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

August 3, 2017

MEMORANDUM FOR: Commander Eric Johnson, NOAA
Commanding Officer, NOAA Ship *Okeanos Explorer*

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

SUBJECT: Project Instruction for EX-17-07
Musician Seamounts (Telepresence Mapping)

Attached is the final Project Instruction for EX-17-07, Musician Seamounts (Telepresence Mapping), which is scheduled aboard NOAA Ship Okeanos Explorer during the period of August 8 – August 31, 2017. Of the 24 DAS scheduled for this project, 24 DAS are funded by Line Office Allocation. This project is estimated to exhibit a Medium Operational Tempo. Acknowledge receipt of these instructions via e-mail to Opsmgr.MOA@noaa.gov at Marine Operations Center-Atlantic.

Ocean Exploration and Research

FINAL Project Instructions

Date Submitted: August 1, 2017

Platform: NOAA Ship *Okeanos Explorer*

Project Number: EX-17-07

Project Title: Musician Seamounts (Telepresence Mapping)

Project Dates: August 8 - 31, 2017

Prepared by: _____ **Dated:** August 1, 2017

Elizabeth Lobecker, NOAA
Expedition Coordinator
Office of Ocean Exploration & Research

Approved by: _____ **Dated:** August 1, 2017

Craig Russell
Program Manager
Office of Ocean Exploration & Research

Approved by: _____ **Dated:** AUGUST 4, 2017

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

I.Overview

A. Brief Summary and Project Period

This document contains project instructions for EX-17-07. Operations for this cruise include focused mapping operations and strategic mapping transits within the waters of Hawaii and in international waters in the vicinity of the Musician Seamounts chain, specifically up to ~650 nm north of Hawaii. The expedition will commence on August 8th in Honolulu and conclude on August 31, 2017 in Honolulu. Operations will include the use of the ship's deep water mapping systems (Kongsberg EM302 multibeam sonar, EK60 split-beam fisheries sonars, Acoustic Doppler Current Profilers (ADCPs), and Knudsen 3260 chirp sub-bottom profiler sonar), and the ship's high-bandwidth satellite connection for hourly data transfer, real-time ship to shore communications, real-time sonar control from shore, and real-time video streaming of sonar screens and ship's cameras.

NOAA's Office of Ocean Exploration and Research (OER) is the only federal organization dedicated to exploring our unknown ocean. OER works with partners to identify priority areas for exploration; support innovations in exploration tools and capabilities; and encourage the next generation of ocean explorers, scientists, and engineers. The publicly available data and information gained from our expeditions and the research we fund gives resource managers, the academic community, and the private sector the information they need to identify, understand, and manage ocean resources for this and future generations of Americans. NOAA Ship *Okeanos Explorer* is the only federal vessel dedicated to exploring our largely unknown ocean for the purpose of discovery and the advancement of knowledge about the deep ocean. America's future depends on understanding the ocean. We explore the ocean to make valuable scientific, economic, and cultural discoveries, and we explore because ocean health and resilience are vital to our economy and to our lives. Exploration supports NOAA mission priorities and national objectives by providing high-quality scientific information about the deep ocean to anyone who needs it.

In close collaboration with government agencies, academic institutions, and other partners, OER conducts deep-ocean exploration expeditions using advanced technologies on the *Okeanos Explorer*. From mapping and characterizing previously unseen seafloor to collecting and

disseminating information about ocean depths, this work helps to establish a foundation of information and fill data gaps. Data collected on the ship follow federal open-access data standards and are publicly available shortly after an expedition ends. This ensures the delivery of reliable scientific data needed to identify, understand, and manage key elements of the ocean environment.

NOAA Ship *Okeanos Explorer* systematically explores the ocean every day of every cruise to maximize public benefit from the ship's unique capabilities. With approximately 90-95% of the ocean unexplored, we pursue every opportunity to map, sample, explore, and survey at planned destinations as well as during transits; "Always Exploring" is a guiding principle. An integral element of *Okeanos Explorer*'s "Always Exploring" model is the ship's seafloor and water column mapping capabilities. The sonars, or a subset of the sonars on board, will be operated at all times 24 hours per day throughout the cruise allowing for continued exploration and seabed, water column, and/or sub-bottom data collection and selected processing.

Objectives for the expedition include:

- Conduct preliminary seafloor mapping operations to contribute to geological understanding of remote areas of the Pacific Ocean.
- Conduct mapping operations to collect key data in preparation for EX-17-08 ROV dive planning and operations.
- Identify and characterize vulnerable marine habitats - particularly potential locations for high density deep sea coral and sponge communities.
- Characterize seamounts within and adjacent to the Prime Crust Zone (PCZ). The PCZ is the area of the Pacific with the highest expected concentration of deep sea minerals, including rare metals and rare earth elements.
- Collect information on the geologic history of Central Pacific Seamounts, including those that are or may be relevant to our understanding of plate tectonics and subduction zone biology and geology.
- Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.
- Murray Fracture Zone mapping: Across the Pacific, there are several very large, multi-segment fracture zones (FZs) that indicate the former existence of oceanic transform faults that existed for millions of years. These FZs underwent dramatic changes in segmentation as revealed by their structure. Mapping data provides a wealth of information about the structure of these TFs when they formed and the subsequent

evolution of their FZs, possibly including information about whether the FZs were weakly or strongly coupled. Weakly coupled FZs can indicate extensive serpentinization, which can alter the production and composition of magma at subduction zones. The suggested mapping data will result in a large swath of mapping data, which will allow a careful analysis of the FZ evolution.

- Musician Seamounts - northern seamounts area mapping: The interaction of plume with nearby mid-ocean ridges is still poorly understood after several decades of research. One feature of plume-ridge interaction is the formation of linear volcanic ridges (such as seen at the Galapagos) that extend between the plume location and the ridge. Two sets of ridge (of which the requested mapping area covers the northern set) are seen to extend from the Musicians to the East. Magnetic anomaly data suggest that these ridges may have formed near a mid-ocean ridge. Poor mapping data make these ridges difficult to characterize, however. For example, are they actually ridges or sets of distinct, aligned seamounts? Being able to analyze the seamount structure and shape can inform the type of formation environment of these seamounts.

Operations for this cruise will include 24 hour mapping, and continuous telepresence-based remote participation in mapping operations. Multibeam and splitbeam mapping operations will be conducted 24 hours a day throughout the cruise. Sub-bottom profile mapping will be conducted 24 hours a day at the discretion of the CO. XBT and Underway CTD 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. All mapping data will be fully processed according to standard procedures and will be archived with the National Centers for Environmental Information (NCEI).

The transit routes between port and the operating areas will maximize mapping of discrete geologic features including seamounts and ridges with little or no existing modern sonar data coverage. The routes were chosen based on the most recent version of the global bathymetric compilation dataset compiled by J.J. Becker et al (http://topex.ucsd.edu/sandwell/publications/124_MG_Becker.pdf).

This expedition will be the seventh cruise to test telepresence enabled mapping operations on *Okeanos Explorer*. Okeanos is a leader in this mode of mapping cruise operation, and continues to see rewards and success and potential for development.

The Expedition Coordinator (Elizabeth Lobecker) for the cruise will be based on shore at the

Exploration Command Center (ECC) at University of New Hampshire Center for Coastal and Ocean Mapping/Joint Hydrographic Center(UNH CCOM/JHC) with regular and ongoing communications with the ship (OPS, CO) and onboard mapping lead (Amanda Bittinger).

The screens of the mapping acquisition systems (EM 302, EK 60, SBP etc.) will be broadcast 24 hours per day, and will be monitored by both onboard and onshore mapping scientists. A specially configured laptop has been prepared for remote access to all the sonar acquisition and data processing machines from shore. This setup will continue to be tested for its reliability and feasibility of controlling the mapping data acquisition and data management from shore. The raw data from all sonars will be transmitted to shore and further processing will be completed on shore. Automated bathymetric gridding will occur on the ship in order for the onboard team to monitor and ensure adequate seabed coverage. The onboard mapping lead will be the primary liaison between ship and OER operations and will attend all the shipboard daily meetings and provide daily situation reports (SITREPS) to the broader OER *Okeanos* operational team.

As telepresence mapping protocols continue to develop during this type of telepresence enabled mapping expedition, possibilities open for OER to conduct operations with nimble teams of mapping personnel onboard and most of data acquisition, processing and quality checks of mapping data being completed on shore. Value gained from this model will continue to expand as the model is tested. Initial predicted benefits include: reduction in travel costs to the ship, participation of a larger number of mapping trainees in expeditions, cruise participation from individuals who are unable to sail, enhanced rapid data processing and archival techniques, enhanced onshore partnership development opportunities, enhanced rapid data report creation, and expanded possibilities for utilizing multiple ECCs during mapping missions.

The onboard ship and mapping team will be provided with all information necessary to successfully conduct the mapping mission should the telepresence component experience significant c9hallenges, such as lack of connectivity due to VSAT or network challenges.

B.Days at Sea (DAS)

Of the 24 DAS scheduled for this project, 0 DAS are funded by an OMAO allocation, 0 DAS are funded by an NOS Line Office Allocation, 0 DAS are Program Funded, and 24 DAS are funded by an OAR Line Office Allocation. This project is estimated to exhibit a Medium Operational Tempo due to 24 hour mapping operations.

