknowledge receipt of these instructions via e-mail to ChiefOps.MOA@noaa.gov at Marine Operations Center-Atlantic.

Ocean Exploration and Research

FINAL Project Instructions

Date Submitted: November 28, 2016

Platform: NOAA Ship *Okeanos Explorer*

Project Number: EX-16-09

Project Title: Main Hawaiian Island Shakedown (Mapping)

Project Dates: December 10, 2016 – December 16, 2016

Prepared by: Derek Sowers **Dated:** 11/28/16

Derek Sowers, NOAA
Expedition Coordinator
Office of Ocean Exploration & Research

Approved by: **Dated:** 11/28/16

Craig Russell
Program Manager
Office of Ocean Exploration & Research

Approved by: COR/NOAA **Dated:** 2-DEC-2016

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

Ocean Exploration and Research

I. Overview

A. Brief Summary and Project Period

This document contains project instructions for EX-16-09, with operations expected to commence on December 10, 2016 in Honolulu, HI and conclude on December 16, 2016 in Honolulu, HI. The primary goals of the cruise are to shakedown, test, and calibrate the ship's suite of scientific sonar systems used for exploratory ocean mapping and baseline characterization. The complete list of cruise objectives are listed in section D. Highest priority tasks include:

1. Patch Test calibration of the EM302 multibeam sonar (if not completed during EX-16-08)
2. Calibration of five EK60 transducers (18, 38, 70, 120, 200 kHz)
3. Testing and possible calibration of the ship's two ADCPs (38, 300 kHz)
4. Testing the UCTD and XBT autolauncher and refining SOPs.
5. Confirmation of equipment and data management readiness to conduct three telepresence mapping cruises in FY17.

Multibeam, split-beam, and/or ADCP sonar mapping operations will be conducted 24 hours a day throughout the cruise. Sub-bottom profile mapping will be conducted periodically during the cruise for testing purposes and is subject to the discretion of the CO. XBT and/or UnderwayCTD sound velocity casts in support of multibeam sonar mapping operations will be conducted at an interval defined by prevailing oceanographic conditions, but not to exceed 6 hours. Multibeam data will be fully processed according to standard onboard procedures and will be archived at the National Centers for Environmental Information.

ADCP data collection work will be conducted while transiting to and from Ford Island into deeper waters (up to about 1000m). This data will then be shared with the University of Hawaii (UH) team to re-evaluate the settings for the applied transducer angles.

If sea state allows, a multibeam patch test calibration will be completed offshore from southwest Oahu. If the patch test is able to be completed on EX-16-08, no patch test on EX-16-09 will be necessary. Just prior to running the multibeam lines for the patch test, both a CTD cast and XBT cast need to be completed. The CTD and XBT casts need to be done in close to the same location in order to characterize the water column sound speed profile at the patch test site and to compare the level of agreement between the two alternative methods of obtaining sound speed profiles. An UnderwayCTD (UCTD) cast may also be conducted for comparison purposes. Patch test multibeam lines can be accomplished overnight.

EK60 calibration work will be conducted during daylight hours only. A small boat transfer will be needed to return the Kongsberg Engineer back to port following completion of the EK60 calibrations.

The ocean is 95 percent unexplored, unknown, and unseen by human eyes. Resource managers cannot manage what they do not know. To understand, manage, and protect the ocean and its resources, NOAA believes it is critical to support a systematic program of ocean exploration, using the best of ocean technology to explore, discover, inform, educate, and motivate. Exploration of our largely unknown ocean supports key NOAA, national, and international goals related to a better understanding of the ocean that will benefit current and future generations. NOAA Ship *Okeanos Explorer* is helping us to better understand the unknown ocean by targeted exploratory mapping.

B. Days at Sea (DAS)

Of the 7 DAS scheduled for this project, 0 DAS are funded by an OMAO allocation, and 7 DAS are funded by a Line Office Allocation. This project is estimated to exhibit a Medium Operational Tempo.

C. Operating Area

The operating area for the cruise is in the vicinity of the main Hawaiian Islands, mostly south of Oahu and west of Molokai and Lanai (Figure 1).

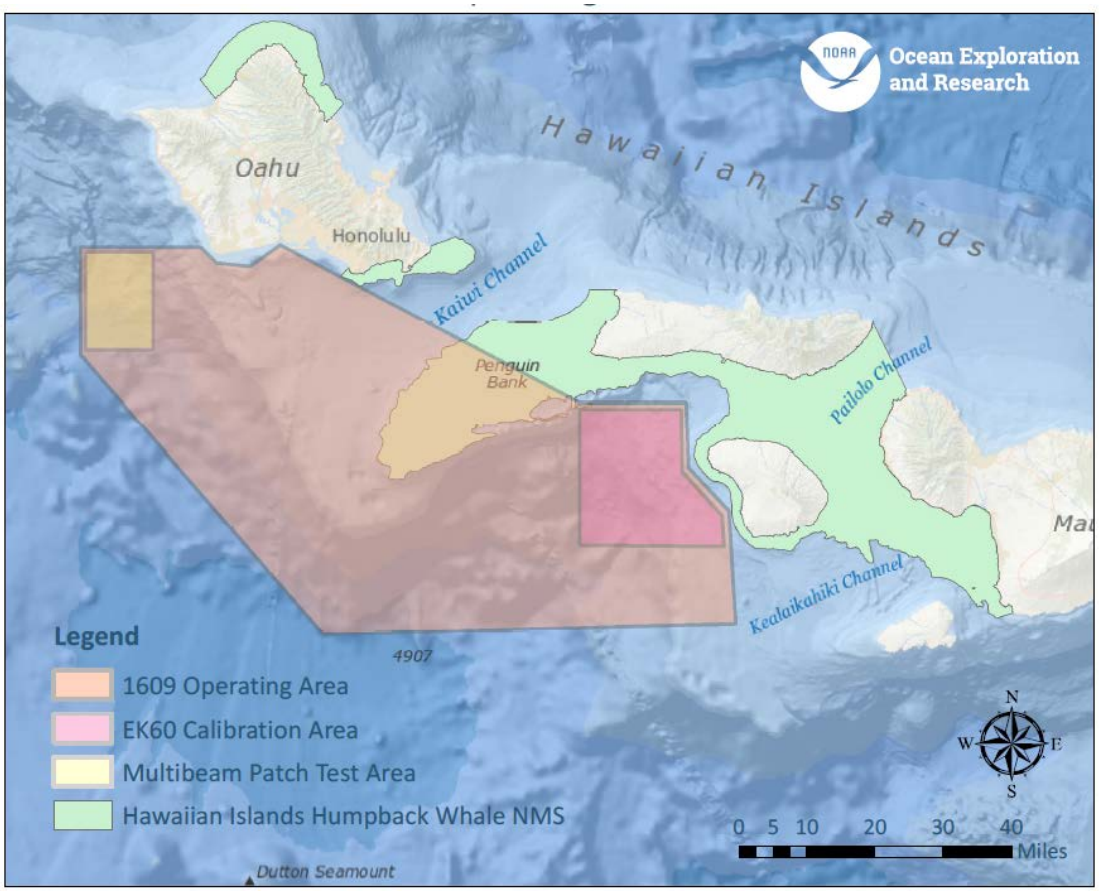

Figure 1: EX-16-09 operating area. All operations will take place within the U.S. EEZ.

Figure 2 shows the preferred general area proposed for multibeam patch test and crossline comparison work if weather conditions are favorable. A contingency location for the patch test is to conduct it within the operations box for the EK60 calibrations near Lanai if weather conditions prohibit the completion of the patch test near Oahu. If the patch test calibration gets completed during EX-16-08, the ship should proceed directly to the EK60 calibration area after leaving port at the start of the cruise.

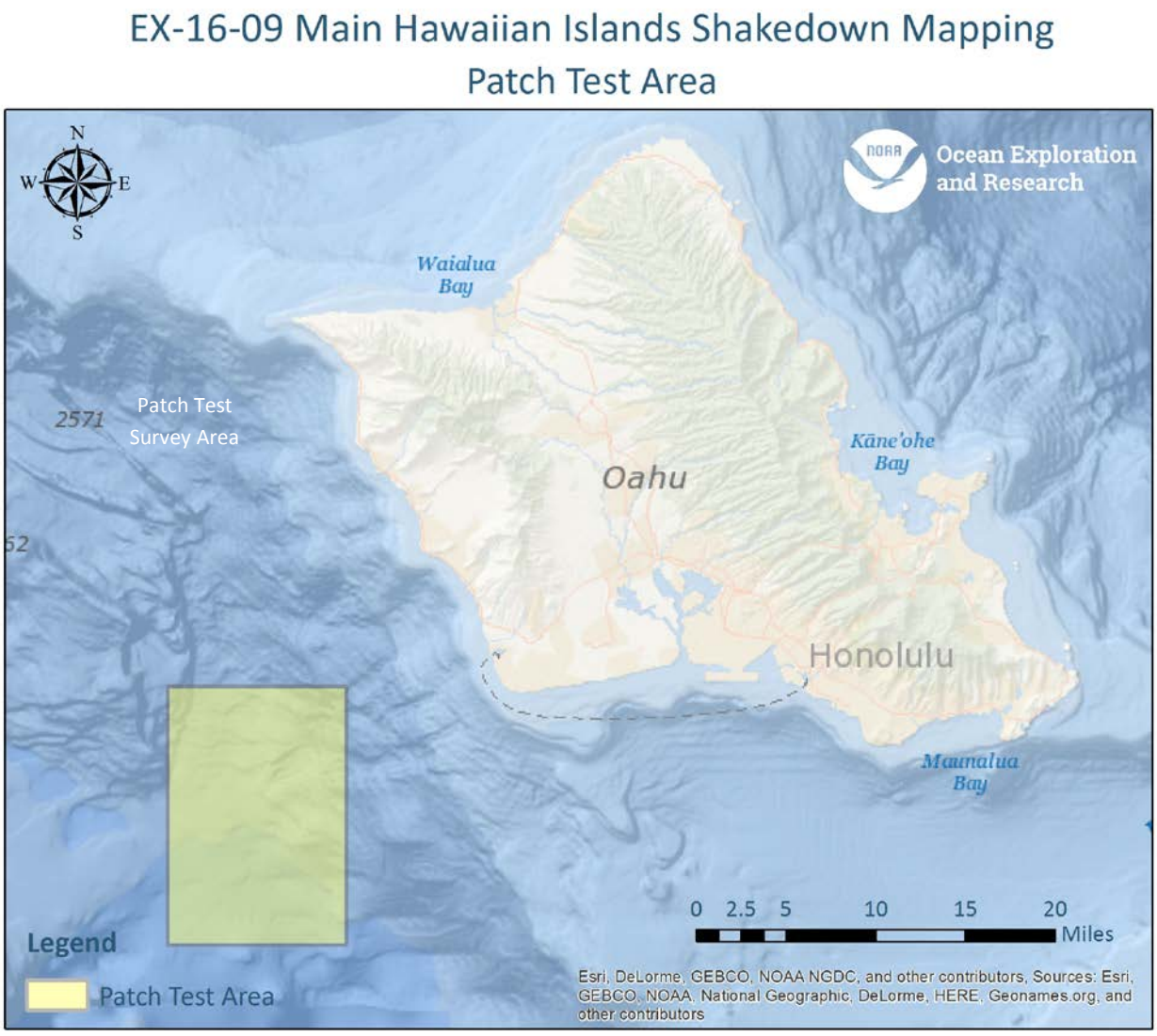

Figure 2. Preferred location for the patch test and crossline comparison near Oahu. This is the same patch test area used on EX-15-04 Leg 1 during the 2015 field season and EX-16-01 during the 2016 field season.

General Bounding Box Coordinates for Proposed Multibeam Patch Test Area:

Latitude (degrees decimal minutes North)	Longitude (degrees decimal minutes West)
21° 18.45 N	158° 23.27 W
21° 18.25 N	158° 14.29 W
21° 6.05 N	158° 13.99 W
21° 6.01 N	158° 23.56 W

The ship will then transit to a sheltered area to conduct approximately 5 days of testing and calibration work for all of the EK60 and ADCP sonars. The proposed sheltered area for this work is south of the islands of Molokai, Lanai and Maui, as shown in Figure 3. This working area should have reasonable currents and hopefully be sheltered from the dominant northern swell direction during the time of operations.

General Bounding Box Coordinates for Proposed EK60 Calibration Area:

Latitude (degrees decimal minutes North)	Longitude (degrees decimal minutes West)
20° 59.29 N	157° 20.04 W
20° 59.26 N	157° 7.01 W
20° 51.88 N	157° 6.96 W
20° 46.64 N	157° 1.87 W
20° 42.90 N	157° 1.57 W
20° 43.017 N	157° 20.57 W

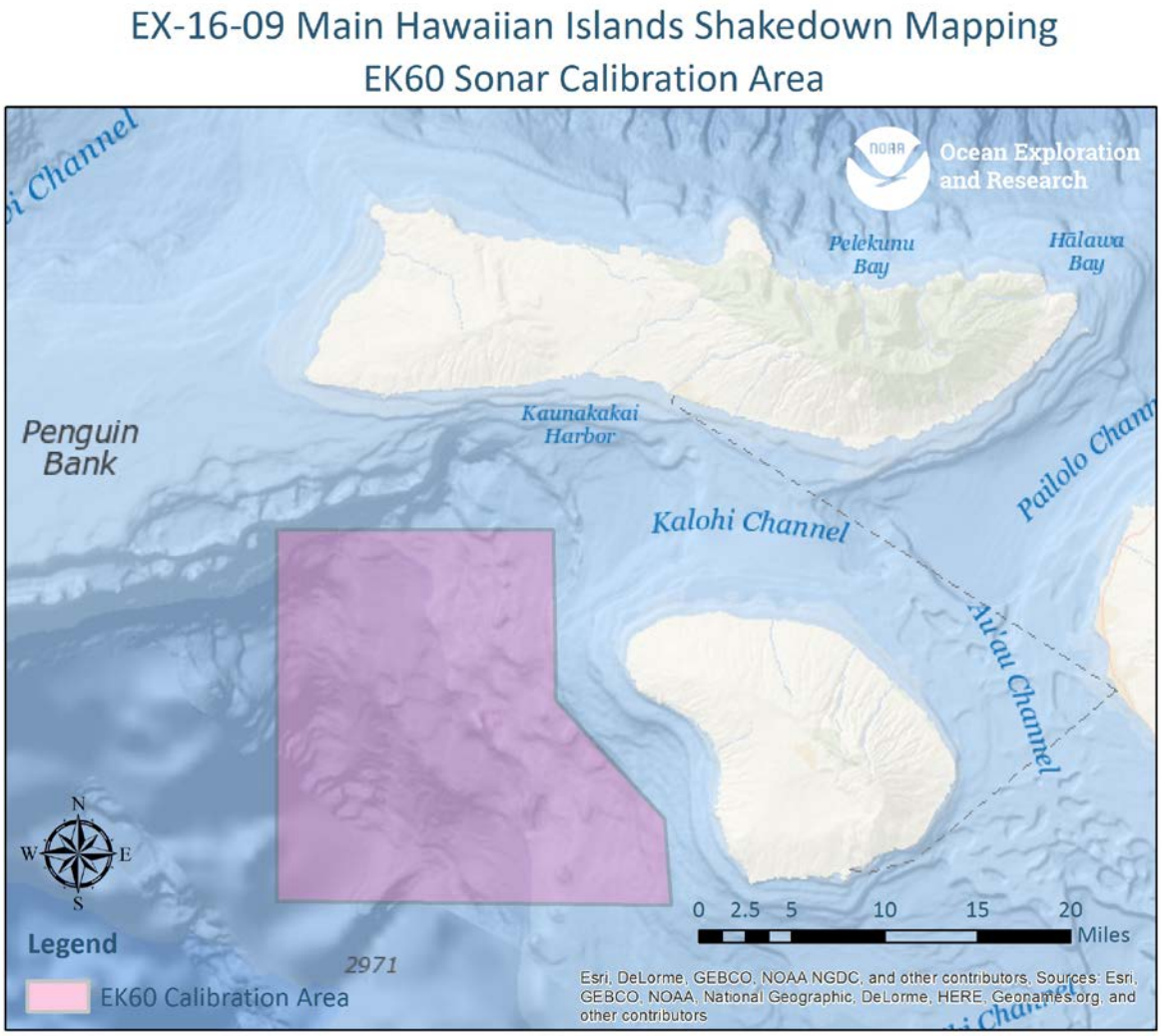

Figure 3. Proposed area for EK60 sonar calibration work (pink box). This area is outside 3 NM from the nearest islands (i.e. not in state waters), and outside of National Marine Sanctuary boundaries. Exact locations for sonar testing work will be determined based on sea state, currents, and vessel traffic during operations.

D. Summary of Objectives

December 10 – December 16, 2016 (Honolulu, HI - Honolulu HI)

Testing and calibrating mission sonars, equipment, data management infrastructure, and telepresence capabilities to ensure readiness for the FY17 field season is the primary objective of this project. It is important that the ship's force completes a hull dive prior to the start of the cruise and carefully cleans sonar transducer faces and the Reson SVP 70 of any fouling prior to the start of the shakedown cruise.

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The following are cruise objectives for EX-16-09:

1. Calibration of the five operational EK 60 sonars (18, 38, 70, 120, 200 kHz) is a top priority of the cruise. Calibration can be conducted while drifting freely in an area with low vessel traffic, no navigational hazards, and a lack of fishing gear. EK60 calibration work is planned to take place during daylight hours only. A Field Engineer from Kongsberg will provide technical oversight of the calibration process. Following successful calibration of the EK60s, the Field Engineer will need a small boat transfer back to shore in Honolulu.

2. Train new OER Physical Scientist in data collection and processing procedures and shipboard equipment and routines (continuous throughout cruise).

3. Data management objectives:
   a) Test modifications to SAN
   b) Ensure integration of ADCP data collection system into consolidation pathways
   c) Maintain Okeanos Atlas with automated delivery of SCS data subsets
   d) Ensure realtime delivery of data products
   e) Ensure delivery of sonar data products in hourly rsync
   f) Verify delivery of automated warehouse products (shiptrack, dashboard, etc)
   g) Verify SCS is working properly

4. Review mapping-specific best practices and procedures with the ship's officers and department heads.
   a. Review sonar and marine mammal procedure for 2017- confirm quick read version is easily accessible on bridge.
   b. Review with ship's crew scientific equipment powerpoint – schedule with good attendance from engineering, deck, and bridge. Consider leaving a version on bridge.
   c. Review pre-mapping checklist (originally made by Lt. Emily Rose) with bridge officers – post on wall on bridge to facilitate good communication between Survey Department and the bridge.
   d. Review diagram describing deep water line driving and turning best practice.

5. Ensure mission-readiness of ADCP sonars.
   a. Collect datasets necessary to check transducer alignment angles on the ship's two ADCPs (38 and 300 kHz). ADCP data will be collected while transiting in and out of Pearl Harbor to a depth of approximately 1000m. Test datasets will be evaluated by Toby Martin from the University of Hawaii to help determine if any setting changes are needed in the ADCP control software. Additional ADCP testing may take place at night.

   b. Ensure spare boot drive for ADCP UHDAS machine is onboard and ready as hot spare (coordinate with Toby Martin and Andy Obrien), ensure UHDAS ADCP datasets are getting back up to new backup NAS.

6. Conduct emergency drills. Drills may include some or all of the following as determined by CO:
   a. Fire/Damage Control
   b. Abandon Ship
   c. Man-Over-Board
   d. Steering Casualty
   e. Oil Spill/ Hazmat spill

7. Conduct sound velocity comparison cast(s) between CTD, XBT via hand held launcher, XBT via automated launcher and UnderwayCTD XBT. Near surface values will be compared to values from the thermosalinograph (TSG) and Reson SVP-70 probe. CTD and XBT comparison casts will be obtained prior to collecting multibeam lines for the patch test. An UnderwayCTD cast may also be completed prior to the patch test if the system and trained personnel are ready at that time.

8. Conduct a patch test calibration for the EM 302 multibeam sonar. A CTD cast using the ship's CTD rosette package will be required prior to running the patch test lines.

9. Collect 24-hr/day deep water multibeam (EM 302), split-beam (EK60), ADCP, and sub-bottom sonar data (Knudsen 3260), as feasible while testing and calibrating new sonars.

10. Test the UnderwayCTD equipment and associated software using the new portable UCTD mount at the center of the fantail. Refine Standard Operating Procedures (SOPs) for safely conducting profiles and appropriately processing the data. Initial test profile casts will use the dummy probe.

11. Conduct XBT operations.
    a. Test the ship's 3 XBT hand-launchers.
    b. Test the new XBT autolauncher and create SOP including any special procedures required if transitioning between automated launcher and hand held launcher.

12. Test new and upgraded mission software.
    a) Multibeam SIS software (if updated)
    b) Ensure proper functioning of updated POSMV firmware and POSview software
    c) Install the latest version of QPS Qimera multibeam sonar data processing software on MBPROC1 and MBPROC2 computers. Use Qimera to clean multibeam data and conduct the patch test calibration. Update SOPs related to Qimera. Moe Doucet from QPS will be on the cruise to assist with the integration of Qimera into EX workflows.
    d) Upgrade QPS Fledermaus software version to latest release.

e) Test the utility of using SVP Manager software for editing/exporting sound velocity profiles from all raw svp file types
f) Test new XBT autolauncher software and write SOP.
g) Continue to refine the SOP for conducting sound velocity casts with the Underway CTD.

13. CTD operations
    a) A CTD cast at the start of the patch test survey is planned.
    b) Additional sensors typically mounted on the rosette should be functional and calibrated to support CTD operations for the FY17 field season, including: dissolved oxygen (DO), light scattering sensor (LSS), Oxidation-Reduction Potential (ORP), and altimeter.

14. Telepresence (VSAT 10 mbps ship to shore; T1 shore to ship)
    a) Test telepresence mapping capability in coordination with onshore PS at UNH/CCOM.
    b) Ensure onshore PS can remote desktop into mapping computers on the ship's mission network.
    c) Troubleshoot and test RTS communications between the ship and the UNH/CCOM Exploration Command Center (ECC) if the VPN tunnel between the ISC and ship is ready for testing.
    d) Test and troubleshoot backup scripts and automated data transfers to shore for remote processing at UNH/CCOM.
    e) Confirm difference in start of cruise procedures for telepresence mapping versus non-telepresence mapping cruises.

15. Sonar Synchronization
    a) Confirm existing trigger jigger and configuration.
    b) Evaluate potential improvements to sonar syncing using the spare trigger jigger device that the ET Department has built. Interference is an issue when running the ship's ADCPs at the same time as the multibeam sonar. Changes will be made only to the new spare Trigger Jigger. Explore alternative syncing approaches to minimize interference problems to see if the ADCPs can be run more during multibeam surveying operations. Evaluate impacts on multibeam data quality and sounding density. Potential changes to syncing mechanisms among the sonars will require assistance from the ship's Chief ET. This work will be done opportunistically throughout the cruise.

16. Work with ET Department to test hot-swappable spare EM302 workstation.

17. Perform any follow up testing required as a result of Kongsberg engineering's EM302 upgrade work on EX1608.

18. Finalize 2017 Mapping Readiness Report, including but not limited to:

a. Update any equipment drawings or photos which may have changed in last year, e.g. antenna farm, rack room, fan tail.
b. Update references to serial #'s of equipment in use for FY17 including calibration confirmation

Primary shakedown tasks and time needed for dedicated testing while underway.

Shakedown Item	**Estimated Time Required Offshore**
MBES deep water patch test – including conducting CTD cast and XBT cast for comparison purposes.	0.5 days (night OK)
EK 60 calibrations, (integration of automated calibration gear if available)	3 days (daylight ops only)
UCTD & XBT Autolauncher testing, operational and data integration, SOP finalization	2 days (daylight ops)
ADCP testing and calibration	.5 days (night OK)
Synchronization updates testing	1 day (night OK)
Transits/Contingency	1 day
Total	~7 days

E. Participating Institutions

Global Foundation for Ocean Exploration, 75 Greenmanville Ave., Mystic, CT 06355

Kongsberg Underwater Technology, Inc., 19210 33rd Avenue West, Lynnwood, WA 98036-4707

National Oceanic and Atmospheric Administration (NOAA) - Office of Ocean Exploration and Research (OER) - 1315 East-West Hwy, Silver Spring, MD 20910 USA

NOAA, National Centers for Environmental Information (NCEI),1021 Balch Blvd, Suite 1003Stennis Space Center, MS. 39529

NOAA Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543-1026

Quality Positioning Services (QPS) QPS - a Saab group company, 104 Congress St, Suite 304, Portsmouth, NH 03801

University Corporation for Atmospheric Research Joint Office for Science Support (JOSS), PO Box 3000 Boulder, CO 80307 USA

University of Hawai`i at Manoa, 1000 Pope Road, Marine Sciences Building, Honolulu, HI 96822 USA

University of New Hampshire (UNH) Center for Coastal and Ocean Mapping (CCOM), Jere A. Chase Ocean Engineering Lab, 24 Colovos Road, Durham, NH 03824 USA

University of Rhode Island, Graduate School of Oceanography's Inner Space Center, 215 South Ferry Rd. Narragansett, RI 02882 USA

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

List of Science Party personnel

Name (Last, First)	Title	Date Aboard	Date Depart	M/F	Affiliation	Nationality
Sowers, Derek	Expedition Coordinator, Mapping Lead	11/29/16	12/17/16	M	NOAA OER (ERT, Inc)	US Citizen
Michael White	Mapping Lead	12/14/16	12/17/16	M	NOAA OER (ERT, Inc)	US Citizen
Freitas, Daniel	Mapping Watch Leader	11/29/16	12/17/16	M	UCAR Contractor	US Citizen
Bittinger, Amanda	Mapping Watch Leader	12/8/16	12/17/16	F	UCAR Contractor	US Citizen
Aragon, Fernando	Data Engineer	11/29/16	12/17/16	M	GFOE	US Citizen
Doucet, Maurice "Moe"	Software Engineer, Mapping Watchstander	12/9/16	12/17/16	M	QPS	US Citizen
Barbee, David	Kongsberg Field Engineer	12/9/16	12/14/16	M	Kongsberg	US Citizen
Atta, Calder	Mapping Watchstander	12/9/16	12/16/16	M	UCAR Contractor	US Citizen

A full mapping complement is necessary for this cruise. Required mission personnel include a Mapping Lead/Expedition Coordinator, two Mapping Watch Leads, and two Mapping Watchstanders. The Expedition Coordinator is responsible for facilitating overall mapping

operations, including participating in operational meetings, providing guidance for mapping/survey troubleshooting, and communicating status of mapping sensors to personnel on shore.

G. Administrative

1. Points of Contacts:

Ship Operations

Chief, Operations Division, Atlantic (MOA)
LT Joe Carrier
Telephone: (757) 441-6842
E-mail:chiefops.moa@noaa.gov

Marine Operations Center, Atlantic (MOA)
439 West York Street
Norfolk, VA 23510-1145
Telephone: (757) 441-6776
Fax: (757) 441-6495

Mission Operations

Derek Sowers
Expedition Coordinator/Mapping Lead
NOAA Office of Ocean Exploration
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Other Mission Contacts

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Jeremy Potter
Expeditions Director
NOAA Office of Ocean Exploration and Research
Phone: (301) 734-1145 / (240) 215-7101
E-mail: jeremy.potter@noaa.gov

2. Diplomatic Clearances

None Required. All operations are in US waters.

3. Licenses and Permits

None Required. See Appendix for Categorical Exclusion documentation.

II. Operations

The Expedition Coordinator 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.

A. Project Itinerary

(All times and dates are subject to prevailing conditions and the discretion of the commanding officer):

Date	Operation	Notes
12/8/2016 Thursday	Mission personnel arrive	Derek Sowers, Dan Freitas, and possibly a data manager will be onboard from EX1608. Most other mission personnel arrive.
12/9/2016 Friday	Pre-cruise preparations. Set up EK60 calibration gear (clamp downriggers to stanchions, prepare weight/lines, etc.). Mission personnel safety meeting/orientation. Pre-cruise meeting between EC, OPS, CO, and Department Heads.	Kongsberg fisheries sonar Engineer arrives.

12/10/2016 Saturday	Touch and go practice at the pier for NOAA officers. Depart Pearl Harbor after lunch and transit to EK60 calibration area. Collect ADCP test dataset when leaving port and transiting. Ping/test all sonars. Conduct emergency drills.	Transit from Ford Island to EK60 calibration site is approximately 8 hours. Sonars may be secured while transiting through Penguin Banks due to high marine mammal presence.
12/11/2016 Sunday	Calibrate EK60s (daytime ops), test alternative sonar syncing with new trigger jigger (night-time ops).	Nighttime operations will stay within a short transit distance of the daytime EK60 calibration area.
12/12/2016 Monday	Calibrate EK60s (daytime ops), test alternative sonar syncing with new trigger jigger (night-time ops).	
12/13/2016 Tuesday	Complete EK60 calibrations (daytime ops). De-mobilize all EK60 calibration equipment and pack for shipping.	
12/14/2016 Wednesday	Transit overnight to Honolulu, conduct AM small boat transfer of Kongsberg Engineer to shore. Transit to multibeam patch test area. Conduct UCTD, XBT, CTD comparison casts. Collect patch test lines overnight. If patch test was completed on EX1608, shiptime will be used instead to test hot-swappable spare EM302 workstation, UCTD, and XBT autolauncher.	Transit from EK60 site to Ford Island is approximately 8 hours. Small boat transfer will require non-EX boat support. Transit from Ford Island to patch test site is approximately 3 hours.
12/15/2016 Thursday	Finish patch test lines in the AM. UCTD and XBT autolauncher testing. Test alternative sonar syncing arrangements and evaluate impact on data quality.	
12/16/2016 Friday	Return to port at Ford Island in the AM. Gather ADCP data while transiting from deep water into Ford Island. Post-cruise meeting.	
12/17/2016 Saturday	Mission personnel depart.	

Telepresence Events

There are currently no telepresence events scheduled.

In-Port Events

There are currently no in-port events scheduled.

B. Staging and Destaging:

Minimal mobilization will be required because the ROVs will already be onboard the ship and ready for the start of the field season. The UnderwayCTD will need to be mounted in the center of the fantail and provided with power prior to the start of the project.

Shipments

Send an email to *Okeanos Explorer's* Operations Officer at OPS.Explorer@noaa.gov indicating the size and number of items being shipped. All items should arrive no later than **COB December 5, 2016**.

Vessel shipping address:
NOAA Ship *Okeanos Explorer*
Attn: Operations Officer
1897 Ranger Loop
Ford Island, HI 96818

C. Operations to be conducted:

Sonar Operations

Multibeam and singlebeam mapping operations will be conducted almost 24 hours a day throughout the cruise. XBT and/or UnderwayCTD sound velocity casts in support of multibeam sonar mapping operations will be conducted at an interval defined by prevailing oceanographic conditions, but not to exceed 6 hours.

Calibration of five EK 60 sonars will be done in the vicinity of Hawaii, and is currently planned for the area shown in Figure 3. The general criteria pertaining to the selection of a suitable calibration site are as follows: water depth of at least 30 meters, minimal impact by fish (to avoid acoustic interference), mild currents and sea state, and minimal traffic hazards. The exact area for calibration work will be determined in consultation with science partners in Hawaii and consultation with the ship's Operations and Navigation Officers and CO. Calibration

operations require the deployment of ropes, weights, monofilament line, and metal spheres underneath the ship as controlled both by hand and on outrigger poles. The ship's mobility is highly constrained during calibration work, and it is anticipated that the ship will need to be drifting freely during daytime calibration work, therefore at sea anchoring is not anticipated. The SOP for EK60 calibration work is provided in the appendix.

ADCP data sets will be collected while transiting in and out of Pearl Harbor to evaluate bottom tracking performance and transducer alignment offsets. ADCP data will also be collected during nighttime mapping operations to test interference with other sonars.

CTD/UnderwayCTD Operations

A CTD cast is planned for the start of the patch test survey in order to obtain a high quality sound speed profile for the water column. XBT and/or UnderwayCTD sound velocity casts may be conducted right after the CTD cast for comparison purposes. Additional CTD/UnderwayCTD operations may be required for the EK60 calibrations.

D. Dive Plan

All dives are to be conducted in accordance with the requirements and regulations of the NOAA Diving Program (http://www.ndc.noaa.gov/dr.html) and require the approval of the ship's Commanding Officer.

Dives are not planned for this project. Prior to the start of this cruise a hull dive should be completed by the ship's dive team to inspect the condition of all sonar transducers and the Reson SVP probe and gently scrape off any biofouling as needed.

E. Applicable Restrictions

Conditions which preclude normal operations: (1) handheld XBTs, UnderwayCTD casts, and CTDs will not be conducted in very rough sea states or when there is significant risk of lightning. (2) If rough sea state is resulting in very poor data quality, sonar data may not be collected for that period of time. (3) EK 60 and multibeam sonar calibration work cannot be conducted in rough seas.

III. Equipment

A. Equipment and Capabilities provided by the ship (itemized)

- Kongsberg Simrad EM302 MultibeamEchosounder (MBES)

- Kongsberg Simrad EK60DeepwaterEchosounders and GPTs (18, 38, 70, 120, 200 kHz)
- Knudsen Chirp 3260 Sub-bottom profiler (SBP)
- Teledyne RDI Workhorse Mariner (300 kHz) ADCP
- Teledyne RDI Ocean Surveyor (38 kHz) ADCP
- Teledyne UnderwayCTD
- LHM Sippican XBT (Deep Blue probes)
- Seabird SBE 911Plus CTD
- Seabird SBE 32 Carousel and 24 2.5 L Niskin Bottles
- Light Scattering Sensor (LSS)
- Oxidation – Reduction Potential (ORP)
- Dissolved Oxygen (DO) sensor
- Altimeter Sensor and battery pack
- CNAV GPS
- POS/MV
- Seabird SBE-45 (Micro TSG)
- Kongsberg Dynamic Positioning-1 System
- NetApps mapping storage system
- CARIS HIPS Software
- IVS Fledermaus Software
- SIS Software
- Hypack Software
- Scientific Computing System (SCS)
- ECDIS
- Met/Wx Sensor Package
- Telepresence System
- VSAT High-Speed link (Comtech5Mbps ship to shore; 1.54 Mbps shore to ship)
- Cruise Information Management System (CIMS)

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

- EK60 calibration equipment

IV. Hazardous Materials

A. Policy and Compliance

The Expedition Coordinator 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). The Expedition Coordinator and Science Team Lead will be responsible for transporting all samples and HAZMAT on and off the ship. 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

No Hazardous Materials are being brought aboard the ship for this project.

C. Chemical safety and spill response procedures

All safety and spill response procedures will be handled according to OMAO guidelines and following the manufacturers MSDS which has been provided to the ship's ECO.

D. Radioactive Materials

NOT APPLICABLE TO THIS CRUISE

V. ADDITIONAL PROJECTS

A. Supplementary Projects

NASA Maritime Aerosol Network

During the cruise the marine aerosol layer observations will be collected for the NASA Maritime Aerosol Network (MAN). Observations will be made by mission personnel (as time allows) with a sun photometer instrument provided by the NASA MAN program. Resulting data will be delivered to the NASA MAN primary investigator Alexander Smirnov by the expedition coordinator. All collected data will be archived and publically available at: http://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html

Equipment resides on the ship and is stewarded by the Expedition Coordinator.

B. NOAA Fleet Ancillary Projects

No NOAA Fleet Ancillary Projects are planned.

VI. DISPOSITION OF DATA AND REPORTS

A. Data Responsibilities

All data acquired on *Okeanos Explorer* will be provided to the public archives without proprietary rights. All data management activities shall be executed in accordance with NAO 212-15, Management of Environmental and Geospatial Data and Information

Ship Responsibilities

The Commanding Officer is responsible for all data collected for missions until those data have been transferred to mission party designees. Data transfers will be documented on NOAA Form 61-29. Reporting and sending copies of project data to NESDIS (ROSCOP form) is the responsibility of OER.

NOAA OER Responsibilities

The Expedition Coordinator will work with the *Okeanos Explorer* Operations Officer to ensure data pipeline protocols are followed for final archive of all data acquired on *Okeanos Explorer* without proprietary rights. See Appendix B for detailed data management plans.