C. Operating Area

24-hour per day mapping operations will focus as several locations in the vicinity of the Musicians Seamounts chain. Mapping operations will focus in depths generally between 250 and 6,000 meters.

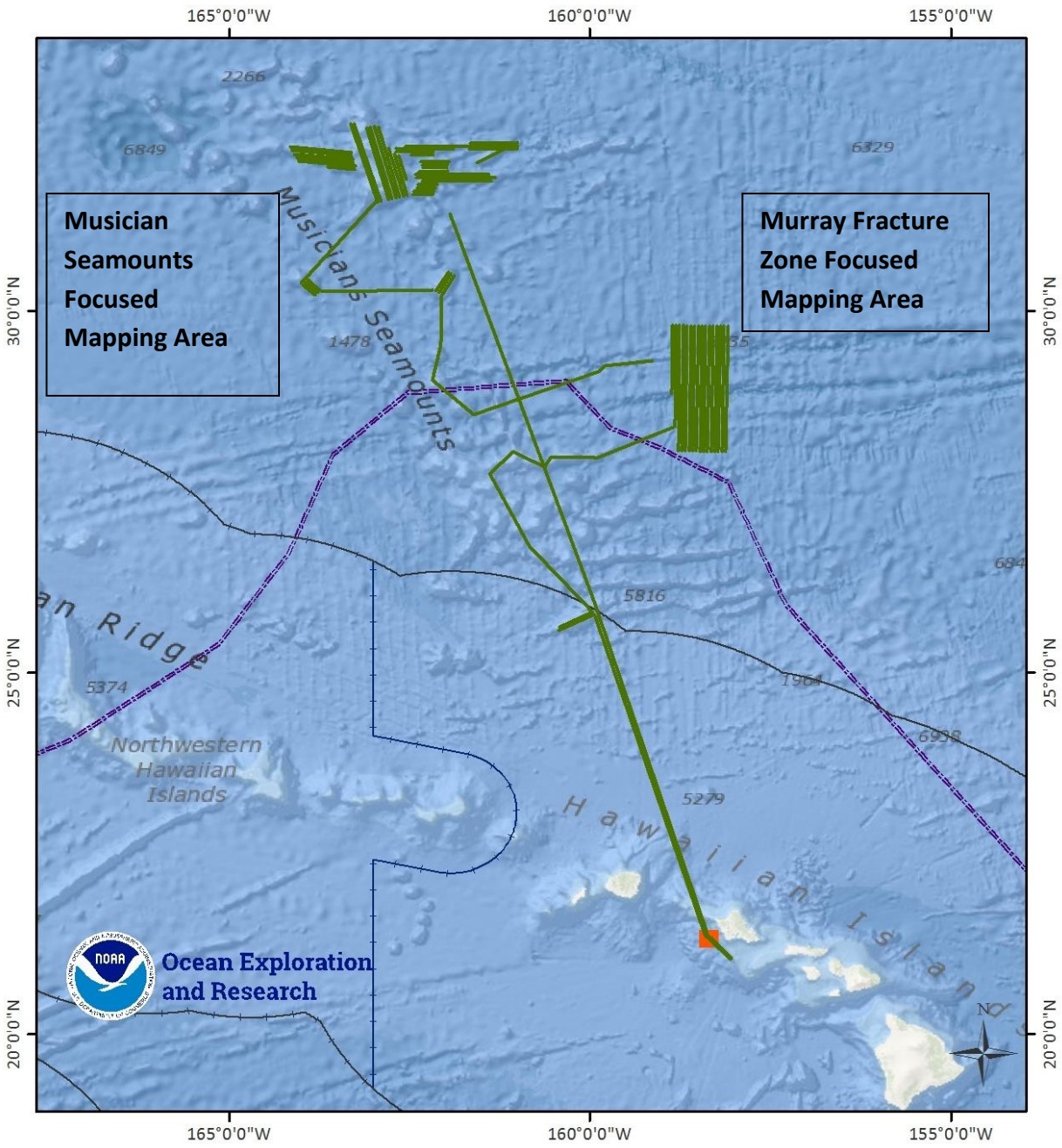

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Figure 1 (above): Map indicating the overall operating area of *Okeanos Explorer* for EX-17-07. Existing publicly available bathymetry coverage for key mapping areas downloaded from National Centers for Environmental Information shown in background.

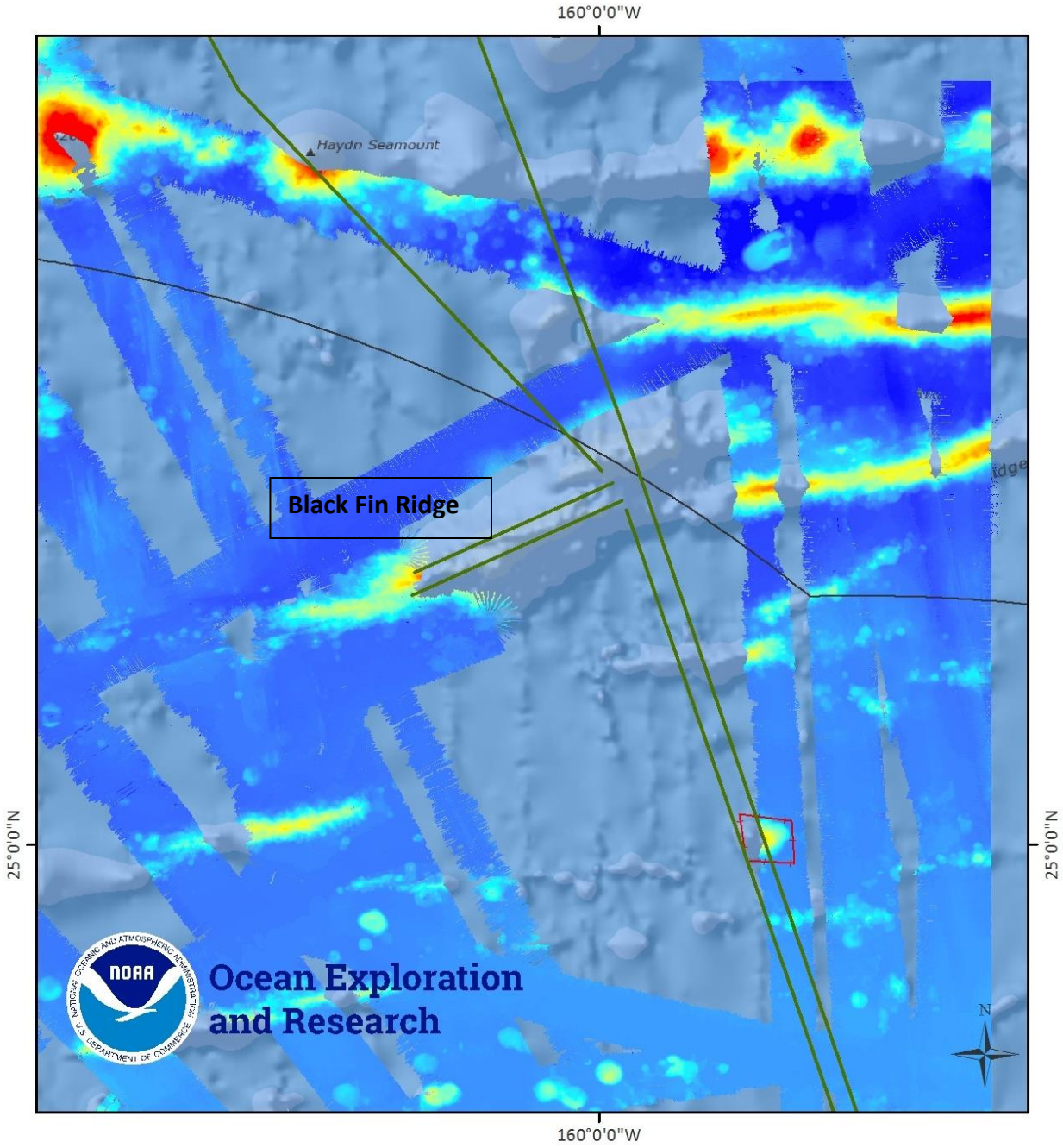

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Figure 2 (above): Map indicating two survey lines at Blackfin Ridge. The green line indicates the generalized cruise track, the red polygons indicate priority areas for focused mapping surveys. Existing publicly available bathymetry from National Centers for Environmental Information shown in background.

A pair of survey lines will be run along the previously unmapped ridgeline of Blackfin Ridge.