Deliverables

1. At sea
    a. Daily plans of the Day (POD)
    b. Daily situation reports (SITREPS)
    c. Daily summary bathymetry data files
    d. Refined SOPs for all pertinent operational activities
    e. Assessments of all activities
2. Science
    a. Multibeam and XBT raw and processed data (see appendix B for the formal cruise data management plan)
    b. EK 60 raw data
    c. Knudsen 3260 sub-bottom profiler raw data
    d. ADCP raw data
    e. Mapping data report
    f. Cruise Report

Archive

OER and ship will work together to ensure documentation and stewardship of acquired data sets in accordance with NAO 212-15. The Cruise Information Management System is the primary tool used to accomplish this activity.

VII. Meetings, Vessel Familiarization, and Project Evaluations

A. Shipboard Meetings

A safety brief and overview of POD will occur on the Bridge each morning at 0800. Daily Operations Briefing meetings will be held at 1330 in the forward lounge to review the current day, and define operations, associated requirements, and staffing needs for the following day. A Plan of the Day (POD) will be posted each evening for the next day in specified locations throughout the ship. Daily Situation Reports (SITREPS) will be posted as well and shared daily through e-mail.

1. Pre-Project Meeting:

The Expedition Coordinator 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 Expedition Coordinator in arranging this meeting.

2. 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.

3. Post-Project Meeting:

The Commanding Officer is responsible for conducting a meeting no earlier than 24 hrs before or seven 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 Expedition Coordinator, and members of the scientific party and is normally arranged by the Operations Officer and Expedition Coordinator.

4. Project Evaluation Report:

Within seven days of the completion of the project, a Customer Satisfaction Survey is to be completed by the Expedition Coordinator. The form is available at http://www.omao.noaa.gov/fleeteval.html and provides a "Submit" button at the end of the form. 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 ship, 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 Expedition Coordinator. The Expedition Coordinator and Operations 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. The Expedition Coordinator 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 Expedition Coordinator is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the cruise and at its conclusion prior to departing the ship.

All NOAA scientists will have proper travel orders when assigned to any NOAA ship. The Expedition Coordinator will ensure that all non-NOAA or non-Federal scientists aboard also have proper orders. It is the responsibility of the Expedition Coordinator 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 7, 1999 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 Expedition Coordinator 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 four 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 one 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
E-mail: MOA.Health.Services@noaa.gov

Please make sure the medical.explorer@noaa.gov email address is cc'd on all medical correspondence.

Prior to departure, the Expedition Coordinator must provide a listing of emergency contacts to the Operations Officer for all members of the scientific party, with the following information: name, address, relationship to member, and telephone number using the Google Form at

https://docs.google.com/a/noaa.gov/forms/d/1pcoSgPluUVxaY64CM1hJ75l1iIYirTk48G-lv37Am_k/viewform

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. Steel-toed shoes are required to participate in any work dealing with suspended loads, including CTD deployments and recovery. The ship does not provide steel-toed boots. Hard hats are also 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.

Operational Risk Management: For every operation to be conducted aboard the ship (NOAA-wide initiative), risk management procedures will be followed. For each operation, risks will be identified and assessed for probability and severity. Risk mitigation strategies/measures will be investigated and implemented where possible. After mitigation, the residual risk will have to be assessed to make Go-No Go decisions for the operations. Particularly with new operations, risk assessment will be ongoing and updated as necessary. This does not only apply to over-the-side operations, but to everyday tasks aboard the vessel that pose risk to personnel and property.

- CTD, ROV (and other pertinent) ORM documents will be followed by all personnel working onboard *Okeanos Explorer*.
- All personnel onboard are in the position of calling a halt to operations/activities in the event of a safety concern.

D. Communications

A daily situation report (SITREP) on operations prepared by the Expedition Coordinator will be relayed to the program office. Sometimes it is necessary for the Expedition Coordinator 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 Expedition Coordinator upon request, in order to conduct official business. The ship's primary means of communication with the Marine Operations Center is via e-mail and the Very Small Aperture Terminal (VSAT) link. VSAT bandwidth at 10 mbps ship to shore; T1 shore to ship will be paid by OER and provided by OMAO.

Specific information on how to contact NOAA Ship *Okeanos Explorer* and all other fleet vessels can be found at http://www.moc.noaa.gov/MOC/phone.html#EX

Important Telephone and Facsimile Numbers and E-mail Addresses

Ocean Exploration and Research (OER):
Phone: (301) 734-1010
Fax: (301) 713-4252

University of New Hampshire, Center for Coastal and Ocean Mapping
Phone: (603) 862-3438
Fax: (603) 862-0839

NOAA Ship *Okeanos Explorer* - Telephone methods listed in order of increasing expense:

Okeanos Explorer Cellular: (401) 713-4114
Okeanos Explorer Iridium:(808) 659-9179
OER Mission Iridium (dry lab): (808) 851-3827

EX INMARSAT B
Line 1: 011-870-764-852-328
Line 2: 011-870-764-852-329

Voice Over IP (VoIP) Phone:
301-713-7772 (expect a delay once picked up by directory)

E-Mail: Ops.Explorer@noaa.gov - (mention the person's name in SUBJECT field)

E-Mail: expeditioncoordinator.explorer@noaa.gov - For dissemination of all hands emails by Expedition Coordinator while on board. See ET for password.

E. IT Security

1. 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: 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 these 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 three days of embarking.

F. Foreign National Guests Access to OMAO Facilities and Platforms

Not applicable to this cruise.

VIII. Appendices

Appendix 1. Data Management Plan

Ocean Exploration and Research

Data Management Plan
Okeanos Explorer (EX1609): Main Hawaiian Islands Shakedown (Mapping)

OER Data Management Objectives
Ensure data pipelines from ship are flowing. Maintain Okeanos Atlas.

03-Nov-16

1. General Description of Data to be Managed

1.1 Name and Purpose of the Data Collection Project

Okeanos Explorer (EX1609): Main Hawaiian Island Shakedown

1.2 Summary description of the data to be collected.

Multibeam, split-beam, and/or ADCP sonar mapping operations will be conducted 24 hours a day throughout the cruise. Sub-bottom profile mapping will be conducted periodically during the cruise for testing purposes and is subject to the discretion of the CO. XBT and/or UnderwayCTD sound velocity casts in support of multibeam sonar mapping operations will be conducted at an interval defined by prevailing oceanographic conditions, but not to exceed 6 hours. Multibeam data will be fully processed according to standard onboard procedures and will be archived with the National Centers for Environmental Information (NCEI). Split-beam EK60 data and ADCP data will be archived in their raw formats with NCEI as well.

1.3 Keywords or phrases that could be used to enable users to find the data.

expedition, exploration, explorer, marine education, noaa, ocean, ocean discovery, ocean education, ocean exploration, ocean exploration and research, ocean literacy, ocean research, OER, science, scientific mission, scientific research, sea, stewardship, systematic exploration, technology, transformational research, undersea, underwater, Davisville, mapping survey, multibeam, multibeam backscatter, multibeam sonar, multi-beam sonar, noaa fleet, okeanos, okeanos explorer, R337, Rhode Island, scientific computing system, SCS, single beam sonar, singlebeam sonar, single-beam sonar, sub-bottom profile, water column backscatter, Hawaiian Islands, Oahu, Molokai, Lanai, Maui, calibration, readiness

1.4 If this mission is part of a series of missions, what is the series name?

Okeanos Mapping Cruises

1.5 Planned or actual temporal coverage of the data.

Dates: 12/10/2016 to 12/16/2016

1.6 Planned or actual geographic coverage of the data.

Latitude Boundaries:	20.5	to	21.31
Longitude Boundaries:	-158.4	to	-157

1.7 What data types will you be creating or capturing and submitting for archive?

Cruise Plan, Cruise Summary, Data Management Plan, CTD (processed), CTD (product), CTD (raw), EK60 Singlebeam Data, Bottom Backscatter, ADCP, Expedition Cruise Report, Mapping Summary, Multibeam (image), Multibeam (processed), Multibeam (product), Multibeam (raw), SCS Output (compressed), SCS Output (native)

03-Nov-16

1.8 What platforms will be employed during this mission?

NOAA Ship Okeanos Explorer

2. Point of Contact for this Data Producing Project

Overall POC:	Derek Sowers, Physical Scientist, NOAA Office of Ocean Exploration and Research, Derek.Sowers@noaa.gov
Title:	Expedition Coordinator, Mapping Lead
Affiliation/Dept:	NOAA Office of Ocean Exploration and Research, UNH CCOM/JHC
E-Mail:	derek.sowers@noaa.gov
Phone:	603-862-0369

3. Point of Contact for Managing the Data

Data POC Name:	Susan Gottfried
Title:	OER Data Management Coordinator
E-Mail:	susan.gottfried@noaa.gov

4. Resources

4.1 Have resources for management of these data been identified? True

4.2 Approximate percentage of the budget devoted to data management. (specify % or "unknown")

unknown

5. Data Lineage and Quality

5.1 What is the processing workflow from collection to public release?

SCS data shall be delivered in its native format as well as an archive-ready, documented, and compressed NetCDF3 format to NCEI-MD; multibeam data and metadata will be compressed and delivered in a bagit format to NCEI-CO

5.2 What quality control procedures will be employed?

Quality control procedures for the data from the Kongsberg EM302 is handled at UNH CCOM/JHC. Raw (level-0) bathymetry files are cleaned/edited into new data files (level-1) and converted to a variety of products (level-2). Data from sensors monitored through the SCS are archived in their native format and are not quality controlled. Data from CTD casts and XBT firings are archived in their native format. CTDs are post-processed by the data management team as a quality control measure and customized CTD profiles are generated for display on the Okeanos Atlas (explore.noaa.gov/okeanosatlas).

6. Data Documentation

6.1 Does the metadata comply with the Data Documentation Directive? True

6.1.1 If metadata are non-existent or non-compliant, please explain:

not applicable

6.2 Where will the metadata be hosted?

03-Nov-16

Organization:	An ISO format collection-level metadata record will be generated during pre-cruise planning and published in an OER catalog and Web Accessible Folder (WAF) hosted at NCEI-MS for public discovery and access. The record will be harvested by data.gov.
URL:	http://www.ncddc.noaa.gov/oer-waf/ISO/Resolved/2016/
Meta Std:	ISO 19115-2 Geographic Information with Extensions for Imagery and Gridded Data will be the metadata standard employed; a NetCDF3 standard for oceanographic data will be employed for the SCS data; the Library of Congress standard, MAchine Readable Catalog (MARC), will be employed for NOAA Central Library records.

6.3 Process for producing and maintaining metadata:

Metadata will be generated via xml editors or metadata generation tools.

7. Data Access

7.1 Do the data comply with the Data Access Directive? True

7.1.1 If the data will not be available to the public, or with limitations, provide a valid reason.

Not Applicable

7.1.2 If there are limitations, describe how data are protected from unauthorized access.

Account access to mission systems are maintained and controlled by the Program. Data access prior to public accessibility is documented through the use of Data Request forms and standard operating procedures.

7.2 Name and URL of organization or facility providing data access.

Org:	National Centers for Environmental Information
URL:	http://explore.noaa.gov/digitalatlas

7.3 Approximate delay between data collection and dissemination. By what authority?

Hold Time: no proprietary rights period

Authority: not applicable

7.4 Prepare a Data Access Statement

No data access constraints, unless data are protected under the National Historic Preservation Act of 1966.

8. Data Preservation and Protection

8.1 Actual or planned long-term data archive location:

Data from this mission will be preserved and stewarded through the NOAA National Centers for Environmental Information. Refer to the Okeanos Explorer FY16 Data Management Plan at NOAA's EDMC DMP Repository (EX_FY16_DMP_Final.pdf) for detailed descriptions of the processes, procedures, and partners involved in this collaborative effort.

8.2 If no archive planned, why?

8.3 If any delay between data collection and submission to an archive facility, please explain.

8.4 How will data be protected from accidental or malicious modification or deletion?

Data management standard operating procedures minimizing accidental or malicious modification or deletion are in place aboard the Okeanos Explorer and will be enforced.

8.5 Prepare a Data Use Statement

Data use shall be credited to NOAA Office of Ocean Exploration and Research.

Ocean Exploration and Research

Appendix 2.Categorical Exclusion

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
OCEANIC AND ATMOSPHERIC RESEARCH
Office of Ocean Exploration and Research
Silver Spring, MD 20910

November 23, 2016

MEMORANDUM FOR: The Record

FROM: Craig Russell, *Okeanos Explorer* Program Manager
Office of Ocean Exploration & Research (OER)

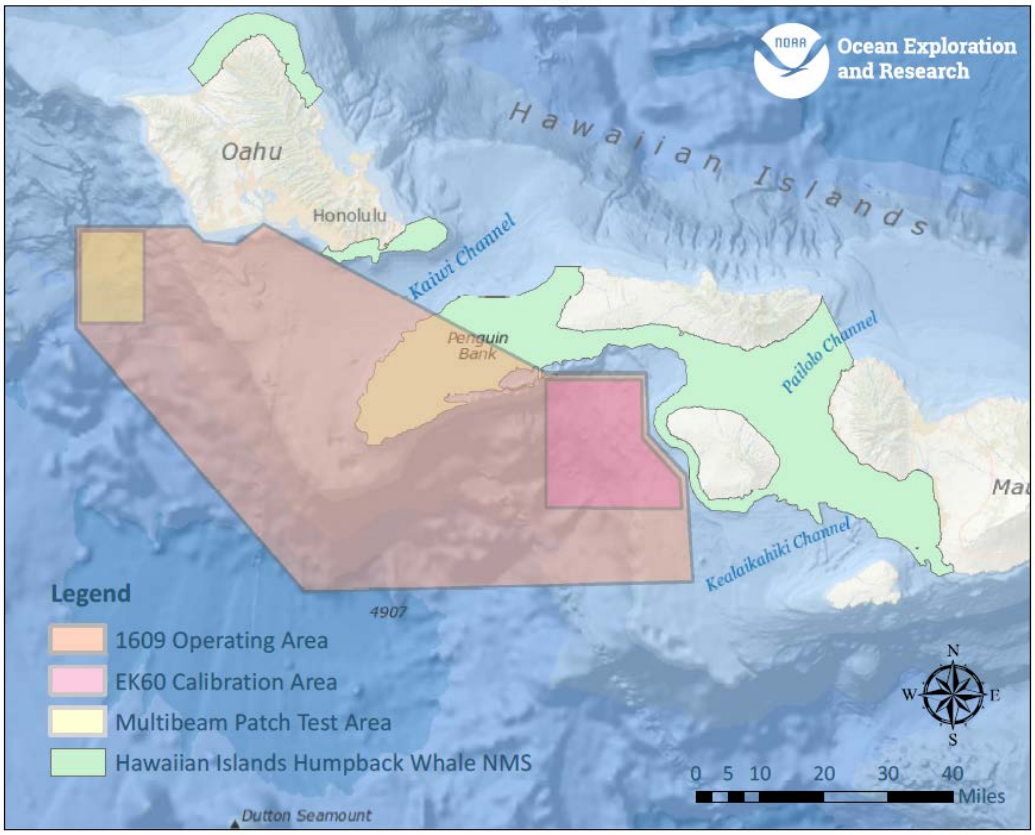
SUBJECT: NEPA Categorical Exclusion for NOAA Ship *Okeanos Explorer*
Cruise EX-16-09, Main Hawaiian Islands Shakedown (Mapping)

This memorandum documents the applicability of a Categorical Exclusion under the National Environmental Policy Act to the NOAA Ship *Okeanos Explorer* Cruise EX-16-09 activities that NOAA's Office of Ocean Exploration & Research (OER) is undertaking for 7 days off the main Hawaiian Islands. NAO 216-6, Environmental Review Procedures, requires all proposed projects to be reviewed with respect to environmental consequences on the human environment. The proposed action is to run and calibrate the scientific sonar systems on the NOAA vessel *Okeanos Explorer* to ensure readiness for the FY17 exploration field season of the ship.

Description of the Project

From December 10 to December 15, 2016, OER will conduct a mapping shakedown cruise near the Hawaiian Islands south of Oahu and west of Lanai. The cruise will depart from, and return to, port in Pearl Harbor in Honolulu. This project is part of the NOAA OER's "FY17 Science Program" and entails ocean mapping activities using active acoustics ranging from 50-4500 meter water depths, and water column profiling measurements using CTD, XBT, and UnderwayCTD casts designed to increase knowledge of the marine environment. The latitude and longitude bounding coordinates for the operating area of the cruise are 20.5° to 21.31° N and -158.4° to -157° W.

EX-16-09 Main Hawaiian Islands Shakedown Mapping Operating Area



The primary goals of the cruise are to shakedown, test, and calibrate the ship's suite of scientific sonar systems used for exploratory ocean mapping and baseline characterization. These sonars include the following systems: Kongsberg EM 302 multibeam sonar (30 kHz), five Kongsberg EK 60 singlebeam sonar transducers (18, 38, 70, 120, and 200 kHz), a Knudsen 3260 Sub-Bottom Profiler sonar (3.5 kHz), a Teledyne Workhorse Mariner 300 kHz ADCP, and a Teledyne Ocean Surveyor 38 kHz ADCP. The multibeam is used to map broad swaths for seafloor bathymetry/backscatter and water column feature detection (e.g. gaseous seeps), the split-beam sonars gather calibrated target strength measurements of biologic and gaseous targets in the water column, the sub-bottom profiler provides data useful for interpreting sub-seafloor geology, and the ADCPs provide information about current velocity and direction at various depths through a water column profile. All sonars will be tested and run to collect test data over the course of the cruise, but typically not all at the same time. Mapping and sonar testing/calibration operations will be conducted nearly continuously throughout the cruise.

Calibration of EK60 fisheries sonars and Acoustic Doppler Current Profilers (ADCPs) in federal waters south of the islands of Lanai and Maui in the Hawaiian Islands region will be the focus of work for approximately four days. Gathering calibration data for ADCPs involves running transect lines from 50m to 1000m and occasionally gathering data in deeper water (>1000m)

while turning and stopping/moving the ship. EK60 calibration work involves suspending a small metal sphere 30 m underneath the ship using fishing line and downriggers while gathering target strength measurements of the sphere with each EK60 transducer (five transducers to calibrate in total). Calibration work will be completed while drifting freely in an area with low vessel traffic, no navigational hazards, a lack of fishing gear in the water from nearby vessels, and only during daylight hours. A Field Engineer from Kongsberg will provide technical oversight of the calibration process. This calibration work is required in order to collect quantitative target strength measurements of objects in the water column (e.g. fish, biology layers, bubbles), and is essential in order to collect scientifically useable data. Many NOAA vessels use EK60 fisheries sonars and are calibrated using the same standardized procedures.

A standard multibeam sonar patch test calibration and crossline validation is planned for an area in deep water (2000-3200 meters deep) southwest of the island of Oahu. Additionally, expendable bathythermographs (XBTs), UnderwayCTD casts, and CTD rosette casts will be conducted in conjunction with multibeam data collection. A multibeam patch test calibration is a standard quality control practice required whenever the ship comes out of a major repair period or had modifications done to key ancillary positioning equipment such as GPS antennas or inertial motion sensors. The *Okeanos Explorer* just finished a several month long period of repairs and improvements, including main mast preservation that required moving the GPS antennas.

Mapping

The acquisition of high-resolution seafloor mapping data is an essential precursor to making significant biological, geological, archaeological and oceanographic discoveries. This cruise will test and calibrate the ship's scientific sonars to verify high quality data collection and ensure readiness for the FY2017 field season. The main focus of the cruise will be on calibrating the multibeam sonar and the EK60 sonars. Calibration work and sonar operations will occur outside the Hawaiian Islands Humpback Whale National Marine Sanctuary boundaries. Sonar operations with the multibeam, EK60, and sub-bottom sonars running simultaneously (without the ADCPs) are planned to confirm normal operation through their typical synchronized configuration. Efforts will also be made to test alternative syncing mechanisms that enable operation of the ship's ADCPs without causing interference to the multibeam, EK60, and sub-bottom sonars. Expendable bathythermographs (XBTs) will be deployed at regular intervals in association with multibeam data collection. All of these systems are routinely used by this exploration vessel.

Bridge Officers and Watch Standers will be on watch during all hours and will look for marine mammals and other observable species potentially sensitive to the sound of the sonars. If cetaceans are sighted, knowledgeable personnel will follow established best management practices to minimize disturbance. If cetacean species are present within 400 m of the ship, the vessel will stop until the animals depart the area.

Multibeam

Multibeam sonar data will produce high-resolution bathymetry and acoustic backscatter maps. The purpose of this cruise is not to complete a large multibeam sonar survey, but rather to complete a standard deep water multibeam patch test calibration and crossline analysis consisting of a series of approximately 2 km parallel and perpendicular lines within an approximately 100 square kilometer area in federal waters. Transit multibeam data will also be collected between the islands of Oahu and Lanai, but not while transiting through the Penguin Banks area.

Expendable bathythermographs (XBT):

XBTs are deployed to obtain sound velocity profiles. The profiles are required to calibrate the multibeam system and ensure accurate bathymetric mapping. During mapping operations water column sound velocity profiles will be conducted every 4-6 hours. If the UnderwayCTD is not yet ready for collecting these profiles, the data will be gathered using XBTs.

UnderwayCTD

The UnderwayCTD (UCTD) is a piece of equipment used to gather conductivity/temperature/depth (CTD) measurements or sound velocity measurements while the ship is moving. Accurate measurements of sound speed as a function of depth down to approximately 700 meters are needed every 3-6 hours during multibeam sonar mapping operations. The ship currently obtains sound velocity profiles using expendable probes (XBTs). These sound speed measurements are essential for ray-tracing calculations used by the EM302 multibeam sonar system in order to accurately collect bathymetry and backscatter data. To get these essential data, the *Okeanos Explorer* can either use an XBT or the UCTD equipped with a sound velocity probe. OER has installed the UCTD in order to minimize the use of XBTs while still gathering essential sound velocity profile data needed in order to accurately collect high quality multibeam sonar data. The UCTD has a re-usable probe that is dropped through the water column to log data then retrieved by rewinding the line onto a motorized spool. The UCTD was installed on the ship in December 2015 on the starboard aft railing and will be tested on this cruise in a new deployment location at the middle of the fantail (as recommended by the manufacturer). When working correctly, UCTD casts will be used instead of XBTs to obtain water column profile data in order to avoid leaving behind expendable XBT waste in the ocean.

Split Beam Sonars:

Kongsberg EK 60 split-beam sonars are used to collect information about the water column, such as at gas plume or seep sites, and to obtain information about biomass. The EK60 split-beam sonar is used as a quantitative scientific echosounder to identify water column acoustic reflectors - typically biological scattering layers, fish, or gas bubbles – providing additional information about water column characteristics and anomalies. Fishery scientists have developed methods to analyze EK60 data to support fish stock assessment (e.g. Atlantic herring, pollock, capelin) and to predict hot spots of large fish in coral reefs. Split-beam sonars are also being used to help develop "acoustic signatures" of different marine species, which will greatly enhance existing efforts to assess abundance, distribution, and behavior using remote sensing methods. Additionally, split beam sonars are being used to estimate gaseous seep flux

rates and improve assessments of their contribution to ocean and atmospheric chemistry. The *Okeanos Explorer* has five operational EK60 transducers at the following frequencies: 18 kHz, 38 kHz, 70 kHz, 120 kHz, and 200 kHz. One or more of these sonars will be operated during the majority of the cruise.

Sub Bottom Profiler:
The primary purpose of the Knudsen Chirp 3260 (3.5 kHz) sonar is to provide echogram images of surficial geological sediment layers underneath the seafloor to a maximum depth of about 80 meters below the seafloor. The Sub Bottom Profiler is normally operated to provide information about the sedimentary features and the bottom topography that is simultaneously being mapped by the multibeam sonar. The data generated by this sonar is fundamental in helping geologists interpret the shallow geology of the seafloor. The profiler will be run intermittently to gather test data sets and to evaluate syncing options with other sonars.

CTD Operations
The CTD instrument package does not emit an acoustic signal and is used to obtain conductivity, temperature, depth and other oceanographic data (dissolved oxygen, light scattering, oxygen reduction potential). At least one, and potentially several, CTD casts are planned for this cruise. The CTD will not touch the seafloor and will have limited time and presence in the marine environment.

Effects of the Project

OER has conducted a Biological Evaluation for all operations to be conducted as part of the program's 2015-2017 expeditions in the Pacific Ocean. On February 7, 2016 OER received concurrence from the National Marine Fisheries Service Protected Resources Division that under Section 7 of the Endangered Species Act (ESA), the activities slated to occur during the 2016 expeditions are not likely to adversely impact ESA-listed marine species, and would have insignificant effects on designated or proposed critical habitat. The ESA Section 7 concurrence letter is provided as Appendix 4 in the Project Instructions document for EX-16-09.

In general, the Pacific around the Main Hawaiian Island is a noisy environment. Exposure to noise from the use of the scientific sonars on the *Okeanos Explorer* may result in avoidance behavior or other finite disturbance to this environment and its marine mammals and fish. The methods used to map the ocean during this cruise are used routinely by NOAA and UNOLS research vessels, are non-destructive in nature, and not known to cause harm. Nonetheless, exposure to noise from use of the abovementioned geophysical equipment may result in avoidance behavior or other finite disturbance to this environment and its marine mammals, sea turtles and fish.

The ship will transit for two hours through the Hawaiian Islands Humpback Whale National Marine Sanctuary to get to the area for EK60 sonar calibration work. During this transit, special precautions will be taken to avoid disturbance or harm to cetaceans that may be present in the sanctuary. All scientific sonars will be secured (not pinging), no XBT, UCTD, or CTD casts will be

conducted, and the ship will transit at no greater than 8.5 knots. If transit is needed again through the area later in the cruise, the same precautions will be implemented. No other work or sonar testing/calibration will be conducted inside the sanctuary.

Standard practice during all *Okeanos Explorer* cruises and operations include Officers or Watch Standers on the Bridge around-the-clock, monitoring the surrounding ocean for the presence of other ships, unanticipated hazards, and marine animals – especially cetaceans. If a cetacean is observed, the Mapping Watch Stander or Science Lead is notified and if appropriate the team then proceeds with protocols to continue monitoring the animal or shut down mapping or other ship operations until the animal has departed the area for an appropriate period of time. If cetacean species are observed within 400 m of the ship, the vessel would stop until the animals depart the area but the mapping sonars would continue transmitting to avoid startle responses. If an observed animal is unable or unwilling to depart the immediate area, sonars will be secured and the ship will slowly move away from the area if feasible.

When marine mammals are able to be identified by Bridge Officers or Watch Standers, these observations are noted in the NOAA fleet marine mammal observation log as part of standard practice. During the 2016-2017 field season, these procedures will include monitoring for the presence of sea turtles and, when appropriate, taking protection measures. It is understood that visual monitoring for the presence of marine mammals at night is not typically effective due to limited visibility – however no practicable alternative is currently available. Modest ship transit speeds (<9-10 knots) and avoidance behavior of mammals to noise that may bother them should make it highly unlikely that a marine mammal would get close enough to the ship's sonar transducers to cause temporary or permanent hearing impacts.

Multibeam Echosounder (MBES)

The Kongsberg EM 302 MBES is hull-mounted on the *Okeanos Explorer* and operates at 30 kHz. The transmitting beamwidth is 0.5° fore–aft and 150° athwartship. In the deepest operating mode the maximum source level of the EM302 is 243 dB re 1 microPa. When operating in shallow modes the source level is 238 dB re 1 microPa. The EM302 is a focused sonar array that uses selective angular directivity and transmits short pulses at limited ping rates (Lurton & DeRuiter 2011). These two characteristics of this type of sonar decrease the potential sound exposure level as well as decrease the probability of the animals being subjected to temporary threshold shift intensity levels affecting hearing.

Dr. Xavier Lurton (IFREMER) has recently created a simplified model of the specific behavior of the *Okeanos Explorer's* EM302 system in terms of direct radiated level inside the water. Model output graphics showing radiated sound transmission patterns in the horizontal and vertical planes of the water column are provided below. This analysis represents our best estimates of radiated sound levels given the current configuration of the sonar. The assumptions behind the model are:

1) The Deep Mode of the EM302 was used (i.e., longest pulse length and highest power -- or worst case scenario).
2) The model uses the current best understanding of the directivity pattern of the sonar that includes both the individual transducer directivity and the transmit sector beam forming.
3) The model does not include any masking effects by the hull or gondola. The draft of the transducer "gondola" on the Okeanos Explorer is 5.65 m below the water line. This configuration causes a baffle effect from the gondola structure and the hull above, and further reduces the likelihood of direct ensonification of an animal on or near the surface, especially a short distance away from the ship.
4) A value of 6 dB/km @ 30 kHz was used as a first-order approximation of the absorption coefficient representative of oceanographic conditions in the vicinity of the Main Hawaiian Islands.

Figure 1 (below) shows horizontal plane (top-down) views of sound pressure levels at three different receiving depths within the water column directly below the transducer: 10m, 50m, and 200m. These figures demonstrate the remarkably narrow zone of ensonification in the along-track direction. Note the difference in the 160 dB/µPa isopleth in the beam plane and elsewhere around the ship. For all but this plane, the isopleth occurs at 400 m or less from the ship. For animals directly within the beam plane, sound pressure levels drop below 160 dB/µPa within 1500 m of the ship near the surface, and within 1800 m at a depth of 200 m. Submerged animals more than 400 m from the ship that are caught in the ensonification volume as the ship passes will be only briefly subjected to the elevated sound levels occurring inside the transmitter beam pattern. Furthermore, the narrow fan-shaped beam patterns of the Okeanos Explorer system provide ample possibilities for the animals to quickly escape the sound. The only possible scenario for more extended exposure would be if the animal were to suddenly start moving in the exact direction and speed as the ship while within the narrow ensonification beam, which is unlikely. This very selective spatial pattern of the sound radiation makes this configuration very different from seismic airgun sources (omnidirectional) or military mid-frequency active sonars that are often directed horizontally through the water column.

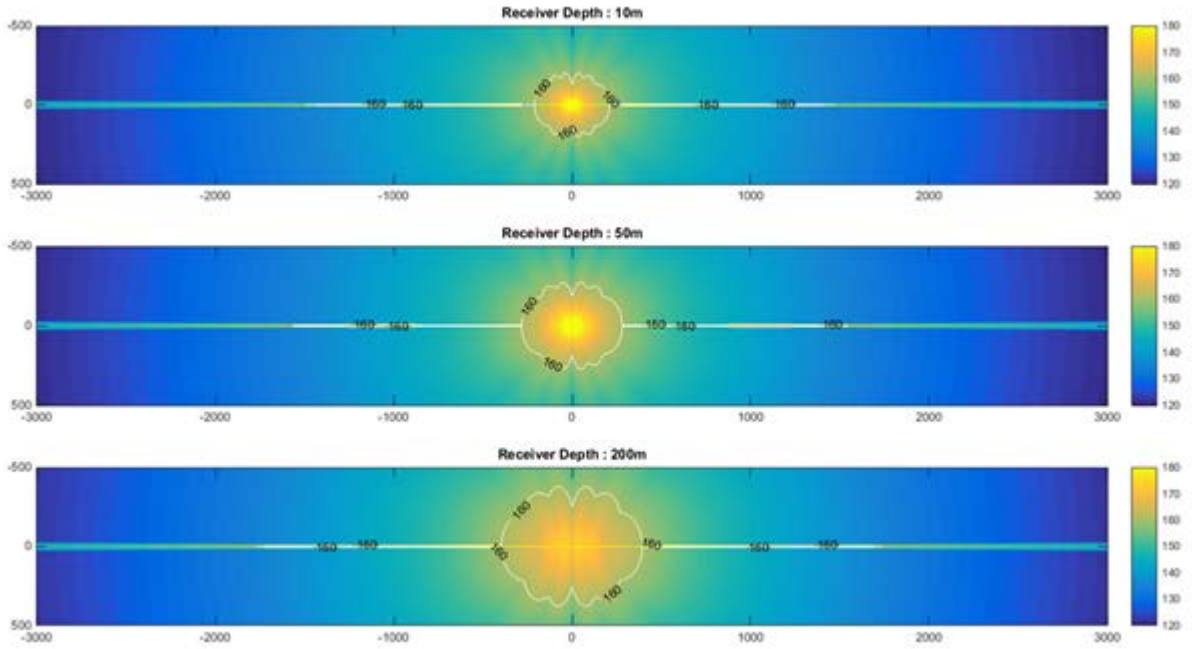


Fig. 1: Top down view image of the EM302 radiated beam pattern at several depths (10m, 50m and 200m created by Dr. Xavier Lurton (IFREMER). The ship track is straight up, the Y axis is distance in meters while the X axis in distance in meters. The color scale is signal strength in decibels (dB).

Figure 2 (below) shows the across track radiation pattern for the full water column below the EM302 transducer, with a close up of the near surface region. The 160 and 180 dB/µPa isopleths are plotted to show ranges from the sonar relevant to potential PTS and TTS impacts on cetaceans.

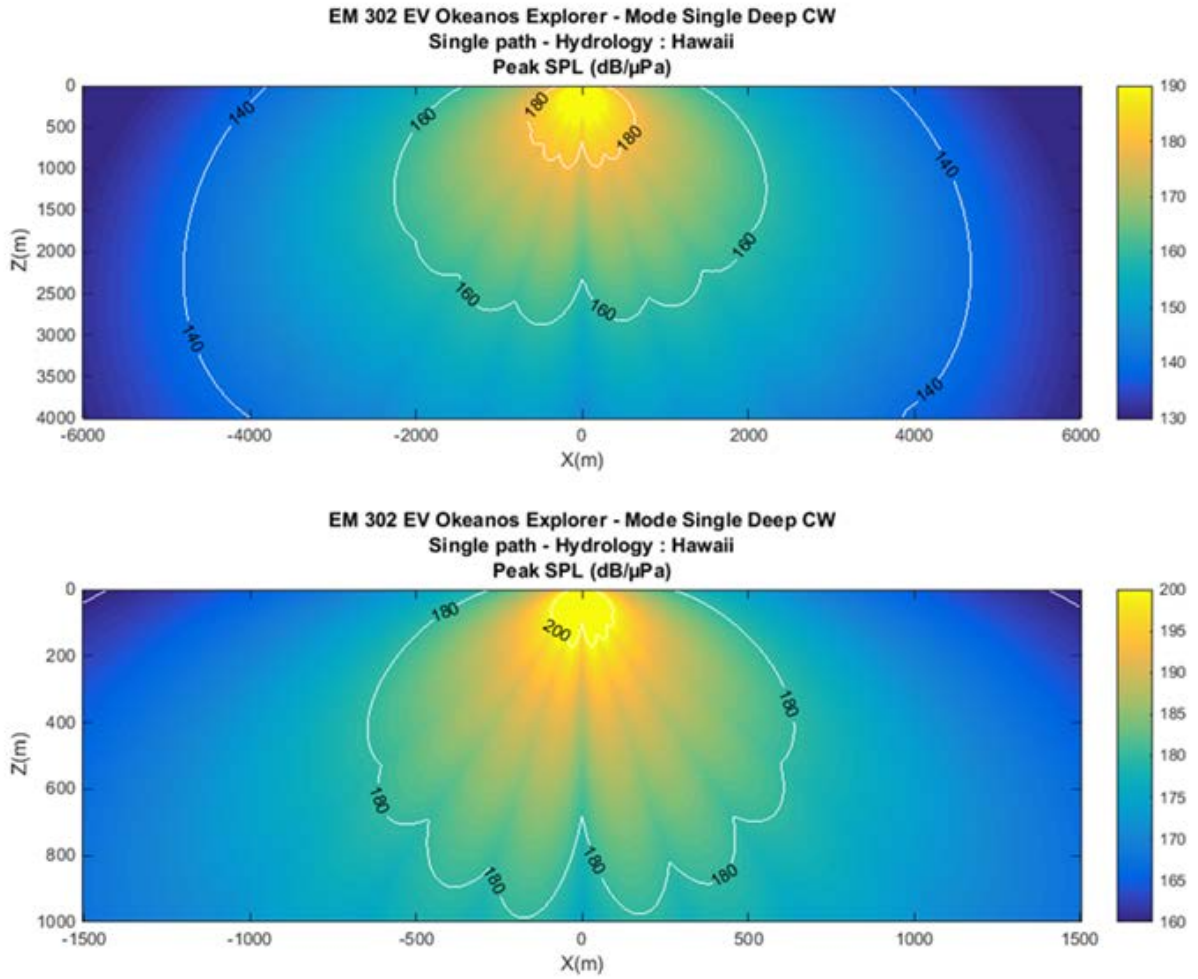


Fig. 2: Model created by Xavier Lurton (IFREMER) of the EM302 radiated transmission patterns with the 140, 160 and 180 dB/µPa isopleths plotted for the full water column (top) and of the near surface region (bottom) of a single ping, looking forward through the water column in the along track direction. The y axis is depth below sea surface in meters, and the x axis is distance in meters. The color scale is signal strength in decibels (dB).