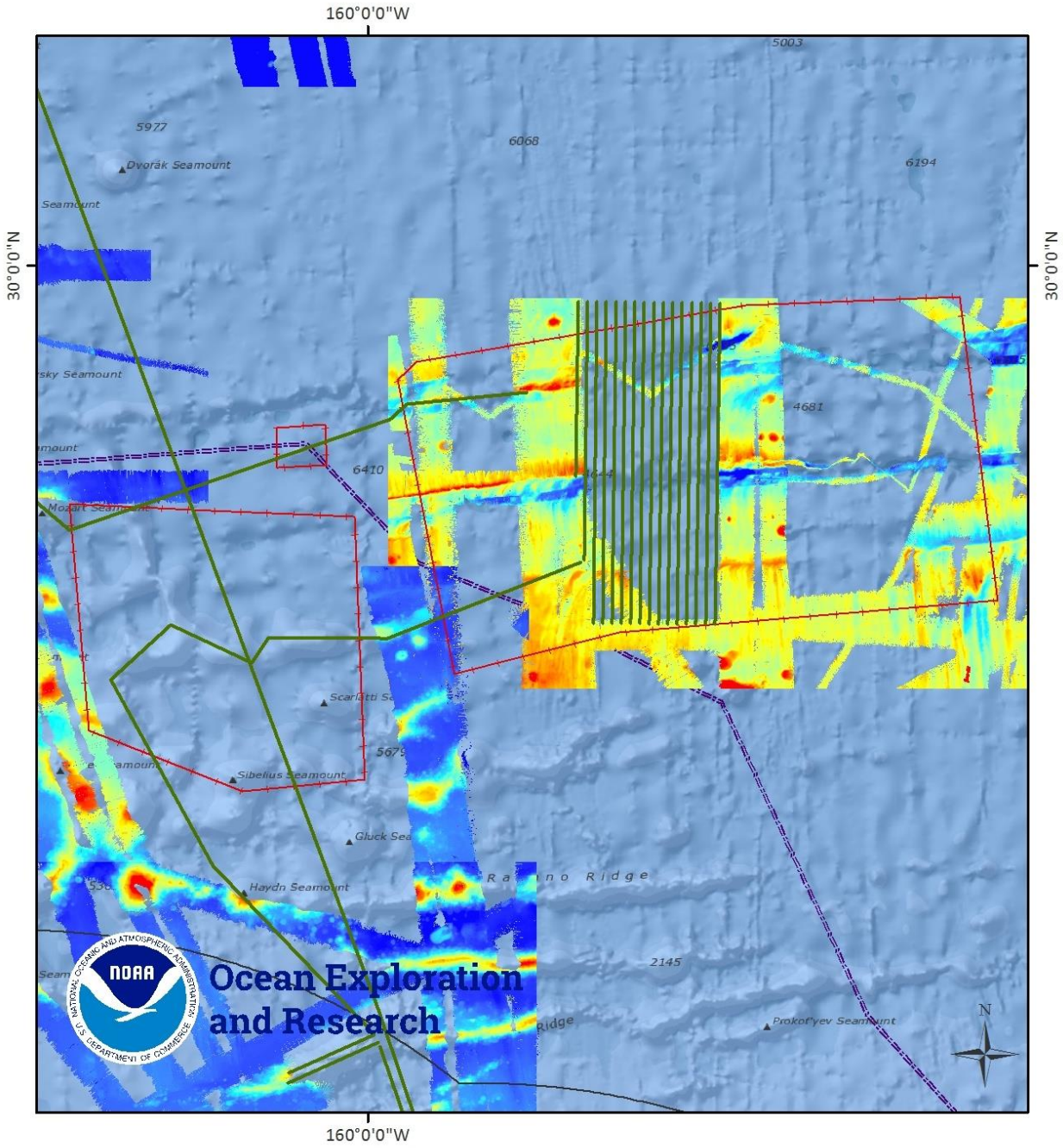

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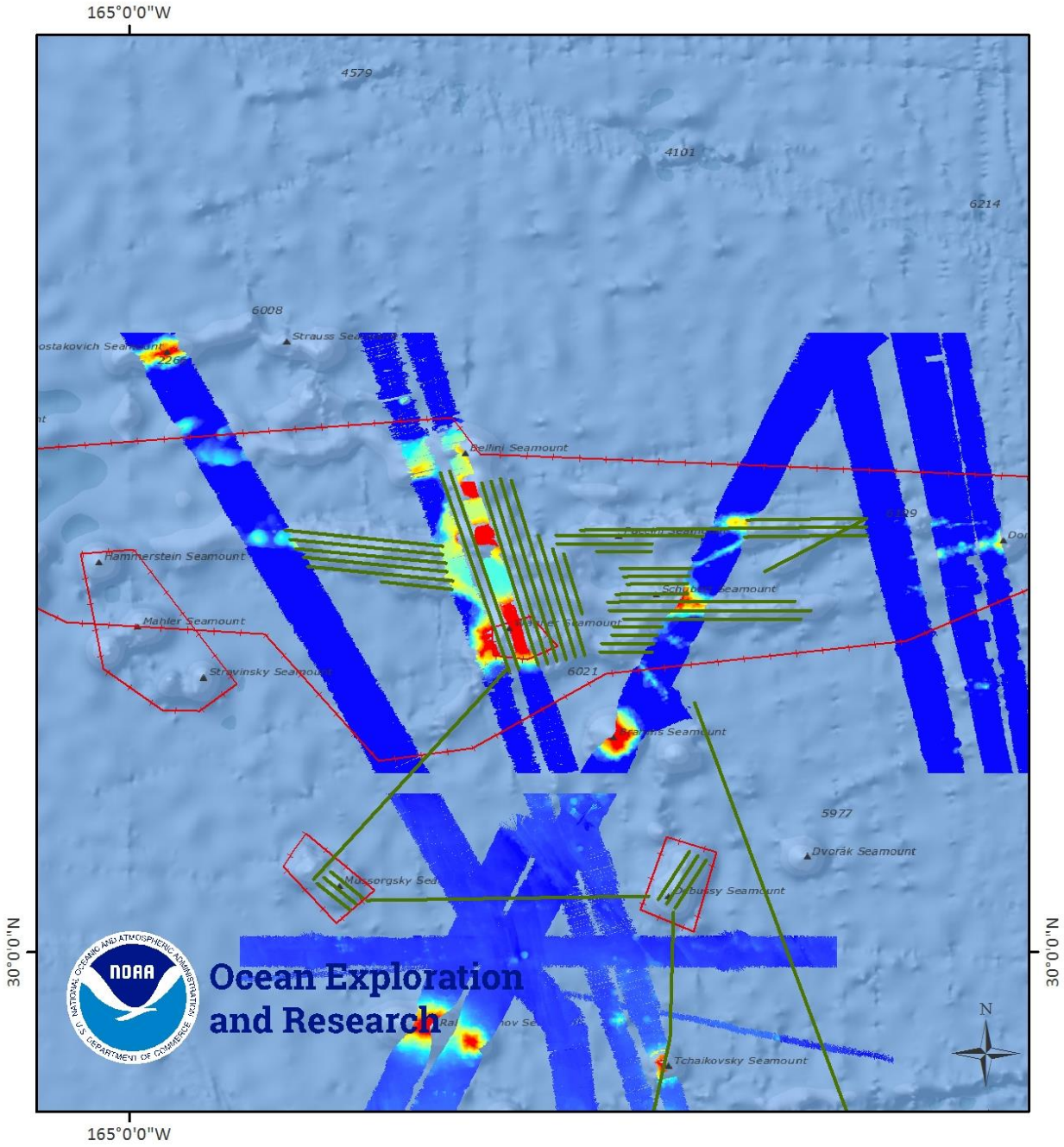
Figure 3 (above): Map indicating the mapping area at the Murray Fracture Zone and nearby Musicians Seamounts. The green line indicates the generalized cruise track, the red polygons indicate priority areas for focused mapping surveys. Existing publicly available bathymetry from National Centers for Environmental Information shown in background.

The Murray Fracture Zone survey area is shown above in Figure 3. The central area indicated in the red rectangle is the first priority in this area.



Service Layer Credits: Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, HERE, Geonames.org, and other contributors

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Figure 4 (above): Map indicating northernmost focused mapping areas at Musicians Seamounts. The green line indicates the generalized cruise track, the red polygons indicate priority areas for focused mapping surveys. Existing publicly available bathymetry from National Centers for Environmental Information shown in background.

The northern survey area encompasses a large grouping of seamounts within the Musician Seamounts chain. The goal is to map the targeted seamounts to a maximum depth of 4500 meters in preparation for ROV dives during EX-17-08.

EX-17-07 Generalized Cruise Track	
Latitude (Degrees Decimal Minutes)	Longitude (Degrees Decimal Minutes)
21 1.949N	158 3.069W
21 21.903N	158 24.055W
21 27.245N	158 26.566W
25 46.642N	159 56.177W
25 52.094N	159 59.578W
26 45.240N	160 50.389W
27 45.468N	161 23.604W
28 3.284N	161 4.100W
27 50.965N	160 38.009W
27 59.169N	160 32.365W
27 58.910N	159 53.660W
28 23.673N	158 50.891W
29 18.832N	159 8.528W
29 14.946N	159 47.501W
29 9.982N	159 52.886W
28 34.034N	161 37.171W
29 2.785N	162 11.028W
29 32.057N	162 4.489W
30 12.808N	162 3.488W
30 17.972N	162 11.360W
30 16.800N	163 42.965W
30 23.674N	164 0.455W
31 31.948N	162 57.460W

31 20.845N	161 56.673W
25 58.695N	159 56.799W
21 27.936N	158 24.327W
21 21.952N	158 23.029W
21 2.725N	158 2.482W

Table 1: EX-17-07 generalized cruise track waypoints.

D. Summary of Objectives

August 8 - 31, Honolulu, HI to Honolulu HI, focused seamount mapping at Musician Seamounts.