Transmit pulse forms and rates are yet two other differences that distinguish multibeam sonar from other types of sonar and acoustic sources and further reduce their potential threat to ESA-listed species. Sound is not transmitted continuously from these systems but rather in extremely short pulses (i.e., pings). Ping durations obtained from the EM302 manual (page 36) are very brief -- 0.7 to 5.0 milliseconds. The ping rate or in other words, how frequently pings are emitted, is depth dependent and is provided for different depths in tables 2 and 3 of the manual and show that at a depth of 400 m, the ping rate is 30 pings/min, decreasing to 3.6/min at 4000 m. Another way of putting it is that when the ship is mapping in 400 m of water, any submerged animal within the ensonification volume will be subjected to only a 0.7 millisecond ping every 2 seconds. When the ship is mapping in 4,000 m of water, a submerged animal could potentially experience a 5-40 millisecond ping every 17 seconds. The fore-aft width of the

ensonification volume at 200 m distance from the ship is approximately 4 meters. Based on a mapping speed of 8 knots and using this width as an example, this distance will be traversed by the ship in 1 second. Therefore, a submerged stationary animal 200m from the ship while it is surveying depths of 400 m should be subjected to at most a single ping of 0.7 milliseconds of duration. If the encounter occurs where the water depth is 4,000 m, the chances are low that it will even be subjected to a single ping.

The low operating frequencies, low duty cycles (because of the narrow fore-aft width of the beam), and short pulse lengths portend limited exposure to the MBES pulse for fish, marine mammals and turtles. Based on observed responses to other types of pulsed sounds, and the likely brevity of exposure to the bathymetric sonar sounds, pinniped and sea turtle reactions to the sonar sounds are expected to be limited to a startle or an otherwise brief response of no lasting consequence. In general, marine animals are expected to exhibit no more than short-term and inconsequential responses to these systems given their characteristics.

As a precautionary measure, to circumvent disturbance and/or possible startling of nearby animals, initial pinging of the multibeam sonar will always be started in the "soft start" mode. The soft start mode is a delay function, starting the sonar transmissions at a low output level and then gradually increasing to the level required for optimal bathymetry data collection. The multibeam power on soft start is set to -20 decibels (20 decibels lower than the full source power setting) with a 10 minute ramp up time to the normal power setting. The soft start feature keeps source levels dampened in case there are cetaceans in the immediate vicinity of the ship, and provides them with time to move away from the ship before the system operates at full power.

Because the EK60, SBP, and ADCP sonars are of lower intensity than the multibeam, and are typically run simultaneously with the multibeam, these protective measures will help avoid inadvertent exposure of marine mammals, sea turtles, and hammerhead sharks to all three sonars. If the multibeam sonar is not being used, but other sonar systems are being turned on, they will be started in lower power settings and will gradually (over a 15 minute time period) be adjusted to higher power settings as appropriate for the water depths. This approach essentially mimics the approach of the "soft-start" mode of the multibeam.

Expendable bathythermographs (XBT):

The very fine wire connecting the XBT probe to the ship is extremely easy to break by hand once the probe reaches maximum depth. The low tensile strength of the wire should represent a minimal entanglement risk for marine animals. The expended materials are unlikely to result either in any significant environmental impacts to the sea floor or in a significant degradation of marine water quality. Over a period of years, these materials would degrade, corrode, and become incorporated into the sediments.

UnderwayCTD

The *Okeanos Explorer* proposes to use the UCTD during the 2017 field seasons as much as possible as a more environmentally-friendly alternative to XBTs, since it does not leave anything

in the ocean after gathering the measurements. Given the limited duration of casts (<1 hour) entanglement risk is considered low.

The UCTD should always be nearly directly behind the ship, either freefalling, or being reeled back in. When UCTD profiling casts are conducted in deep water, the probe has its own tail spool that has hundreds of meters of line wound on to it. This tail spool allows the probe to freefall through the water column with very little drag, since it does not have to pull all the line between the probe and the ship as it falls. Once the probe is dropped off the back of the ship, all of the line on the tail spool must be paid out before it is even possible to begin rewinding the line to reel back in the probe. If a marine mammal is spotted while the probe is falling, we will still have to wait until all the line on the tail spool is paid out prior to starting recovery. Therefore once a deep water UCTD cast is started, there is really not a practicable way to make it much shorter or abort it.

If a marine mammal is spotted by the bridge while the UCTD is in the water, the ship will slow down to 3-5 knots (as possible given what the Engineering Department needs to do with the engines to make this happen), and maintain heading. The Survey Department will finish the UCTD cast as quickly as possible by rewinding the line as soon as they measure the time by which all of the tail spool line should have completed paying off the spool. Slowing the ship down and maintaining heading are the only measures practicable to minimize the risk of entanglement. We will also monitor for entanglement during probe recovery.

Split Beam Sonars:
EK60 and ADCP sonar calibration work planned near Hawaii is specifically planned for an area outside any marine managed areas, Sanctuaries, known sensitive habitats, and state waters. There are no known impacts of EK60 split-beam sonars on marine animals, and there are used routinely by NOAA to assess water column biomass.

Sub Bottom Profiler:
Marine mammal responses to the sub-bottom profiler are likely to be similar to those for other pulsed sources. The pulsed signals from the sub-bottom profiler are much weaker than those from the multibeam echosounder described above. Since they are usually operated simultaneously with other higher-power acoustic sources, behavioral responses are not expected, unless marine mammals are very close to the source. In fact, most animals will move away in response to the approaching higher-power sources or the vessel itself before being close enough for there to be the possibility of effects from the less intense sounds of the sub-bottom profiler.

ADCPs:
Both ADCP instruments on the *Okeanos Explorer* are manufactured by Teledyne RD Instruments. Teledyne has provided OER with a proprietary technical memorandum dated April 28, 2015 that provides sound pressure levels associated with their ADCP instruments. Source levels for the ADCPs are far less than the EM302 multibeam. The acoustic beams from the ADCPs are also very focused, with sound energy levels that decrease rapidly away from the

main lobe of the transducer. Given the more limited ranges, narrow beams, and sound pressure values reported for the ADCPs, they are expected to have minimal impacts on species of concern. Teledyne states that it has never received a report any marine mammals being affected by its ADCPs.

CTD Operations

The planned cruise would include the deployment of a CTD, which would be deployed over the side of the vessel with a cable; creating the potential for entanglement should any animals encounter the cable or tether. However, ship officers maintain watch for and avoid protected marine species in the area during CTD operations and no deployment would occur if sea turtles, marine mammals or scalloped hammerhead sharks are within 50 yards of the vessel, and all individuals participating in the activity would closely monitor the instrument cables at all times while they are deployed. Based on these measures, and given that protected marine species would likely be widely scattered throughout the proposed areas of operation, we consider it extremely unlikely that any of those animals would come into contact with any of the cables, and have determined that the risk of entanglement would be discountable.

In Summary

In general, these scientific techniques are routinely used by NOAA As expected for ocean research with limited duration or presence in the marine environment, this project will not have the potential for significant impacts. Knowledgeable experts, who are aware of the sensitivities of the marine environment, will conduct the at-sea portions of this project. The testing and calibration of sonar systems during the cruise are essential for ensuring these systems provide the best possible quality data for the rest of the *Okeanos Explorer*'s 2017 missions. Providing the United States with scientifically robust and quality-controlled oceanographic data is a key benefit that will result from the cruise.

The survey activities will be localized and of short duration in any particular area at any given time. The survey also will not bring about any permanent influence on marine mammals, their habitats, or the food sources they utilize. This project will not result in any notable or lasting changes to the human environment. In sum, the survey activities are not expected to have any significant impacts of a direct or cumulative nature.

Categorical Exclusion

The geographic scope of this action is small and the temporal duration is short. It is a research project of limited size or magnitude and with only short-term effects on the environment, and for which any adverse or cumulative impacts are negligible, consistent with the class of CE in Section 6.03.c.3(a) of NOAA Administrative Order (NAO) 216-6. It does not trigger any exceptions in section 5.05c of the NAO that would require an environmental assessment or environmental impact statement.

Ocean Exploration and Research

Appendix 3: EK60 Calibration Procedures

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*O*perating

EK60 Calibration

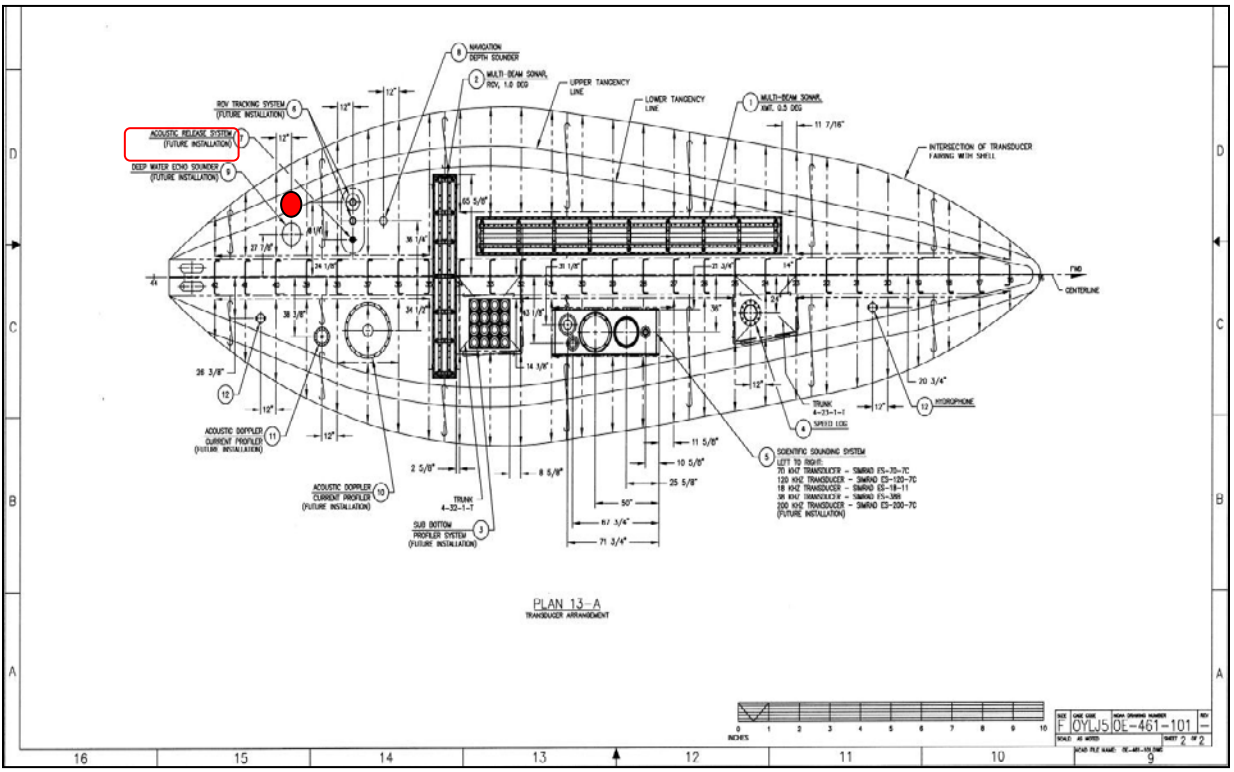
PROCESS OWNER
NOAA Ship *Okeanos Explorer*

REVISION HISTORY			
REV	Description of Change	Author	Effective Date
0	Initial release	Malik and Peters	August 2011
1	Revised to reflect updated pictures using calibration equipment provided by UNH CCOM as part of EK80 testing. Simplified text.	Derek Sowers	March 2015
2	Revised	Chris Taylor	March 2015
3	Revised	Jennifer Johnson	Jan 2016

REFERENCE DOCUMENTS	
Document Number	Document Title
	Simrad EK 60 Scientific Echo Sounder Reference Manual Release 2.2.0, January 2008

Simrad EK60 calibration procedures are outlined in Simrad EK60 Scientific Echo Sounder Reference Manual Release 2.2.0, January 2008. The following procedures have been adapted for the *Okeanos Explorer*. EK60 calibration is required to maintain the accuracy of the data for scientific applications and is generally recommended when the ship moves to an operating area with substantially different water mass properties (*e.g.* temperature, salinity, depth, or moving from N. Atlantic to the Gulf of Mexico or Tropical Pacific).

EK60 18kHz Transducer, installed May 2011. Arrows point towards the bow of the ship .The transducer is on the port side of the ship.



EX Transducer Arrangement in hull blister. Not all of the labeled equipment is currently installed. Indicated is the location of the EK60 transducer. It is on the port side of the vessel.

1.0. Purpose/Overview

This plan describes an in situ beam pattern measurement procedure for the Simrad ES-18-11, 18kHz split-beam scientific transducer using the Simrad EK60 general purpose transceiver (GPT, 18 kHz) aboard the *Okeanos Explorer.* During calibration a reference target with known target strength (TS) is lowered into the sound beam, and the measured target strength is compared with the known target strength. If it is necessary to adjust the echo sounder, this is performed automatically by the calibration software. If you have an EK60 system with several transceivers, you must calibrate each frequency separately. All the different combinations of pulse duration and transmitter power for each frequencythat will be used during normal operation of the echo sounder must be calibrated.

A CTD profile should be conducted prior to calibration to obtain temperature and salinity depth profiles. If it is relatively shallow and expected mixed watercolumn, the readout from the surface TSG can be used. Measurements on the main response axis (MRA) are of primary importance to provide a general offset for TS in the center of the beam pattern. If no other data are collected elsewhere in the echosounder FOV, this MRA offset may be used in conjunction with beam pattern models to estimate TS corrections across the beam pattern. If conditions and time constraints allow, and only after MRA data have been collected, it is also useful to collect data with the sphere in positions across the beam pattern to provide beam pattern corrections directly.

Preparation of the materials on deck and selection of favorable sea conditions can save several hours of ship time. It is ideal to minimize current relative to the ship, because relative currents of 1 kt or more will severely complicate sphere deployment and control. More importantly, stress and failure of the lines, rods, and reels increase the chances of losing the sphere and may present hazards to personnel on deck.

2.0. Location

A water depth of at least 30m is required to conduct this calibration. It is recommended to conduct calibration at a deep pier facility (with depth > 30 m). If no deep pier facility is available the calibration can be conducted at anchor or drifting in a location where there is minimal impact by fish (to avoid acoustic interference) and current/sea conditions (to avoid excessive movement which makes the mechanics of the calibration difficult). Allowing some drift is okay because the ship will follow similar movement to the sphere. The calibration can also be conducted while the ship is drifting in an area with light winds, calm seas, mild currents, and minimal traffic hazards. Wind should be on the opposite side of ship where two downriggers are mounted (usually port side). A final location will be chosen based on the impeding weather conditions and discussions with the ship's command.

3.0. Equipment

The following equipment is required to conduct the calibration and resides on the EX:

- 150 feet of line and 3 weights (Two same size, one smaller) secured in a loop equally distant from each other.
  - *The line is bright yellow as of Feb. 2015 (white line shown in picture has been replaced)*
- EK 60 transducer and ER60 software
  - *These are installed on the ship.*

- 4 people minimum: 1 for each of 3 outriggers and at least 1 in the lab to conduct the calibration.
  - *Lead Scientist/Mapping Lead/Expedition Coordinator, Survey Technicians, Mapping personnel.*
- 4 handheld VHF radios
  - *Located in the Dry Lab and/or available from upon request from ETs.*

- 3 Canon Easi-Troll ST Manual Downrigger reels with 100+ meters of high strength braided line (100lb or 200lb test green or yellow "Spectra", "PowerPro" or similar braided fishingline is excellent)

- 3 stainless outrigger holders
- 3 eight-foot long fiberglass outrigger poles with eye-bolt at end
- Hardware to secure downriggers to the side of the ship
  - 3 (three) 6" angle aluminum with reel base screwed in – one per downrigger
  - 6 (six) metal C-clamps – 2 per downrigger
  - 3 (three) metal C-clamps LARGE- 1 per downrigger, 2 on one downrigger for port fwd position
  - 9 (nine) hose clamps – 3 per outrigger
  - Calibration sphere (Copper= 63.0 mm diameter for 18 kHz , Tungsten Carbide=38.1 mm for 38,70,120,200, Tungsten Carbide= 23 mm for 333 kHz) and liquid soap +
- 3-way swivel for connecting bow, port, and starboard lines without entanglements
- 20-25 m length of monofilament line (30 or 50 lb test) with snap swivel for sinker weight. Make loop knot at end to attach to three downrigger snap swivels. Make loop knot in mono line 10 meters down to attach sphere.
- Gloves for protecting hands during deployment of the monofilament line, sphere, and weight (3-5kg)
- Boat hook for maneuvering lines for setup and retrieving sphere/weight.

3.0. Pre Calibration

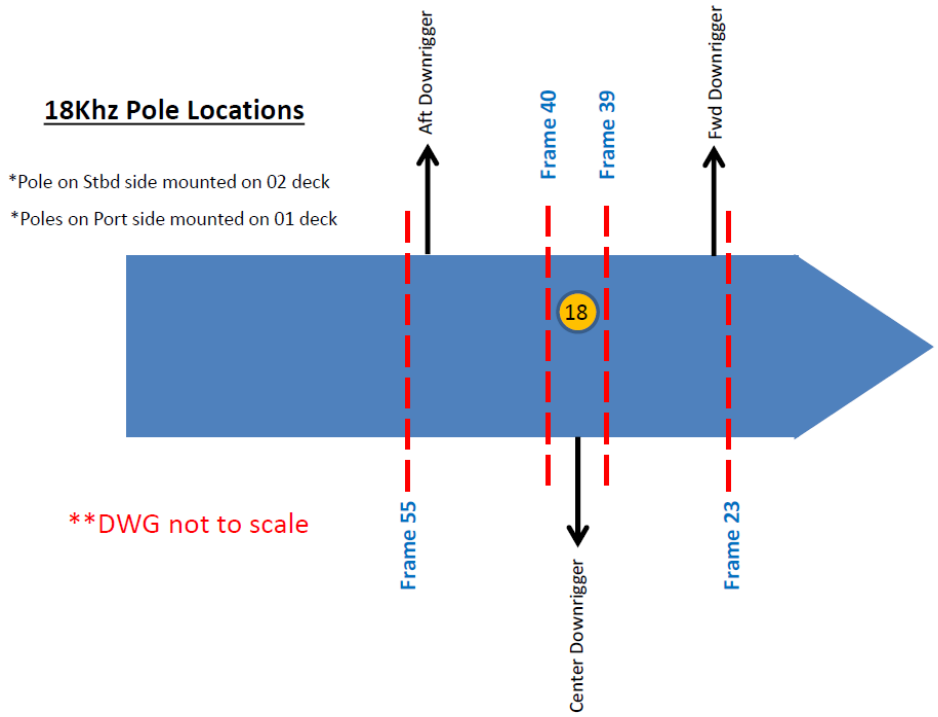
Significant preparations have to be made to set up the gear for EK 60 calibrations. Three lines on reels with outrigger rods are used for positioning the sphere within the beam of the transducer. Control over the sphere position within the beam requires approximately equiangular and equidistant spacing of rods and reels with respect to the transducer. Having the rods, reels, lines, sinker, sphere, and personnel prepared and in place before the calibration will save many hours of ship time.

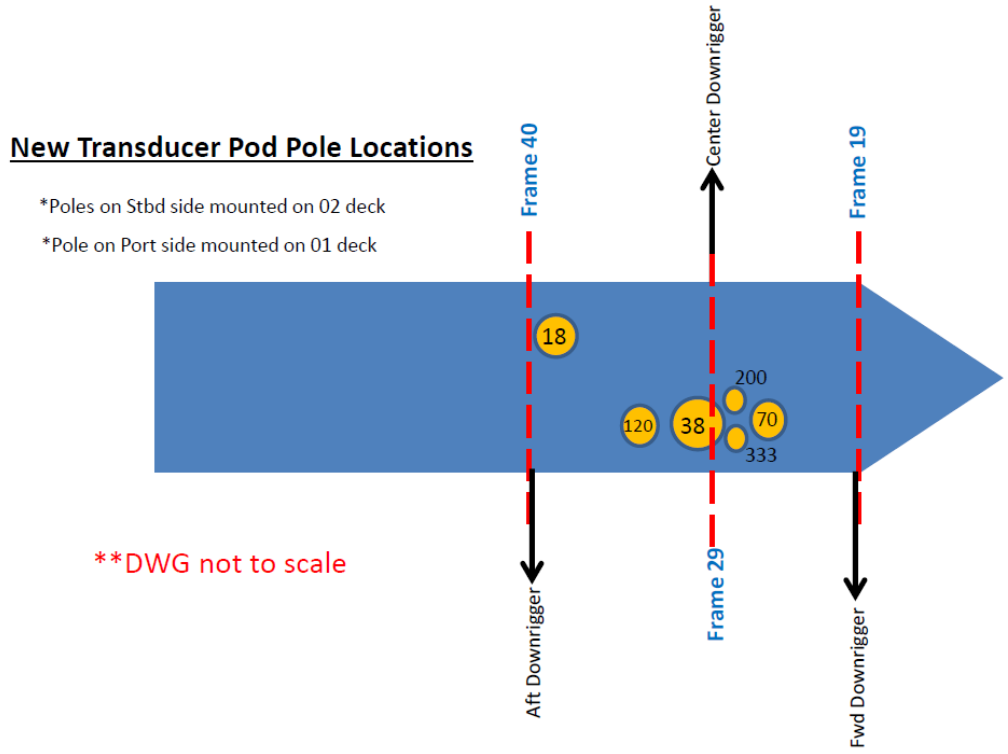
3.1. Equipment Setup:

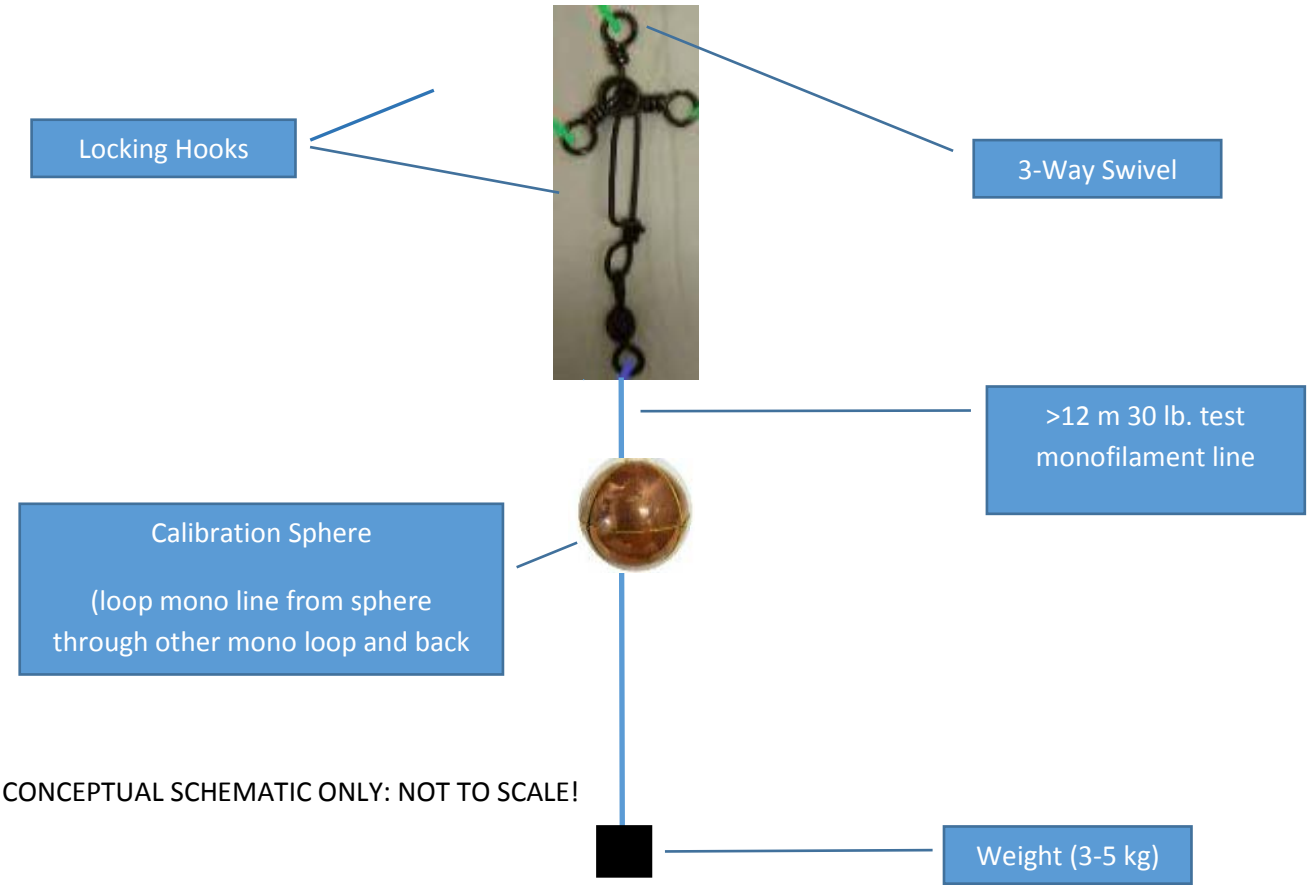
There are two locations for outrigger setup. One set up will be for the 18 kHz, while the second setup will be for the 38, 70, 120, 200,333 kHz.

The following is a conceptual diagram illustrating the arrangement of the lines, sphere, and weight.

Depictions created by Gregg Juergens (Kongsberg)





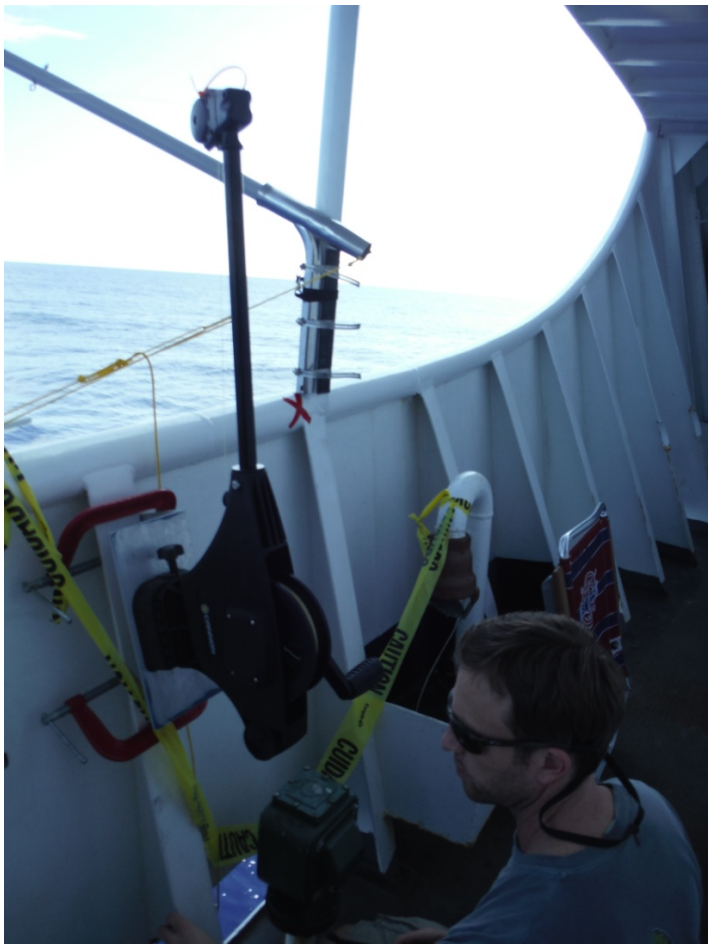


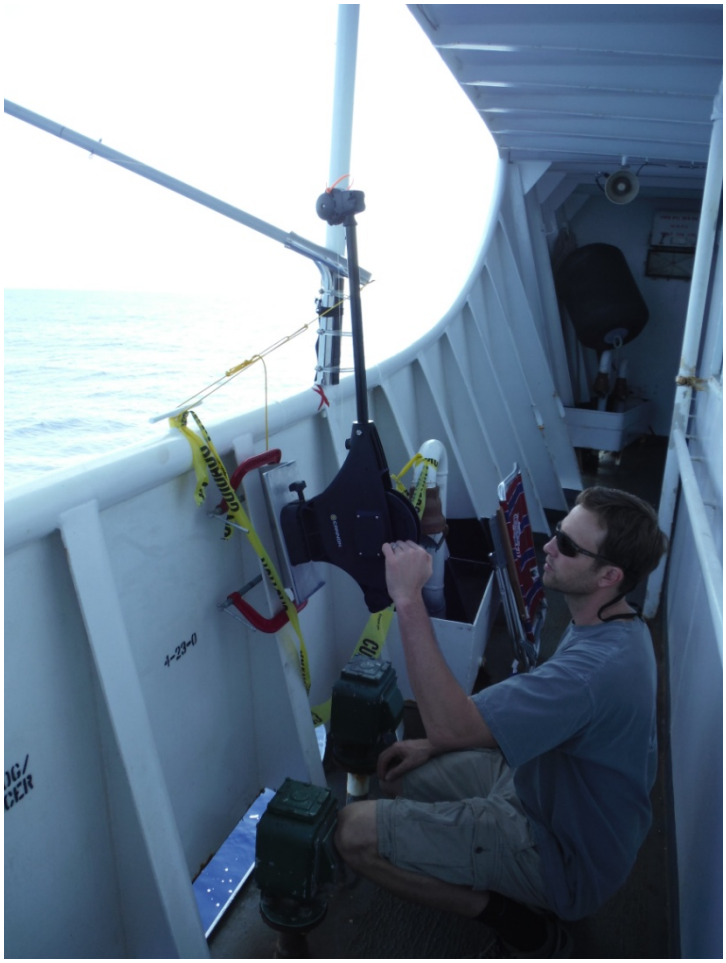
Note: There should be 3m of line before and after the sphere. Also when using a swivel, this can usually be seen in the 200 kHz during calibration.

18 KHz setup:

Port Forward:

This station is set up on the port side 0-1 deck, as shown below. The pole is mounted on the stanchion furthest forward, and the Canon reel is mounted on the bulwarks vertical flaring just aft of the bulwark directly under the pole mount.





Secure the angled aluminum plate to the metal bulwarks flaring on the ship using C-clamps as shown in the photos above.

- Attach the Canon downrigger into its mounting plate that is screwed into the aluminum plate. Orient the downrigger reel handle to face the walkway so it is easy to operate. Secure the metal pole holder to the stanchion using rubber padding and screwing tightly three hose clamps to minimize rotation of the holder.

- Before putting the fiberglass pole in the holder, run the end of the monofilament line through the eyelet at the end of the fiberglass downrigger pole. Make sure to run the line through the eyelet in such a way that it will freely move when being reeled in or let out. While having one person holding the end of the monofilament line and letting line out from the reel, have another person place the

pole into the holder. Clip the end of the monofilament line into the orange zip tie at the end of the Canon reel. Keep the line taught to avoid any tangles.

Note: To keep the pole facing the center of the transducer mount, tie a line to the end of the pole mount to prevent movement. This applies to all pole mounts.

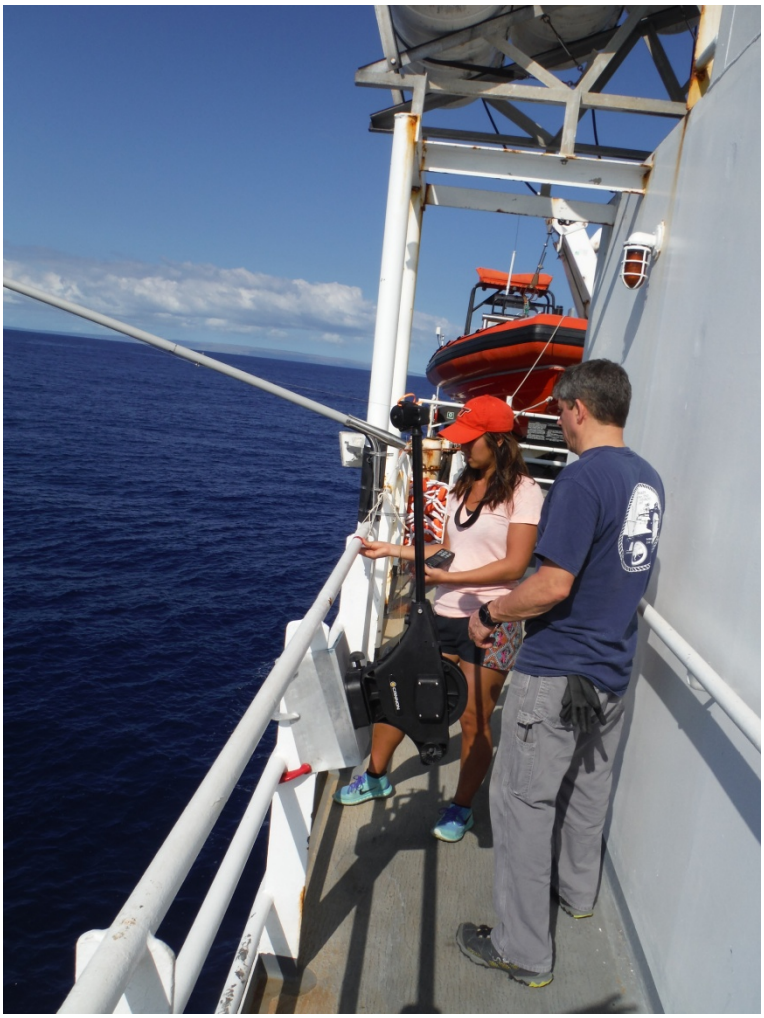
Port Aft:
This station is mounted mid of the chains on the port 01-deck, as shown below.

- Secure the angled aluminum plate to the metal post on the ship using C-clamps as shown in the photo below. Secure the metal pole holder to the ship stanchion in the middle position of the chains using rubber padding and screwing tightly three hose clamps to minimize rotation of the holder.

- Put the monofilament line through the fiberglass pole and secure to the orange zip tie as described for the Port Forward station.

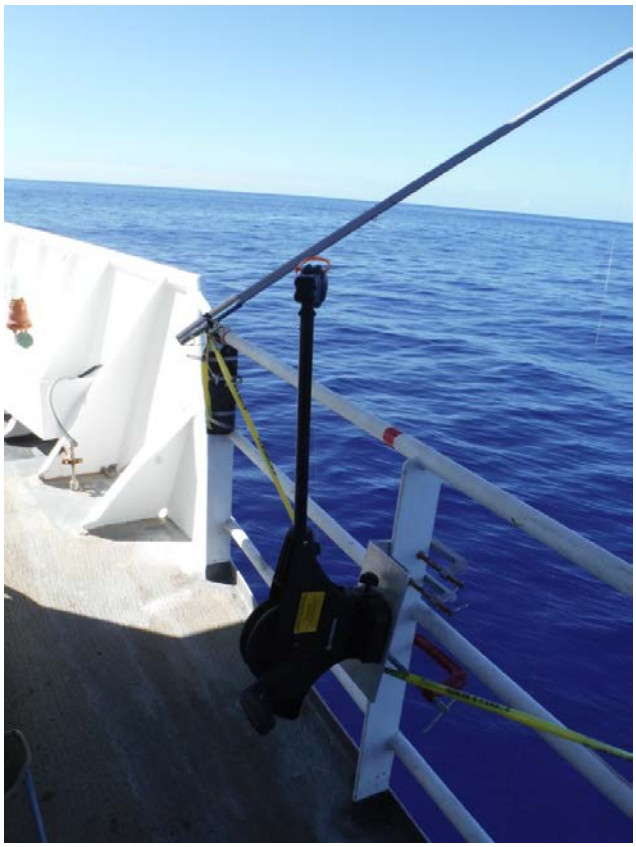
Starboard:

This station is mounted fwd of the stairwell on the 02 deck, as shown below.