EX-17-07 operations will occur in the U.S. EEZ and primarily in international water.

Mission objectives for EX-17-07 include a combination of mapping/operational, science, education, outreach, and data management objectives:

1. Onboard Mapping
    a. Conduct 24 hr/day mapping operations for the entirety of the cruise using EM 302 multibeam, EK 60 suite, and subbottom profiler sonars.
    b. Execute mapping line plans as defined by onshore personnel, with adjustments made in the field to obtain complete coverage as necessary. All line plans are currently set to 5 kilometer line spacing.
    c. Collect high resolution mapping data from sonars in priority areas as dictated by operational needs as well as science and management community needs.
    d. Collect XBT/ UnderwayCTD (if system operational) casts as mapping data quality requires.
    e. Utilize Qimera realtime gridding functionality.
    f. Create daily standard bathymetry mapping products.
    g. Ensure all raw data from all sonars is transferred to shoreside repository hourly using automated scripts.
    h. Collect sun photometer measurements as part of Exploration Project of Opportunity (EPO).
    i. Average survey speeds of 8-9 kts will be utilized.
    j. Transit speeds of 9-11 kts will be utilized.
    k. Host two Explorers-in-Training who were trained onshore during EX-17-04 at the UNH Center for Coastal and Ocean Mapping.

2. Onshore mapping
    a. Train three Explorers-in-Training at the UNH CCOM/JHC in preparation for them to sail on a later mapping cruise in FY18.
    b. Conduct detailed bathymetric data processing.
    c. Write mapping data report.
    d. Generate tracklines of all sonar data types.
    e. Generate cruise map.
    f. Generate cruise statistics.
    g. Process subbottom, EK60, multibeam bottom backscatter and water column backscatter data according to SOPs.
    h. Shoreside operation of sonar computers on the ship using desktop access through NOAA OMAO supplied laptop.
    i. Test telepresence mapping workflow with OER physical scientists at UNH.
    j. Support onboard watchstanders by monitoring data collection from shore in realtime
    k. Provide data acquisition and processing troubleshooting from shore
    l. Possibly collaborate with GECBO students based at CCOM.

3. Data Management
    a. Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities;
    b. Use daily bathymetric mapping products and SCS mailers to update Okeanos Atlas for onshore situational awareness.
4. Science
    a. Explore the diversity and distribution of benthic habitats – including bottom fish habitats, deep sea and precious coral communities and hydrothermal vents.
        i. Collect data on: habitat size and extent
    b. Collect geophysical data at sites to aid the understanding of the geologic history of Pacific seamounts.
    c. Build capacity in the scientific community and public in telepresence-based mapping exploration.
    d. Successfully conduct operations in conjunction with shore-based Exploration Command Centers and remote science team participants.

5. Remote Science/Exploration Command Centers
    a. Provide operational support and training to scientists and managers to enable remote participation in at-sea operations.
    b. Facilitate outreach and engagement activities and events at the ECCs.
    c. Test and refine ship-to-shore communications procedures that engage multiple

ECCs and other remote participants.

d. Test and refine operating procedures and products.

6. Outreach
   a. Onshore EC and EiTs participate in various UNH outreach activities based in the UNH ECC including TBD

7. Ship
   a. Possibly conduct full depth test CTD cast to confirm all sensors functional including altimeter.
   b. Conduct ship safety drills including man overboard and maneuvering.
   c. Continue to refine SOPs for the new VSAT.
   d. Provide a high quality stable internet connection with the new VSAT.
   e. Provide stable and reliable VoIP telecommunications.
   f. Continue to train new Survey Technician and familiarize him with *Okeanos* Operations and his/her responsibilities.

E. Participating Institutions

- National Oceanic and Atmospheric Administration (NOAA), Office of Ocean Exploration and Research (OER)–1315 East-West Hwy, Silver Spring, MD 20910 USA
- NOAA, National Oceanographic Data Center, National Coastal Data Development Center, Stennis Space Center MS, 39529 USA
- University Corporation for Atmospheric Research Joint Office for Science Support (JOSS), PO Box 3000 Boulder, CO 80307 USA
- University of Hawai'i at Manoa- 2500 Campus Rd, Honolulu, HI 96822
- University of New Hampshire (UNH) Center for Coastal and Ocean Mapping (CCOM) Jere A. Chase Ocean Engineering Lab, 24 Colovos Rd, Durham, NH 03824 USA
- Global Foundation for Ocean Exploration, P.O. Box 417, Mystic, CT 06355
- NOAA National Marine Fisheries Service, Pacific Islands Regional Office, 1845 Wasp Blvd, Honolulu, HI 96818
- NOAA National Marine Fisheries Service,Pacific Islands Fisheries Science Center, 1845 Wasp Blvd, Honolulu, HI 96818

F. Personnel(Mission Party)

Table 2: Full list of shore based and sea going mission party members and their affiliations

Nationality	Affiliation	Gender	Date Disembark	Date Aboard	Location during cruise	Title	Name (First, Last)	#
ONBOARD MAPPING TEAM								
USA	UCAR	F	9/1	8/6	Ship	Onboard Mapping Lead	Amanda Bittinger	1
USA	UCAR	M	9/1	8/6	Ship	Onboard Mapping Watch Lead	Dan Freitas	2
USA	UCAR	F	9/1	8/7	Ship	Explorer in Training / Watchstander	Elizabeth "Claudia" Thompson	3
USA	UCAR	M	9/1	8/6	Ship	Explorer in Training / Watchstander	Brandon O'Brien	4
ONSHORE MAPPING TEAM								
		n/a	n/a	n/a	UNH CCOM/JHC ECC	Expedition Coordinator	Elizabeth 'Meme' Lobecker	1
		n/a	n/a	n/a	UNH CCOM/JHC ECC	Mapping Lead	Derek Sowers	2
		n/a	n/a	n/a	UNH CCOM/JHC ECC	Explorer in Training	Kelsey Lane	3
		n/a	n/a	n/a	UNH CCOM/JHC ECC	Explorer in Training / EPP Intern	Laura Almodóvar	4
		n/a	n/a	n/a	UNH CCOM/JH	Explorer in Training	TBD	5

C ECC

G. Administrative

1. Points of Contact:

Ship Operations	
Chief, Operations Division, Atlantic (MOA)	Marine Operations Center, Atlantic (MOA)
LT Joe Carrier, NOAA	439 West York Street
Telephone: (757) 441-6842	Norfolk, VA 23510-1145
E-mail: Chiefops.MOA@noaa.gov	Telephone: (757) 441-6776
	Fax: (757) 441-6495

Mission Operations	
CDR Eric Johnson, NOAA	EElizabeth 'Meme' Lobecker
Commanding Officer	Mapping Manager
NOAA Ship *Okeanos Explorer*	NOAA Office of Ocean Exploration
Phone: (401) 378-8284	and Research (ERT)
Email: CO.Explorer@noaa.gov	O: (603) 862-1475
	C: (240) 429-7023
LT Aaron Colohan, NOAA	E-mail: elizabeth.lobecker@noaa.gov
Operations Officer	
NOAA Ship Okeanos Explorer	
Phone: (808) 659-9197 (Ship's Iridium)	

E-mail: Ops.Explorer@noaa.gov

Other Mission Contacts

CDR William Mowitt, Deputy Director

NOAA Ocean Exploration & Research

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E-mail: William.Mowitt@noaa.gov

Craig Russell

Program Manager

NOAA Ocean Exploration & Research

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Alan Leonardi, Director

NOAA Ocean Exploration & Research

Phone: 301-734-1016/ Cell: 202-631-1790

E-mail: alan.leonardi@noaa.gov

Vessel Shipping Address

Shipments: Send an email to the *Okeanos Explorer* Operations Officer at OPS.Explorer@noaa.gov indicating the size and number of items being shipped.

Items sent to Honolulu should arrive at the following address prior to COB 8/4/17.
NOAA Ship Okeanos Explorer
c/o LT Aaron Colohan
1845 Wasp Blvd, Honolulu, HI 96818

2. Diplomatic Clearances

N/A.All data collection to occur in U.S. or international waters.

3. Licenses and Permits

The expedition is being planned and conducted by NOAA as an agency of the U.S. Federal government.

Pursuant to the National Environmental Policy Act (NEPA), NOAA OER is required to include in its planning and decision-making processes appropriate and careful consideration of the potential environmental consequences of actions it proposes to fund, authorize and/or conduct. NOAA's Administrative Order (NAO) 216-6A Companion Manual describes the agency's specific procedures for NEPA compliance. Among these is the need to review all proposed NOAA-supported field projects for their environmental effects. A categorical exclusion (CE) worksheet has been completed for this survey, in accordance with Section 4 of the Companion Manual. This worksheet describes EX1707 and explains how it is consistent with one or more of the CE categories listed/described in Appendix E of the Companion Manual. The completed worksheet also summarizes the review conducted to determine that no extraordinary circumstances exist that would preclude the use of a CE or require preparation of an environmental assessment or environmental impact statement.

Informal consultation was initiated under Section 7 of the Endangered Species Act (ESA), requesting NOAA Fisheries' Protected Resources Division concurrence with our biological evaluation determining that 2016 Marianas Expedition and all other planned *Okeanos Explorer* operations during the 2016-17 field season, may affect, but are not likely to adversely affect, ESA-listed marine species. The informal consultation was completed on February 3, 2016 when NOAA OER received a signed letter from the Regional Administrator of NMFS Pacific Islands Regional Office, stating that NMFS concurs with OER's determination that conducting proposed *Okeanos Explorer* cruises are not likely to adversely affect ESA-listed marine species. Documentation is provided in appendix of this PI.

OER has completed consultation with NOAA's Habitat Conservation Division on potential

impacts of our operations to Essential Fish Habitat (EFH). They concurred that our operations would not adversely affect EFH provided adherence to our proposed procedures and their guidance stated in the letter. Documentation is provided in appendix of this PI.

II. Operations

The Expedition Coordinator is responsible for ensuring the scientific staff are trained in planned operations and are knowledgeable of project objectives, priorities and environmental compliance procedures. 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)

Activities	Approx Survey Time (hrs)	Date
Onboard mission personnel arrive to ship (flight dependent)		8/6
Depart port 0900 from Ford Island pier for Navy Fuel Dock, take on fuel, commence mapping at sea buoy		8/8
Transit mapping over S28 wreck target	-	8/8
Transit to Blackfin Ridge	35 hours	8/8-8/9
Blackfin Ridge survey	6 hours	8/9
Transit to Murray Fracture Zone and nearby seamounts	14 hours	8/9-8/10
Focused mapping at Murray Fracture Zone (Fig 4)	8 days	8/10-8/17
Mapping of over Mozart, Liszt, Debussy, and Mussorgsky Seamounts en route to northern Musician Seamounts area	2 days	8/17-8/20

Focused mapping at large Musician Seamount group (Fig 6)	8-9 days	8/20-8/28
Transit south from Musicians Seamount mapping area to Honolulu (~680 nm distance estimate, 3 days @ 9 kts)	3 days	8/28-8/31
Transit mapping over S28 wreck target		8/31
Arrive sea buoy Pearl Harbor,Honolulu 0800		8/31

Table 4: Detailed Cruise Itinerary. This is an approximate itinerary and is subject to change based on survey results, field conditions, and discretion of the CO.

B. Staging and Destaging

Minimal staging and destaging is expected as all mission equipment will be onboard already, and the following cruise is another telepresence-enabled ROV cruise.

C. Operations to be Conducted

1. Telepresence / Outreach Events
    a. Two live video feeds will be used throughout the cruise to provide situational awareness for onshore personnel.
2. In-Port Events
    a. There are no in-port events planned for this cruise.

D. SCUBA Dive Plan

All dives are to be conducted in accordance with the requirements and regulations of the NOAA Diving Program and require the approval of the ship's Commanding Officer.

E. Applicable Restrictions

Sonar Operations

EM 302, EK 60, ADCP, and sub-bottom profiler data acquisition is planned for this cruise. All data acquisition will be conducted in accordance with established standard operating

procedures under the direction of the mapping team lead. These operating procedures will include protection measures when operating in the vicinity of marine mammals, sea turtles or Endangered Species Act-listed species as described in appendices of this document. The final decision to operate and collect 24-hour sub-bottom profiler data will be at the discretion of the Commanding Officer.

III. Equipment

A. Equipment and capabilities provided by the ship

- 2 working small boats in seaworthy and reliable working condition for mission operations and fast rescue
- ~~NOAA OER 6000 m *Deep Discoverer* ROV~~
- ~~NOAA *Seirios* Camera Platform~~
- Kongsberg Simrad EM302 MultibeamEchosounder (MBES)
- Kongsberg Simrad EK60DeepwaterEchosounders and GPTs (18, 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 Mark21 System(Deep Blue probes)
- AOML Automated XBT Launcher (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
- MarineStar GPS
- POS/MV

- Seabird SBE-45 (Micro TSG)
- Kongsberg Dynamic Positioning-1 System
- Netshares mapping storage system
- IVS Fledermaus Software suite
- SIS Software
- Hypack Software
- Scientific Computing System (SCS)
- ECDIS
- Met/Wx Sensor Package
- Telepresence System
- VSAT High-Speed link (Comtech 9 Mbps ship to shore; 2 Mbps shore to ship)
- Cruise Information Management System (CIMS)
- Three VoIP telephone lines

B. Equipment and capabilities provided by the scientists

- Microtops II Ozone Monitor Sunphotometer and handheld GPS required for NASA Marine Aerosols Network supplementary project.

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

Approx. locations	Use	Item
~~Wetlab, under the chemical hood~~ removed from ship for EX1707	~~Sample preservation~~	~~95% Denatured Ethanol (35 gallons)~~
~~Wetlab, under the chemical~~ hoodremoved from ship for EX1707	Sample preservation	10% Buffered Formalin (1 gallon)
Wetlab, under the chemical hood	Sample preservation (genetics)	Chaos Buffer (250 ml) (4 M guanidine thiocyanate, 0.5% N-laurosylsarcosine, 25 mMTris pH

		8.0, 0.1 M beta-mercaptoethanol)
ROV Workshop Fire Cabinet, Pit	Underwater Lubricant	Aqua Shield
ROV Workshop Fire Cabinet, Pit	Electrical insulating compound	Dow Corning 4
ROV Workshop Fire Cabinet	Silicone Lubricant	Fluid Film Spray
ROV Workshop Fire cabinet	Solvent	Isopropanol Alcohol (35 gallons)
ROV Workshop Fire cabinet	Electrical insulating compound	Scotchkote
ROV Workshop Fire cabinet	Silicone Lubricant	3M Silicone Spray
Hanger, Pit, Vehicles	Amsoil (AWG-05)	Synthetic AW Hydraulic Oil, ISO-22
ROV Workshop Fire cabinet	Cutting/Machining Lubricant	Tap Magic Cutting Fluid
ROV Workshop Fire cabinet	Cutting/Machining Lubricant	Tap Magic Heavyweight Cutting Fluid
Winch room	Marine Lubricant	Tuff Coat M
ROV Workshop Fire cabinet, Pit	Valve Lubricant and Sealant	Dow Corning Molykote 316, 111
ROV Workshop Fire cabinet	Lubricant	WD40
ROV Workshop Fire cabinet	Bolt adhesive	Loktite
Hanger, Vehicles	Vitrea	Mineral Oil
ROV Workshop Fire cabinet	Paint Kit	Por-15
Hanger, ROV *D2*	Hydraulic Fluid	Univis HVI 13
ROV Workshop fire cabinet	Butane fuel	Ultratane
ROV Workshop fire cabinet	Protective Enamel	Rust-oleum
ROV Workshop fire cabinet	Soldering Flux remover	Flux-Off
ROV Workshop fire cabinet	Torch Fuel	Propane
Tool Room	General adhesive	Adhesive Pliobond 25
Pit	Degreaser/cleaner for metal surfaces	AP 120 Metal Prep

Tool Room	Torch refill	Butane Fuel
Tool Room	Adhesive for PVC plastic piping	PVC Cement
Tool Room	Ferrous metal rust removal	Phosporic Acid
Too Room/Pit	Plumbing sealant	Pipetite Paste
Tool Room	Lubricant/compensation oil	Spindle Oil 10, ROS PT
Tool Room / Pit	Silicon grease	DC557
Pit	Two part expoxy catalyst	Tether Potting Catalyst
Pit	Two party expoxy ingredient	Tether Potting Compound
Pit	Lubricant	ThermaPlex Bearing Grease
Pit	Compensator oil for sonar head	Tritech Seaking

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. Exploration Projects of Opportunity

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.

See Appendix for full Survey of Opportunity Form.

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 section 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. Raw sonar files (EM 302, EK 60, Subbottom, ADCP)
    e. Refined SOPs for all pertinent operational activities
    f. Assessments of all activities
2. Science
    a. Multibeam raw and processed data (see Appendix section for the formal cruise data management plan)
    b. XBT raw and processed data

c. EK 60 raw data
d. Knudsen 3260 sub-bottom profiler raw data
e. ADCP raw data
f. Mapping data report

Archive

OER and *Okeanos Explorer* 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. As necessary and no less than every third day, daily Operations Briefing meetings will be held at a time convenient for OPS officer and onboard mapping lead 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-Cruise 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-Cruise Meeting:

The Commanding Officer is responsible for conducting a meeting no earlier than 24 hours before or seven days after the completion of a project to discuss the overall project outcomes. During this meeting the following will be discussed; concerns regarding safety and efficiency; challenges encountered and suggestions for future improvements (all mitigation ideas will be

documented for future projects); as well as successes during the project. This meeting shall be attended by ship's officers, applicable crew, the Expedition Coordinator, and representatives 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 Chief Scientist. The form is available at https://sites.google.com/a/noaa.gov/omao-intranet-dev/operations/marine/customer-satisfaction-survey and provides a "Submit" button at the end of the form. It is also located at https://docs.google.com/a/noaa.gov/forms/d/1a5hCCkgIwaSII4DmrHPudAehQ9HqhRqY3J_FXqbJp9g/viewform. Submitted form data is deposited into a spreadsheet used by OMAO management to analyze the information. Though the complete form is not shared with the ships, specific concerns and praises are followed up on while not divulging the identity of the evaluator.