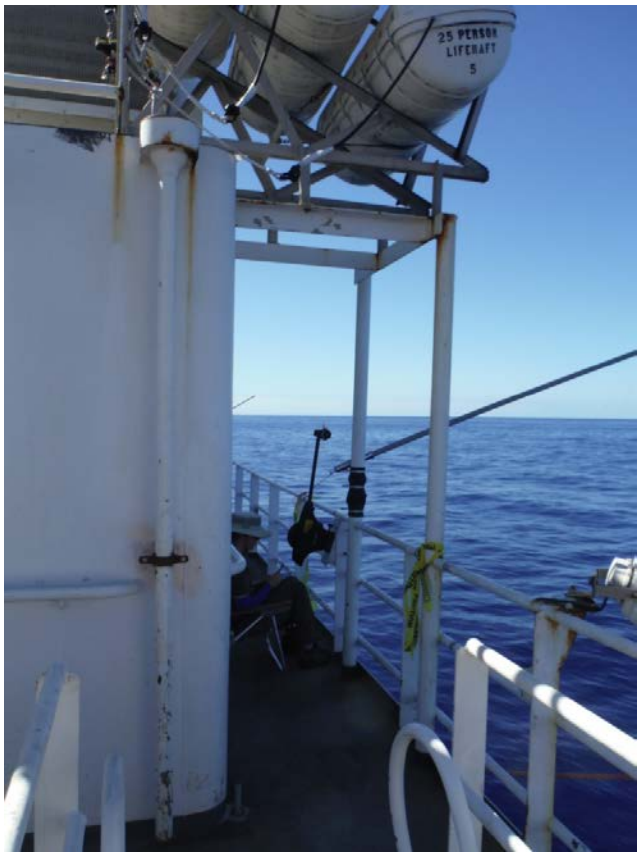


Note: After the 18 kHz calibration is complete, the sphere must come up and the lines disconnected for the mounting stations to move to the next locations for the pod calibrations.

Pod Setup (38, 70, 120, 200, 333 kHz):

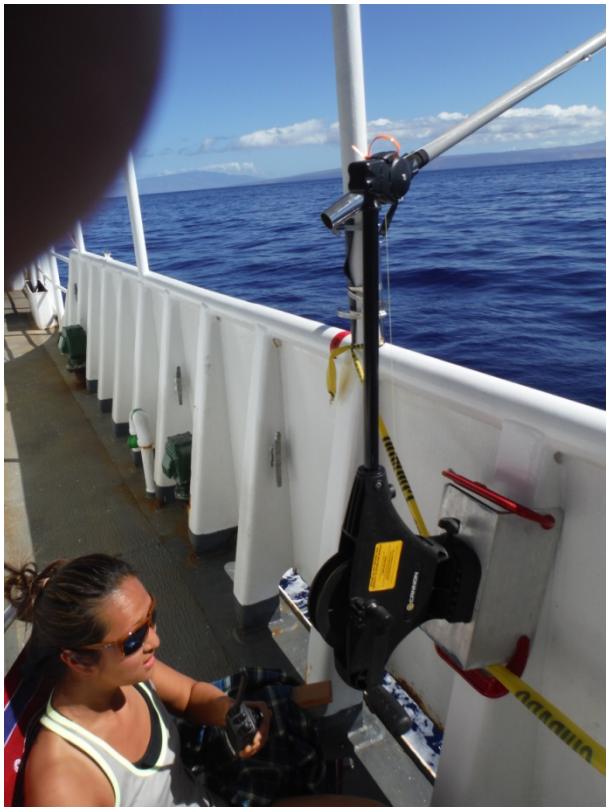


Stbd fwd: This station is mounted furthest fwd before the bow on the 02 deck, as shown.



Stbd Aft: This station is mounted fwd of the stairwell on the 02 deck, as shown.

Port Side: This station is mounted fwd across from the life ring on the 01 deck, as shown below.



Note: The 38,70,120,200 will use the 38.1 mm Tungsten Carbide sphere, the 333 kHz will use the 23 mm Tungsten Carbide sphere. Therefore before the 333 kHz calibration is done, you must bring up the sphere and switch them out.

Once the mounting equipment is in place, the line can be run through the eyes of the poles, and the poles can be placed in the holders until it is time to connect the rest of the gear.

1. Take the yellow paracord line and 3 weights to the front deck, tie one end of the paracord to a railing, and carefully unreel the paracord line around the front of the ship's bow. Maneuver the paracord around the ship's anchors to get the line below them without entanglement. Keep the loop in the middle of the paracord at the front of the bow (you can tie it the front with a lot of slack on either side.) Once the line has been place around the bow and tied to railings on both the starboard and port side, attach the 3 weights and drop the line clear of the ship to sink the paracord underneath the vessel. Carefully move on end of the paracord line to the starboard downrigger (for the 18 kHz cal) or the port side downrigger (for the 38, 70, 120, 200, 333 kHz cal) and attach to the downrigger's spectra line. Move the other end of the paracord to the forward port downrigger and do the same. This line will then be used to join the port and stbd filament line on the downriggers (will be opposite for doing specific cal).

    a. Note: If anchoring, set up the line with the weight prior to anchoring or it will not be possible to get the line past the anchor chain on the bow.

2. Dip the sphere in liquid dish detergent to ensure there are no bubbles or fouling on the target.

3. Confirm that the vessel is secure in a suitable location (bow/stern anchored in still water that is free of biological scatterers, or drifting). If anchoring is not possible, calibration can be conducted while adrift.

3.2. CTD Cast:

A CTD cast is required to obtain a sound velocity measurement for the depth of the sphere. The CTD only needs to be lowered to about 50 meters. Once the cast is completed, print out a sound velocity profile for the top 50 meters of the water column. Once the sphere is lowered, and a depth is determined, use the profile to select the appropriate sound velocity. You will also need the sound speed or temperature in order to select the correct sphere target strength during the calibration. The CTD cast will be conducted by the Ship's crew—OOD, SST and deck department.

3.3. Time Estimates:

It could take a few hours to precisely place the sphere under the EK 60. Up to 12 hours on-site may be required to conduct the full calibration for one frequency. Two days are required to complete all frequencies.

NOTE: Make sure everyone working outside is cognizant of the weather conditions—to take breaks and wear sunblock in extreme heat or to bring suitable layers for cold weather—this process may take several

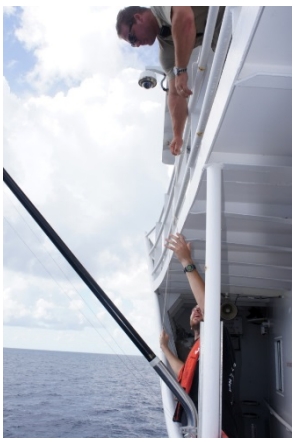
hours. Also make sure to rotate personnel through the positions so that everyone can have enough breaks.

3.4. Risks:

Gear entanglement: The ship's motion during the calibration procedure should be minimal to avoid any gear entanglement. If gear entanglement is suspected, the calibration procedure will be halted and ship's divers will inspect the ship hull for any entanglement.

4.0. Calibration

Once the line with the weight has been draped below the ship's hull, and the vessel is secure either at anchor or adrift, the following methodology is the recommended approach for giving us the best control of the gear under the ship's hull.



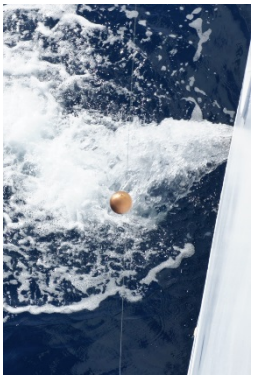
4.1. Deployment

1) With the spectra line fully reeled in to end of the outrigger pole, reset all the reel counters to zero. Attach one end of the line to a pole/reel on the stbd side of the vessel.

2) Pay out the monofilament on the stbd side reel, and pull in the paracord on the port side until the monofilament is reached. Detach the line, and attach the two remaining reels (e.g., fwd and aft port reels).

3) Attach a >12m length of monofilament, the calibration sphere, and a weight (weight needs to be at least one pulse length below the calibration sphere, and the sphere needs to be at least one pulse length below the swivel) to the point where the monofilament from all three reels are attached.

4) Soap the calibration sphere using ordinary dish detergent to avoid bubble development on the surface of the sphere.

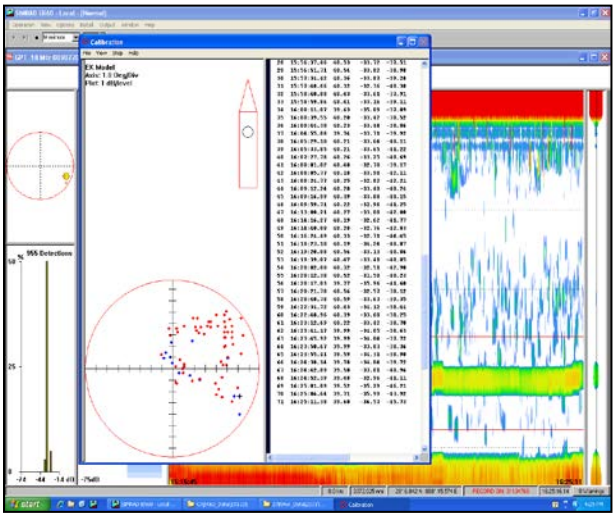


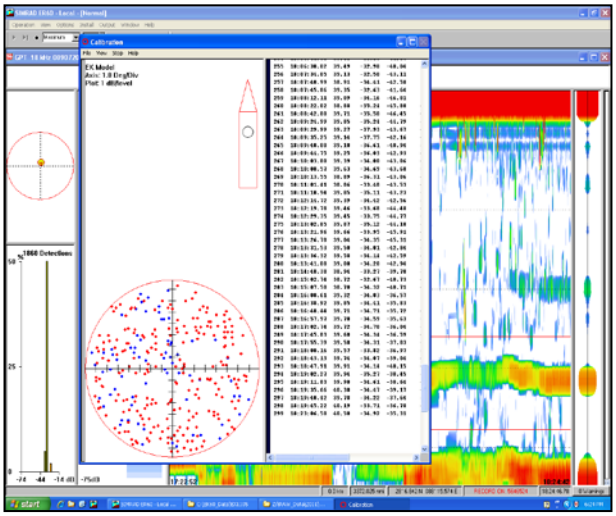
5) Lower the weight and calibration sphere over the port side with the port side reels holding tension. Instruct the port side reel personnel to pay out line slowly as the starboard side takes up line. Keep some tension on the starboard side to avoid too much slack in the line that could entangle ship's hull or

instruments. Instruct reel operators to payout/takeup line until the sphere can be seen in the sonar's field of view.

6) Adjust the lines in order to conduct the calibration. This will require someone in the control room and on each reel, all with radios, to communicate the direction each reel needs to be operated to position the sphere.

7) The sphere needs to be moved into all four quadrants of the sonar beam. It is suggested to keep a written log of these changes in order to keep track of the motion of the sphere. Once the entire circle has been filled with points, the calibration is complete. (Consult section 5.0 for details of operating the calibration software. Make sure the RAW data is being recorded. The calibration can be re-examined in playback mode if necessary.





4.2. Recovery

1) After the calibration is finished, pay out the lines on port side and reel in on stbd until the stbd line is vertical and the connection point reaches the surface.

2) Next, grab the stbd line with a boat hook to bring it closer to the ship. Haul in the sphere and weight by hand until the gear is on deck. Use gloves for protection.

3) Disconnect the sphere and the weights.

4) Disconnect the port lines and attach a small weight to each line and tell each person standing by the reels to haul in.

5) Inform the bridge when all equipment is out of the water and stowed.

5.0. Troubleshooting

- If the ship is drifting, and you cannot get the sphere into a particular quadrant simply by shifting the lines on the downriggers, consider turning the ship around. A shift in current direction may help get the sphere into the sector you need.

6.0. ER60 18 calibration software

Once the sphere has been lowered below the transducer, use the following procedure to run the calibration routine on the EK 60 software. The settings used for calibration on 08/29/2011 are provided as guidelines.

The theoretical target strength of the calibration sphere can be calculated using the following link http://swfscdata.nmfs.noaa.gov/AST/SphereTS/. Enter the sphere material (e.g., Cu), size (e.g., 64mm), temperature and salinity at target depth, frequency and pulse length for calibration.

Setting up the calibration window

1. Click **Operation →Ping control**.
2. In the **Ping Control** dialogue, set **Ping rate** to *Interval* and *1 second*. This can also be done from the toolbar.
3. Click **Operation →Normal**.
4. In the **Normal Operation** dialogue:
Select transceiver, and switch to *Active* mode.
Set the *Transmit Power* to the level you wish to calibrate [2000 W]
Choose the *Pulse Duration* you wish to calibrate [0.512ms, 1.024ms, 2.048ms, or 4.096 ms]
5. In the **Output -> File** set the Current Output Directory to a folder ../<Cruise>/Calibration/<pulselength>/. On the **Raw Data** tab, specify a filename prefix to reference the cruise/ship and pulselength used. Set **Range** to 50m and Max. file size to 50Mb. **Start recording the raw data!**
6. Right-click in an echogram, select **Range** on the short-cut menu, and set the range for one of the echogram views to cover the range you wish to see around the sphere. This range should include the depth range where you expect to find the reference target, weight below the target (and seafloor if visible).
7. Check that you see the reference target in the *Single Echo* view.
8. Turn bottom detection off.
9. Disable Motion under the Install dropdown.
10. Right-click in the *Single Echo* view corresponding to the echogram to open the **Single Target Detection** dialogue box.
11. In the **Single Target Detection** dialogue, click the **Calibration** button to start the calibration program, and to create a new *Calibration* window. The calibration program allows you to record new calibration data, or read previously recorded calibration
data.
12. In the *Calibration* window, click **File →New** to open the **Record** dialogue and to start a new calibration.
13. Enter the following data in the **Record** dialogue box:
a.Transducer's serial number

b. Correct theoretical target strength (TS) for the reference target [e.g., -34.60 dB, dependent on sphere and sound speed at the calibration depth, see http://swfscdata.nmfs.noaa.gov/AST/SphereTS/ for a TS calculator]
*c. Allowed deviation from the TS for the reference target [10 dB]
**d. Upper and lower depth limits for the target window (that include only the sphere and exclude the weight and seafloor).
e. Any comments you may wish to add to the calibration file

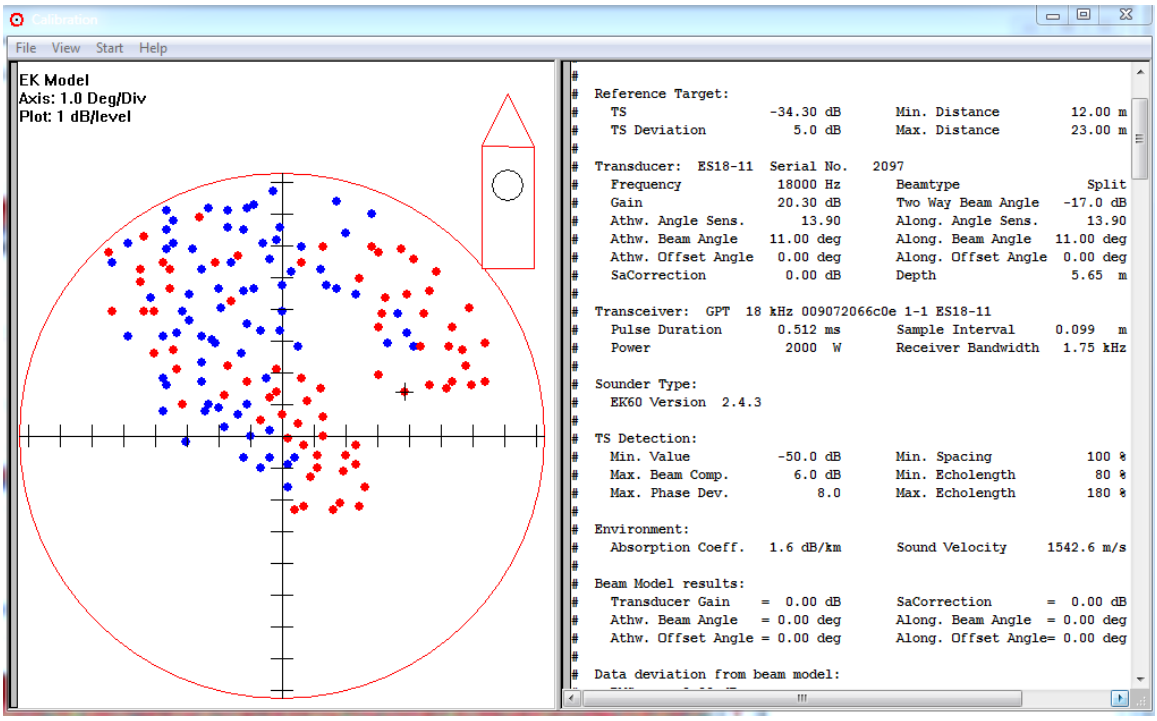
*This is a window giving the limits for the system's acceptance of single target echoes coming from fish. The closer to the correct reference target TS the limits have been set, the more of the unwanted fish echoes will be rejected. On the other hand, if the echo from the reference target is too close to one of the limits, the deviation has to be increased before starting collecting data. This is because it will always be a certain variation in TS values when the reference target is being moved to cover the complete beam.

**A narrow window will have same effect as above, reducing the possibility of detecting unwanted echoes from fish. But change in the range of the sphere may take it outside the depth. It is best to keep the sphere within 1-2 m range/depth during entire calibration.

14. Click OK when you have finished entering data. The calibration program will now begin.

Running the calibration routine

Different views can be set up during the calibration. You will see two views in the *Calibration* window; a *Plot* view and an *Information* view.



Plot view (left) shows position of the reference target in the transducer beam, crosshairs over dot show current or last target location. Information view (right) shows calibration and EK60 system parameters. Scrolling down in right panel shows target strength and position as target position is recorded.

A vertical bar is shown on the left side of each view. A blue colour indicates that the view is active, while gray colour indicates a passive view. If you wish to print a view, or perform other operations connected to it, you must make sure that the desired view is active.

In the *Plot* view you will see recorded data plotted as blue and red circles. Blue circles indicate TS values below the current beam model, while red circles indicate values above the current beam model. In the upper part of the *Information* view you will see various information associated with recording of the calibration data. Lines containing this information all begin with a #. Below this information, recorded values for each new TS detection are updated continuously during data recording.

1. Move the reference target slowly around to record a sufficient number of data points (>100) evenly distributed inside the beam. Make sure that a reasonable number of hits are made close to the centre of the beam. This is important in order to ensure a correct estimate for the Sa correction parameter.

2. While moving the target you should keep the reference target within the depth limits you entered in the **Record** dialogue (<2m change in range over calibration).

3. While moving the target and recording of data points stops, the measured TS value may be outside the limits entered in the **Record** dialogue.
4. Stop and restart recording as required by using the **Stop/Start** command found in the **Main** menu. It is recommended to stop collecting data if unwanted fish echoes are entering into the depth window, and restart again when disappeared.