VIII. Miscellaneous

A. Meals and Berthing

The ship will provide meals for the scientists listed above. Meals will be served 3 times daily beginning one hour before scheduled departure, extending throughout the project, and ending two hours after the termination of the project. Since the watch schedule is split between day and night, the night watch may often miss daytime meals and will require adequate food and beverages (for example a variety of sandwich items, cheeses, fruit, milk, juices) during what are not typically meal hours. Special dietary requirements for scientific participants will be made available to the ship's command at least twenty-one days prior to the survey (e.g., Expedition Coordinator is allergic to fin fish).

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 makeup 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 Chief Scientist or the NOAA website http://www.corporateservices.noaa.gov/noaaforms/eforms/nf57-10-01.pdf.

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

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

sail if a legible email address is provided on the NHSQ.

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

The only secure email process approved by NOAA is Accellion Secure File Transferwhich requires the sender to setup an account.Accellion's Web Users Guideis 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 toaccellionAlerts@doc.gov requesting access to the "Send Tab" function. They will notify you via email usually within 1 business day of your approval. The 'Send Tab" function will be accessible for 30 days.

Contact Information:

Regional Director of Health Services
Marine Operations Center – Atlantic
439 W. York Street
Norfolk, VA 23510
Telephone: (757) 441.6320
Fax: (757) 441.3760
E-mail: MOA.Health.Services@noaa.gov

Please make sure the medical.explorer@noaa.govemail 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.

Emergency contact form is included as Appendix A.

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.

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 **9 Mbps** 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):

OER Program Administration
Phone: (301) 734-1010
Fax: (301) 713-4252
E-mail: craig.russell@noaa.gov

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
*OkeanosExplorer*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 Internet Protocol (VoIP) Phone:
(541) 867-8932
(541) 867-8933
(541) 867-8934

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 onboard. 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.

Appendix A. Categorical Exclusion

Form Version: June 2017

Categorical Exclusion (CE) Evaluation Worksheet

Project Title: EX-17-07, Musician Seamounts (Telepresence Mapping)

Date Review Completed: 7/20/2017

Completed by: Craig Russell, NOAA Office of Ocean Exploration and Research

Worksheet File Name: 2017-07-OER-CE-EX1707

Step 1.CE applicability

1. **What is the proposed federal action?**

   The proposed action is to collect baseline mapping data using the NOAA Ship *Okeanos Explorer*'s sonar systems and CTD rosette system on the NOAA Ship *Okeanos Explorer*.

   The expedition will commence on August 8, 2017 in Honolulu, HI (21° 21.659'N, 157° 59.438'W) and conclude on August 31, 2017 in Honolulu, HI, and will conduct operations in US waters near Oahu, and in international waters north of Oahu at the Musician Seamount chain. See Project Instructions EX-17-07 for more details.

2. **Which class of CE in Appendix E of the NAO 216-6A Companion Manual is applicable to this action and why?**
   a. The topical scope of this action is consistent with CE number E4 in Appendix E of the Companion Manual to NOAA Administrative Order (NAO) 216-6A
   b. Activities that remotely survey or observe living resources in the field using non-invasive techniques, which have little to no potential to adversely affect the environment or interfere with organisms or habitat.

Step 2. Extraordinary Circumstances Consideration

3. **Would the action result in adverse effects on human health or safety that are not negligible?**

   No. The NOAA Ship *Okeanos Explorer* will be operating in remote deep sea areas of the Pacific Ocean. Expedition EX-17-07, an expedition of the NOAA CAPSTONE campaign, will focus operations at the Musician Seamount chain, which are all underwater and therefore have no human presence, (see *Figure 1 of EX-17-07 Project Instructions for a map of generalized cruise track*) and additionally does not involve any procedures or outcomes known to result in impacts on human health and safety more than would be negligible.

4. **Would the action result in adverse effects on an area with unique environmental characteristics that are not negligible?**

   This survey/expedition overlaps with the following areas with unique environmental characteristics: deep sea seamounts and seafloor fracture zones. However, the survey effects will be negligible or less than negligible, as acoustic mapping operations will not cause any impact on the seabed.

5. **Would the action result in adverse effects on species or habitats protected by the ESA, MMPA, MSA, NMSA, or MBTA that are not negligible?**

   OER has taken measures to ensure that any effects on species or habitats protected by the ESA, MMPA, MSA or NMSA meet the definition of "negligible". In January 2016, a request from OER was submitted to the NMFS PIRO Protected Resources Division to initiate consultation under Section 7 of the ESA. Accompanying this request was a biological assessment that described the planned operations proposed for 2016-2017 expeditions in the Pacific and identified all ESA-listed species, including corals, in the vicinity of the operations. On February 7, 2016, OER received a letter that concurred with our determination that these 2016-2017 operations are not likely to adversely affect ESA-listed species. The ESA Section 7 concurrence letter is provided as an appendix in the Project Instructions document for EX-17-04.

   Given the offshore focus area of our work, it is highly improbable that we will encounter marine mammals protected under the MMPA or sea birds protected under the MBTA. If we did encounter any marine mammals or seabirds, our effect would be negligible because of the best management practices to which we adhere to avoid or minimize environmental impacts.

   OER also initiated a request for a Magnuson-Stevens Essential Fish Habitat (EFH) consultation for this same series of cruises and subsequently received a determination that the proposed cruises will not reduce the quality and/or quantity of EFH, provided there is adherence to the OER proposed procedures and the NMFS guidance conveyed via email from NMFS PIRO's Richard Hall, dated November 30, 2016.

   Operations will not occur in any sanctuaries and therefore NMSA does not apply.

6. **Would the action result in the potential to generate, use, store, transport, or dispose of hazardous or toxic substances, in a manner that may have a significant effect on the environment?**

No. The cruise operations will be in compliance with FEC 07 Hazardous Materials and Hazardous Waste Management Requirements for Visiting Scientific Parties (or superseding OMAO procedures) to ensure generation, use, storage, transport, and disposal of such substances will not result in significant impacts.

7. **Would the action result in adverse effects on properties listed or eligible for listing on the National Register of Historic Places authorized by the National Historic Preservation Act of 1966, National Historic Landmarks designated by the Secretary of the Interior, or National Monuments designated through the Antiquities Act of 1906; Federally recognized Tribal and Native Alaskan lands, cultural or natural resources, or religious or cultural sites that cannot be resolved through applicable regulatory processes?**

Brief transit mapping will occur over the possible resting location of the WWII diesel submarine USS S-28. Seafloor mapping data with any clear evidence of the wreck location will be held according to standard OER sensitive data archiving procedures under the guidance of the OER Maritime Archeology expert.

8. **Would the action result in a disproportionately high and adverse effect on the health or the environment of minority or low-income communities, compared to the impacts on other communities (EO 12898)?**

No, the NOAA Ship *Okeanos Explorer* will be operating in remote deep sea areas of the Pacific Ocean (see figure 1, EX 17-07 Cruise Project Instructions). There are no communities within or near the geographic scope of the cruise, and the cruise does not involve actions known or likely to result in adverse impacts on human health.

9. **Would the action contribute to the introduction, continued existence, or spread of noxious weeds or nonnative invasive species known to occur in the area or actions that may promote the introduction, growth, or expansion of the range of the species?**

No. During EX-17-07, the ship will not make landfall in areas other than commercial ports. The ship and OER mission team will comply with all applicable local and federal regulations regarding the prevention or spread of invasive species. At the completion of every CTD cast, the CTD will be thoroughly rinsed with fresh water and completely dried to prevent spreading organisms from one site to another. Also, the Engineering Department aboard the NOAA Ship *Okeanos Explorer* attends yearly Ballast Management Training in accordance with NOAA Form 57-07-13NPDES VGP Annual Inspection and Report to prevent the introduction of invasive species.

10. Would the action result in a potential violation of Federal, State, or local law or requirements imposed for protection of the environment?

The proposed action **will not** result in any violations of Federal, State, or local law or requirements imposed for protection of the environment. The survey coordinators obtained (or are in the process of obtaining) authorizations and/or consultations pursuant to applicable laws. See responses to questions #4, 5, and 6 for details.

11. Would the action result in highly controversial environmental effects?

No. The exploration activities will be localized and of short duration in any particular area at any given time. Given this project's scope and breadth, no notable or lasting changes or highly controversial effects to the environment will result.

12. Does the action have the potential to establish a precedent for future action or an action that represents a decision in principle about future actions with potentially significant environmental effects?

No. While each cruise contributes to the overarching goal of exploring, mapping, and sampling the ocean, every cruise is independently useful and not connected to subsequent cruises.

13. Would the action result in environmental effects that are uncertain, unique, or unknown?

No. The techniques and equipment used are standard for this type of field activity.

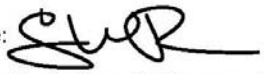
14. Does the action have the potential for significant cumulative impacts when the proposed action is combined with other past, present and reasonably foreseeable future actions, even though the impacts of the proposed action may not be significant by themselves?

By definition, actions that a federal agency classifies as a categorical exclusion have no potential, individually or cumulatively, to significantly affect the environment. This cruise is consistent with a class of CE established by NOAA, and there are no extraordinary circumstances for this action that may otherwise result in potentially significant impacts.

CE Determination

X I have determined that a Categorical Exclusion is the appropriate level of NEPA analysis for this action and that no extraordinary circumstances exist that would require preparation of an environmental assessment or environmental impact statement.

☐I have determined that an environmental assessment or environmental impact statement is required for this action.

Signature: 

Signed by: Craig Russell, Manager, Okeanos Explorer Expeditions

Date Signed: 7/21/2017

Appendix B. Essential Fish Habitat Consultation

Kelley Elliott - NOAA Federal <kelley.elliott@noaa.gov>

EFH Consultation Response for CAPSTONE cruises

Richard Hall - NOAA Federal <richard.hall@noaa.gov> Wed, Nov 30, 2016 at 4:21 PM
To: Kelley Elliott - NOAA Affiliate <kelley.elliott@noaa.gov>
Cc: Ian Lundgren - NOAA Affiliate <ian.lundgren@noaa.gov>, Samantha Brooke <samantha.brooke@noaa.gov>, Kasey Cantwell - NOAA Affiliate <kasey.cantwell@noaa.gov>

Kelley,

On November 14, 2016, the Office of Exploration and Research (OER), through personal communication, initiated a request for an Essential Fish Habitat consultation for a series of cruises by the NOAA Ship *Okeanos Explorer*. The cruises would run from early-December 2016 through late-September 2017, and include the waters around the Main Hawaiian Islands, the Musician Seamounts (north of Hawaii), the American Samoa Archipelago; Johnston, Howland, Baker, Jarvis, Kingman and Palmyra Atolls of the Pacific Remote Islands, and portions of the Cook Islands. The operational minimum depth during the cruises would be 250 m, with the majority of the cruise activities would be in water depths over 500 m.

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855 et seq.) requires review of federally permitted projects for potential impacts to EFH (§305(b)). Pursuant to this authority, I have reviewed and provided comments as necessary for the Habitat Conservation Division of NOAA's Pacific Islands Regional Office.

The proposed cruises are the final legs of the larger 2-year Campaign to Address Pacific Monuments Science, Technology and Ocean Needs (CAPSTONE Project), which is designed to improve the understanding of the distribution and diversity of deepwater habitats within the Pacific monuments and protected areas.

The primary activities to be conducted during this series of cruises would be: remotely operated vehicle (ROV) dives to conduct engineering trials and sonar calibration and testing during two shakedown cruises scheduled for the waters of the Main Hawaiian Islands (no biological or geological samples would be collected); and mapping and ROV dives in the waters of American Samoa, West Samoa, the Pacific Remote Islands, the Musician Seamounts, and portions of the Cook Islands. Five cruises would be dedicated mapping cruise, resulting in 92 days of constant mapping, while six cruises would be combined ROV and mapping cruises which would result in approximately 96 ROV dives and 110 days of overnight mapping. Other activities to be performed during the cruises would include: deployment and recovery of a conductivity-temperature-depth (CTD) sampling rosette and underway CTDs, and possible deployment of Argo floats to acquire ocean chemistry data. During ROV dives various biological and geological samples would be collected.

In order to avoid/minimize impacts to EFH, the OER and the *Okeanos Explorer* have proposed to institute the following procedures:

- The vessel would employ the use of dynamic positioning during ROV dives (no anchoring);
- ROVs would be operated in a manner to avoid seafloor disturbance, and setting the ROV on the seafloor will be held to a minimum. For those situations when the ROV does make contact with the seafloor, visual observations will confirm that the area is sand, mud, or hard-bottom;
- Sample collections would be limited (typically 4 - 6 total rocks and primary biological specimens per dive) that represent new species, new records, or the dominant morphotype animal in a community. Clonal biological specimens (corals, sponges) would be subsampled; and
- Instruments deployed to collect water samples and current data (except for expendable instruments) would not be allowed to contact the seafloor;

In addition to the management practices proposed by OER and the *Okeanos Explorer*, NMFS provides the following guidance to further avoid/minimize impacts to EFH from the proposed cruise activities and vessel operations:
1. Except in an emergency, the vessel should not anchor while at sea;
2. The vessel should adhere to MARPOL discharge regulations at all times during the proposed cruises;
3. The ROV should be thoroughly rinsed between dives, allowed to dry, and checked for the presence of biological

organisms to prevent the spread of invasive or non-endemic species from one location to another.
4. The use detergents and other pollutants which may be washed into the marine environment should be avoided or held to a minimum;

Based on my review of the documents provided, and through our personal communications, NOAA Fisheries has determined that the proposed cruises of the NOAA Ship *Okeanos Explorer* would not adversely affect EFH provided adherence to OER proposed procedures and the NMFS guidance made above. Thank you for the opportunity to review the plans for the upcoming field season of the *Okeanos Explorer*, and to provide our comments. This completes your obligation to consult with our office with regards to EFH for this series of actions. If you have any questions or comments feel free to contact me at your convenience.

--
Richard Hall
Fishery Policy Analyst
Pacific Islands Regional Office
NOAA Inouye Regional Center
1845 Wasp Blvd., Building 176
Honolulu, HI 96818
808-725-5018

Appendix C. Endangered Species Act Section 7 Consultation

January 14, 2016

Ann Garrett
Assistant Regional Administrator
Protected Resources Division
NMFS Pacific Islands Regional Office
1845 Wasp Blvd., Building 176
Honolulu, HI 96818

Re: Request to Initiate Consultation under Section 7 of the Endangered Species Act for the Campaign to Address Pacific Monument Science, Technology and Ocean Needs (CAPSTONE Project)

Dear Ms. Garrett:

Operating under a partnership with NOAA's Office of Ocean Exploration and Research and the Office of Marine and Aviation Operations, the *Okeanos Explorer* team is preparing to continue the CAPSTONE campaign into the Central and Western Pacific during the 2016 and 2017 field seasons. The action area for the 2016 – 2017 season will include the marine environments in and around: the 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.

The activity would occur during two years and could include up to twenty different research cruises aboard the NOAA Ship *Okeanos Explorer* scheduled between February 2016 and December 2017. All cruises will focus on collecting critical baseline information in monuments and sanctuaries to meet NOAA science and management needs. The overarching goal of the project is to extend and improve the understanding of the distribution and diversity of deep-water habitats within the marine protected areas in the Pacific. Data and information from the cruises will build on previous work where appropriate, and provide a foundation of publicly-accessible baseline information to improve management and spur further exploration and research. Like previous expeditions in the Gulf of Mexico, western Atlantic, Indonesia, and Hawaii, NOAA

will work with the scientific community and public to characterize unknown and poorly-known areas through telepresence-based exploration. Operations will use the ship's deep water mapping systems, NOAA's 6000m remotely operated vehicles (ROV), CTD rosette, and a high-bandwidth satellite connection for real-time ship to shore communications. These expeditions will help establish a baseline of information in the region to catalyze further exploration, research and management activities.

We propose to conduct activities to explore and improve understanding of the distribution and diversity of deep water habitats. No activities would occur on land. The expedition teams (26 crew and up to 20 rotating scientists/technicians on each cruise leg) would be authorized to conduct mapping and 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.

Enclosed is a Biological Evaluation (BE) to initiate consultation under Section 7(a)(2) of the Endangered Species Act (ESA). As described in the BE, we have determined that the proposed 2016 CAPSTONE cruises may affect, but are not likely to adversely affect, the following ESA-listed marine species: 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.*

We request your concurrence with our 'not likely to adversely affect' determination for the species listed above and for Hawaiian monk seal critical habitat.

Please contact Kelley Elliott (**Kelley.Elliott@noaa.gov**, 301-734-1024) with questions regarding this consultation request.

Respectfully,

For John McDaugh

Appendix D: Endangered Species Act LOC

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

NMFS File No.: PIR-2016-9774
PIRO Reference No.: I-PI-16-1347-AG

Literature Cited

Campaign to Address Pacific Monument Sciecne, Technology and ocean Needs (CAPSTONE) 2016. Request for Informal Consultation. Letter from John McDonough to Ann Garrett dated January 14, 2016 and attachments.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook. Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act.
http://www.nmfs.noaa.gov/pr/pdfs/laws/esa_section7_handbook.pdf

Appendix E: Survey of Opportunity Form: NASA Marine Aerosols Project

SURVEYS OF OPPORTUNITY - INITIAL REQUEST FORM

A surveys of opportunity is a small, exploratory expedition that takes advantage of the elastic schedules of ocean-going, research vessels, - in this case, the Okeanos Explorer - by maximizing transit times between ports or projects, or by filling smalls gaps in the ship's calendar.

Given the ship's unique technology and capabilities, NOAA's Office of Ocean Exploration and Research (OER) invites regional researchers to help acquire additional data within the vessel's operating areas to assess specific but poorly known sites, adding to an inventory of submerged resources. In circumstances where individuals cannot serve on a "survey of opportunity", then OER ensures that acquired data and any other pertinent information are transferred to the appropriate researchers after the expedition. Previously successful surveys of opportunity have included mapping geological features, locating and characterizing shipwrecks, and defining marine protected areas. Some surveys are completed in only a few hours, while others last a couple days.