5. When you have finished data recording, click **File →Save As** to open the **Save As** dialogue.

6. Choose the directory where you want the calibration file to be saved, and enter a file name for your calibration file.

7. Click **Save As** to finish.

Name the Results file according to the Date, Frequency and Pulse Length.

The calibration program will now use two different models to fit recorded data, a polynomial model and a beam model. The *Plot* view will plot the model along with the recorded data points. Blue circles indicate values below the model; red circles indicate values above the model. The green circles close to the centre axis indicate the points that have been used when estimating the Sa Correction value.

Examine the Information view. Under the "Data Deviation from Beam Model", the RMS value should be <0.4 A higher RMS may be caused by encroaching fish targets or other noise that has contributed to the reference target strength. If there were fish targets during portions of the Calibration, the RAW file can be Replayed (Main Menu – Operation – Replay) and follow the same Calibration program procedures above. Use Stop/Start in the Calibration program main menu to not record targets when fish are present.

Updating transducer parameters

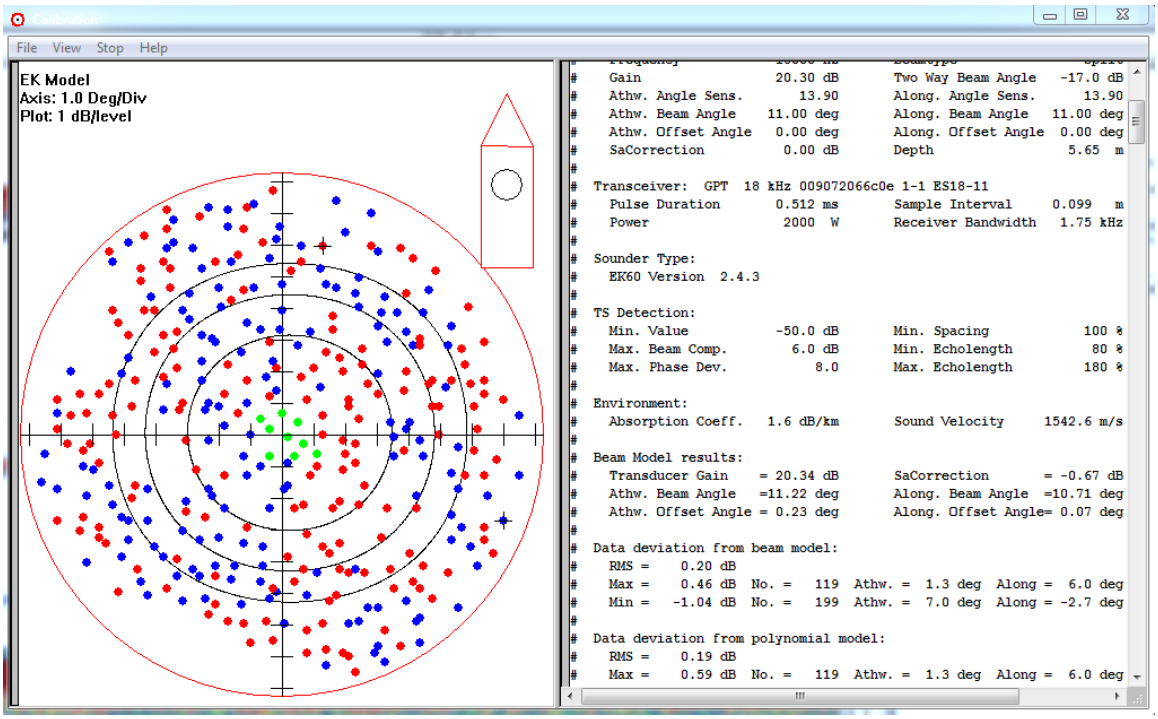
When you are satisfied with the calibration results you can use the results to update your transducer parameters in the echo sounder. This includes changing the Gain and Sa Correction value after saving the calibration results for the pulse duration used in the field.

In the ER60 installation directory, find the TrList.ini file. This file contains factory default parameters for all Simrad Tranceiver and Transducers. Copy this file and paste is the same directory as "TrList-Default.ini".

1. In the *Calibration* window, click **File →Update Beam Data** to perform this task.

This step updates the Gain, SaCorrection, and Beam Angle parameters in the TrList.ini file for the selected transducer and pulse length for the calibration.

NOTE:



Calibration program view after saving calibration data. Green targets indicate those used to calculate Gain and Sa Correction. Blue targets are below expected target strength and red are above expected target strength using the updated Beam Model.

Repeat Calibration steps for other pulse lengths and frequencies. Copy and rename the TrList.ini with TrList_<date> <frequency><pulse length(s)>.ini

Note:
This is a serious operation, which will affect the transducer installation parameters and will thus affect all future results to be obtained using the current transducer and pulse duration.Thus, to prevent accidentally use of this operation, you are asked
to confirm this operation. The changes take effect automatically the next time you start Normal operations on the echo sounder. ***If the RMS in the calibration beam model results is >0.4, do not update beam data.***

Ocean Exploration and Research

August 29, 2011 calibration results

(Tom)

```
#  Calibration  Version   2.1.0.12
#
#  Date:  8/29/2011
#
#  Comments:
#
#
#  Reference Target:
#    TS                  -34.60 dB       Min. Distance         36.00 m
#    TS Deviation          5.0 dB        Max. Distance         47.00 m
#
#  Transducer:  ES18-11  Serial No.   2097
#    Frequency            18000 Hz       Beamtype                Split
#    Gain                 23.00 dB       Two Way Beam Angle   -17.2 dB
#    Athw. Angle Sens.       13.90       Along. Angle Sens.      13.90
#    Athw. Beam Angle    10.60 deg       Along. Beam Angle   10.40 deg
#    Athw. Offset Angle   0.00 deg       Along. Offset Angle  0.00 deg
#    SaCorrection          0.00 dB       Depth                 4.57  m
#
#  Transceiver:  GPT  18 kHz 009072066c0e 1-1 ES18-11
#    Pulse Duration       4.096 ms       Sample Interval     0.771   m
#    Power                 2000  W       Receiver Bandwidth   0.72 kHz
#
#  Sounder Type:
#    EK60 Version  2.2.1
#
#  TS Detection:
#    Min. Value           -38.0 dB       Min. Spacing            100 %
#    Max. Beam Comp.        6.0 dB       Min. Echolength          80 %
#    Max. Phase Dev.          10.0       Max. Echolength         470 %
#
#  Environment:
#    Absorption Coeff.   1.5 dB/km       Sound Velocity     1505.0 m/s
#
#  Beam Model results: Used to change transducer parameters!!!!
#    Transducer Gain     = 23.09 dB       SaCorrection       = -0.43 dB
#    Athw. Beam Angle   =10.93 deg       Along. Beam Angle  =10.61 deg
#    Athw. Offset Angle = 0.17 deg       Along. Offset Angle= 0.03 deg
#
#  Data deviation from beam model:
#    RMS =    0.42 dB
#    Max =    1.21 dB  No. =   228  Athw. = -5.2 deg  Along = -2.8 deg
#    Min =   -1.87 dB  No. =   263  Athw. = -1.2 deg  Along =  5.0 deg
#
#  Data deviation from polynomial model:
#    RMS =    0.39 dB
#    Max =    1.16 dB  No. =   228  Athw. = -5.2 deg  Along = -2.8 deg
#    Min =   -1.66 dB  No. =   263  Athw. = -1.2 deg  Along =  5.0 deg
```

Ocean Exploration and Research

```
#
#  Data:
#  No.    Time     Distance  TS-c    TS-u      Athw.    Along     sA
#                    [m]      [dB]    [dB]      [deg]    [deg]  [m2/nm2]
#
 1  15:39:55.89  40.42   -34.54  -34.81     1.11     0.20       482
 2  15:40:00.64  40.41   -34.56  -34.74     0.91     0.00       484
 3  15:42:04.39  40.37   -34.43  -34.74     1.11     0.40       516
   ///////
   ///////
 295  18:19:11.83  39.90   -34.61  -38.64    -3.24     2.93       207
 296  18:19:35.66  40.30   -34.47  -39.17    -3.54     3.14       154
 297  18:19:40.42  39.78   -34.22  -37.64    -2.73     2.93       257
 298  18:19:45.22  40.19   -33.71  -36.78    -2.63     2.73       308
 299  18:23:06.58  40.50   -34.92  -35.31     0.51     1.21       444
```

Appendix 4: ESA Section 7 Letter of Concurrence

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818
(808) 725-5000 · Fax: (808) 725-5215

Mr. John McDonough
Deputy Director
NOAA Office of Ocean Exploration and Research

Dear Mr. McDonough:

This letter responds to your January 14, 2016 Request for Consultation by the Office of Exploration and Research (OER) regarding efforts aboard the NOAA vessel *Okeanos Explorer* with the proposed action consisting of activities to explore and improve understanding of the distribution and diversity of deep water habitats in the Pacific, and in particular in the Marine National Monuments. You have requested our concurrence under Section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. §1531 et seq.), with your determination that the proposed action may affect but is not likely to adversely affect green, hawksbill, leatherback, olive ridley, and north Pacific loggerhead sea turtles; Main Hawaiian Islands false killer whale distinct population segment, humpback whales, blue whales, fin whales, sei whales, sperm whales, north Pacific right whales, the Indo-West Pacific and Central Pacific distinct population segment of the scalloped hammerhead shark, Hawaiian monk seals; and the coral species *Acropora globiceps,* A. *jacquelineae, A. retusa, A. speciosa, Euphyllia paradivisa, Isopora crateriformis,* and *Seriatopora aculeata.*

Proposed Action/Action Area: The proposed activity is more fully described in your request for consultation and the associated biological evaluation (CAPSTONE 2016). The proposed action (Okeanos Explorer cruises) includes the use of various ship and submersible-deployed electronic systems to collect data on the distribution and diversity of deep water habitats in the Marine National Monuments. The activity would occur during two years with up to 20 research cruises scheduled between February 2016 and December 2017. The expedition teams (26 crew and up to 20 rotating scientists and/or technicians on each cruise leg) would be authorized to conduct mapping and Remotely Operated Vehicle (ROV) surveys using the Okeanos Explorer's multibeam, split beam, subbottom profiler and acoustic Doppler current profiler (ADCP) sonar systems, utilizing the ship's conductivity-temperature-depth (CTD) sampling rosette for various water measurements and deploying an ROV. No activities are scheduled to occur on land.

The suite of sonars aboard the vessel includes a Kongsberg EM302 30 kHz multibeam system, which collect bathymetry and backscatter data; several Simrad EK 60 split-beam sonars that

range from 18 to 333 kHz which are designed to gather measurements of biological and gaseous targets in the water column; and a Knudsen 3.5 kHz chirp sub-bottom profiler. The 300 kHz and 38 kHz ADCPs provide information about current velocity and direction at various depths. Sonar mapping activities will be conducted throughout the proposed action area and during transits to and from sites where operations will be conducted in an effort to fill in gaps in data knowledge and to build on data already collected. The maps generated from these activities will improve understanding of the geology and important biological habitats in the project area.

Conductivity, temperature and depth data will be collected by both an Underway CTD and a CTD rosette instrument. The CTD rosette, which is deployed while the ship is stopped and holding dynamic position, is lowered by a winch and wire to a maximum depth of 6800 m to collect water samples through 24 2.5 L niskin bottles. The CTD rosette will be deployed at select sites where ROV operations are conducted to allow for an improved understanding of the environmental conditions at that particular site. The deployment and retrieval of the CTD rosette takes up to several hours (depending on depth), while the Underway CTD can be deployed while the ship is moving, saving hours of time and fuel. The instrument is mounted on the stern railing and outfitted with a re-useable probe that is deployed and retrieved through the use of motorized spool. The Underway CTD will be used to collect water column profiles to a maximum depth of 700 m.

ROV operations will be designed to provide interdisciplinary site characterization at priority targets in and around monuments, sanctuaries and protected areas, through visual observation of priority targets while acquiring environmental data with onboard sensors. Sampling will be focused on corals and sponges, but will target specimens believed to be new species or new records for an area. No ESA-listed corals would be sampled. As many as 200 deployments of the ROV may occur during the 2016 – 17 field season resulting in 1600 hours of total dive time. The dives will better enable scientists and managers to understand the diversity and distribution of deep water habitats.

The action area covered by the accompanying biological evaluation encompasses the marine environments of Papahānaumokuākea Marine National Monument (PMNM); Oahu and the big island of Hawai'i; the area south and west of Molokai, Lana'i, and Kaho'olawe, the Geologists Seamounts located about 100 nm south of Honolulu; the Musicians Seamounts located about 150 nm NNE of Nihoa Island; all of the Pacific Remote Island Areas composing the Pacific Remote Islands Marine National Monument (PRIMNM); the Commonwealth of the Northern Marianas Islands (CNMI) and the Marianas Trench Marine National Monument (MTMNM); the vicinity of American Samoa and the National Marine Sanctuary of American Samoa (NMSAS); the Rose Atoll Marine National Monument (RAMNM); and the vessel transit areas between Honolulu, Hawai'i, Guam, Saipan, Kwajalein, Pago Pago where ESA-listed marine species or their habitats may be impacted by the proposed activities.

Species That May Be Affected: OER determined that the proposed action may affect but is not likely to adversely affect green sea turtles (*Chelonia mydas*), hawksbill sea turtles (*Eretmochelys imbricata*), North Pacific distinct population segment of loggerhead sea turtles (*Caretta caretta*),

olive ridley sea turtles (*Lepidochelys olivacea*), leatherback sea turtles (*Dermochelys coriacea*), Main Hawaiian Islands false killer whale distinct population segment (*Pseudorca crassidens*), humpback whales (*Megaptera novaeangliae*), sperm whales (*Physeter macrocephalus*), fin whales (*Balaenoptera physalus*), blue whales (*Balaenoptera musculus*), sei whales (*Balaenoptera borealis*), north pacific right whales (*Eubalaena japonica)*, the Indo-West Pacific and Central Pacific distinct population segments of the scalloped hammerhead shark (*Sphryna lewini*), Hawaiian monk seals (*Neomonachus schauinslandi*), Hawaiian monk seal critical habitat and the coral species *Acropora globiceps, A. jacquelineae, A. retusa, A. speciosa, Euphyllia paradivisa, Isopora crateriformis,* and *Seriatopora aculeata*. Detailed information about the biology, habitat, and conservation status of sea turtles can be found in their recovery plans and other sources at http://www.nmfs.noaa.gov/pr/species/turtles/. The same can be found for Hawaiian monk seals and cetaceans at http://www.nmfs.noaa.gov/pr/species/mammals/; and more information on listed corals can be found at http://www.fpir.noaa.gov/PRD/prd_coral.html.

Critical Habitat: The proposed action would take place within designated monk seal critical habitat. Critical habitat was designated under the ESA for the Hawaiian monk seal on April 30, 1986 and revised on May 26, 1988 (53 FR 18988) and again on August 21, 2015 (80 FR 50926). Designated critical habitat includes all beach areas, lagoon waters, and ocean waters out to a depth of 200 m around Kure Atoll; Midway Islands (except Sand Island), Pearl and Hermes Reef, Lisianski Island, Laysan Island, Gardner Pinnacles, French Frigate Shoals, Necker Island, Maro Reef, and Nihoa Island, and includes the seafloor and all subsurface waters and habitat within 10 meters of the seafloor. Around the Main Hawaiian Islands, critical habitat extends in designated areas from the beach out to the 200 meter depth contour, and includes the seafloor and subsurface waters within 10 meters of the seafloor.

Analysis of Effects: In order to determine that a proposed action is not likely to adversely affect listed species, NMFS must find that the effects of the proposed action are expected to be insignificant, discountable, or beneficial as defined in the joint USFWS-NMFS Endangered Species Consultation Handbook: (1) insignificant effects relate to the size of the impact and should never reach the scale where take occurs; (2) discountable effects are those that are extremely unlikely to occur; and (3) beneficial effects are positive effects without any adverse effects (USFWS & NMFS 1998). This standard, as well as consideration of the probable duration, frequency, and severity of potential interactions, was applied during the analysis of effects of the proposed action on ESA-listed marine species, as is described in detail in the OER consultation request. The OER determined that the risk of collisions with vessels and the risk of entanglement would be discountable; and that the risk from exposure to elevated noise level, disturbance from human activity, as well as exposure to wastes and discharges would result in insignificant effects on ESA-listed sea turtles, marine mammals, sharks and corals; and that the potential effects of the proposed action to designated or proposed critical habitat would also be insignificant.

Considering the information and assessments presented in the OER consultation request, and in the best scientific information available about the biology and expected behaviors of the ESA-listed marine species considered in this consultation; NMFS agrees that: 1) the list of ESA-listed species and critical habitats potentially exposed to the effects of the action is correct, 2) the suite

of identified stressors is comprehensive, and 3) the assessment of exposure risk and significance of exposure to those stressors is accurate. Therefore, NMFS agrees that:

- the risk of collisions with vessels for marine mammals, turtles, sharks and the listed coral species in the action area is discountable;
- the risk of entanglement with marine mammals, sea turtles and sharks is discountable; and,
- ESA-listed species in the action area are unlikely to respond to anticipated elevated noise levels, disturbance from human activity, and exposure to wastes and discharges. Further, if any response were to occur, it would be temporary in nature and never reach the scale where it would affect the individual's health, and as such, have insignificant effects.

Conclusion: NMFS concurs with your determination that conducting the proposed Okeanos Explorer cruises are not likely to adversely affect ESA-listed marine species. This concludes your consultation responsibilities under the ESA for species under NMFS's jurisdiction. However, this consultation focused solely on compliance with the ESA. Additional compliance review that may be required of NMFS for this action (such as assessing impacts on Essential Fish Habitat) would be completed by NMFS Habitat Conservation Division in separate communication, if applicable.

ESA Consultation must be reinitiated if: 1) a take occurs; 2) new information reveals effects of the action that may affect listed species or designated critical habitat in a manner or to an extent not previously considered; 3) the identified action is subsequently modified in a manner causing effects to listed species or designated critical habitat not previously considered; or 4) a new species is listed or critical habitat designated that may be affected by the identified action.

If you have further questions please contact Richard Hall on my staff at (808) 725-5018. Thank you for working with NMFS to protect our nation's living marine resources.

Sincerely,

Michael D. Tosatto
Regional Administrator

cc: Justin Rivera, Papahanaumokuakea Marine National Monument
Aaron Nadig, ESA Section 7 Program, USFWS, Honolulu

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