Although exploration potential and scientific merit plays a role in which opportunistic surveys are conducted, they are not chosen through a peer-reviewed process. Rather, their selection is based more on the vessel operating in the right place with the right equipment at the right time, and the ship's calendar and on-board resources allow for the added work. All requests for a survey of opportunity are archived with OER and the ship, and expire only when the survey work is completed. There is no guarantee that any request for a survey will be accomplished, nor is there any system of prioritization or ranking. Keep in mind that this proposal may be available to the public upon request except for privileged information and material that is personal, proprietary or otherwise exempt from disclosure under law.

Survey or Project Name

Maritime Aerosol Network

Points of Contact (POC)

Lead POC or Principle Investigator (PI & Affiliation)	*Supporting Team Members ashore*

POC: Dr. Alexander Smirnov	*Supporting Team Members aboard (if required)*

Activities Description(s) *(Include goals, objectives and tasks)*

The Maritime Aerosol Network (MAN) component of AERONET provides ship-borne aerosol optical depth measurements from the Microtops II sun photometers. These data provide an alternative to observations from islands as well as establish validation points for satellite and aerosol transport models. Since 2004, these instruments have been deployed periodically on ships of opportunity and research vessels to monitor aerosol properties over the World Oceans.

Appendix F: Biological Evaluation

Note: Sections detailing ROV operations do not apply to this cruise.

Biological Evaluation
Campaign to Address Pacific Monument Science, Technology and Ocean Needs (CAPSTONE Project)

Background

NOAA Ship *Okeanos Explorer*, "America's Ship for Exploration", is the nation's first and only federal vessel with a mandate to systematically explore our mostly unknown ocean for the purpose of discovery and the advancement of knowledge. Operating under a partnership with NOAA's Office of Ocean Exploration and Research and the Office of Marine and Aviation Operations, the CAPSTONE project is a major multi-year foundational science effort focused on deepwater areas of U.S. marine protected areas (MPAs) in the central and western Pacific. The overarching goal of theCAPSTONE project is to extend and improve the understanding of the distribution and diversity of deepwater habitatswithin the MPAs, and collect data and information to support priority monument and sanctuary science and management needs.The effort will also provide critical information relevant to emerging regional issues like deep-sea mining and the potential U.S. Extended Continental Shelf. Data and information from the cruises will provide a foundation of publicly-accessible baseline information to improve management and spur further exploration and research. Like previous expeditions in the Gulf of Mexico, western Atlantic, and Indonesia, NOAA will work with the scientific community and public to characterize unknown and poorly-known areas through telepresence-based exploration. Operations will use the ship's deep water mapping systems, NOAA's 6000m remotely operated vehicles (ROV), underway CTD, CTD rosette, and a high-bandwidth satellite connection for real-time ship to shore communications. These expeditions will help establish a baseline of information in the region to catalyze further exploration, research and management activities.

Action Area

The action area covered by this biological evaluation encompasses the marine environmentsin and around: the 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 and these locations where ESA-listed marine species or their habitats may be impacted by an applicant’s activities.

All mapping and ROV operations are expected to be in waters at depths of 250m and greater (one exception is noted in Appendix A, figure 2), including within the boundaries of PMNM, PRIMNM, MTMNM, NMSAS, RAMNM,and the U.S. EEZ. Transit mapping operations are planned between all areas mentioned, including the high seas.

Proposed Action

The applicant proposes to conduct activities to explore and improve understanding of the distribution and diversity of deep water habitats. The activity would occur during two years and could include up to twenty different research cruises aboard the NOAA Ship *Okeanos Explorer* scheduled between February 2016 – December 2017. No activities would occur on land. The expedition teams (26 crew and up to 20 rotating scientists/technicians on each cruise leg) would be authorized to conduct mapping and 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 measurementsand deploying an ROV.

The overarching goal of the project is to extend and improve the understanding of the distribution and diversity of deepwater habitats within Monuments and protected areas. Data and information from the cruises will build on previous work where appropriate, and provide a foundation of baseline data to improve management and spur further exploration and research. NOAA priorities for the work include a combination of science, education, outreach, and open data objectives that will support management decisions at multiple levels. The effort also serves as an opportunity to highlight the uniqueness and importance of these national symbols of ocean conservation.

The acquisition of high-resolution seafloor mapping data is an essential precursor to making significant biological, geological, archaeological and oceanographic discoveries. The *Okeanos Explorer* cruises will collect seafloor mapping data, supplementing previous work where possible. These maps form the basis for selecting ROV dive targets. ROV cruises would take the next major step in baseline habitat characterization by using the ROV system to visually investigate unknown and little known deep water habitats within and around monument waters identified as priority by scientists and managers. CTD casts may be conducted two ways: 1) with the underway CTD to gather

conductivity/temperature/depth measurements or sound velocity measurements to calibrate sonar data, and 2) using a CTD rosette to collect additional information about the physical and chemical properties of the water column, including at sites of interest identified from mapping and ROV investigation.

The information and data generated by this project will directly contribute to a better understanding of the deep water habitats, ecosystems and geologic history of the Hawaiian Islands, the PRIMNM, the CNMI and MTMNM, the RAMNM, the vicinity of American Samoa and NMSAS, the Geologists Seamounts, and the Musicians seamounts by providing basic information about the rich and unique biological resources and habitats of these regions. It is this understanding that provides continuous support for the monuments and theirprotection of these resources.The collective understanding established from these expeditions will increase understanding of deep-sea biogeographic patterns across the Central and Western Pacific.

MAPPING

NOAA Ship *Okeanos Explorer* has a suite of scientific sonars, each with a unique exploration application. All of these systems are routinely used by the ocean science community and have provided invaluable scientific data for oceanographers, marine researchers and managers, including numerous National Marine Sanctuaries, the Bureau of Ocean Energy Management and the U.S. Geological Survey. Each sonar's acoustic signal is designed to be narrowly focused to provide precise information about a specific, narrowly defined area of the seafloor or water column beneath the ship.The sonars include a Kongsberg EM302 30 kHz multibeam system; 18 kHz, 38 kHz, 70 kHz, 120 kHz, 200 kHz, and 333 kHzSimrad EK60split-beam fisheries sonars (the 333 kHz will likely not be operational since we don’t currently have the hardware general purpose transceiver to run it, but is included just in case);aKnudsen 3.5 kHz chirp sub-bottom profiler sonar; and 300 kHz and 38 kHz Teledyne Acoustic Doppler Current Profilers (ADCPs). The multibeam maps 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 of these sonars may not be able to be run concurrently with the multibeam due to inter-sonar acoustic interference – particularly the 38 kHz EK60 which is close to the 30 kHz central operating frequency of the multibeam. To address potential interference these new sonars may be synced to ping at different times than the multibeam, or may be run by themselves without the multibeam pinging.

Mapping activities would occur continuously throughout the day and night except when the ROV is deployed. If cetacean species are present 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. 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. Whenever possible, marine mammals are identified by Bridge Officers or Watch Standers, and these observations are noted in the NOAA fleet marine mammal observation log as part of standard practice. During the 2016-2017 field seasons, these procedures will include monitoring for the presence of sea turtles and, when appropriate, taking protection measures.

Multibeam:

Multibeam sonar mapping will be conducted with a Kongsberg EM 302 (30 kHz) sonar in areas within and in the vicinity of thePMNM, the PRIMNM, the CNMI and MTMNM, the RAMNM, the vicinity of American Samoa and NMSAS, offshore of Hawai'i, Oahu and the Geologists Seamounts, and the Musicians Seamounts where gaps are present in the existing coverage, or the existing data is poor quality. Multibeam mapping will also take place during the transits to and from sites where other operations will be conducted, and are planned to continue to build upon previous mapping surveys as much as feasible. Multibeam sonar data will produce high-resolution bathymetry and acoustic backscatter maps. These maps will provide critical baseline information to scientists and resource managers interested in identifying and expanding our understanding of the geology and important biological habitats and ecological connections in the monuments and sanctuaries. Additionally, the data collected will help scientists better understand the size and character of seafloor habitats in the area, allowing for improved targeting of future exploration and research, including the selection of sites for further investigation with a ROV.

UnderwayCTD:

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. These sound speed measurements are essential for ray-tracing calculations used by the EM302 multibeam sonar system in order to collect accurate bathymetry and backscatter data. To obtainthese essential data, the *Okeanos Explorer*can either use an XBT or the new underwayCTD (UCTD) equipped

with a sound velocity probe. The *Okeanos Explorer* proposes to use the UCTD during the 2016-17 field seasonsas much as possible as rather than conducting XBTs, since UCTD does not leave anything in the ocean after gathering the measurements.

The UCTD (http://www.oceanscience.com/Products/UnderwayCTD/Underway-CTD.aspx) manufactured by Teledyne Oceanscience is a piece of equipment used to gather conductivity/temperature/depth (CTD) measurements or sound velocity measurements while the ship is moving. A brochure from the manufacturer with pictures and specifications is included as appendix B. This instrument is mounted on the stern railing and has a re-usable probe that is dropped through the water column then retrieved by rewinding the line onto a motorized spool. The unit would not touch the seafloor. The unit can be equipped with a CTD probe or a sound velocity probe. When equipped with the sound velocity probe, the UCTD can obtain water column profiles down to over 700 meters while the ship is moving at 8 knots. 8 knots is the ship's normal ocean mapping survey speed, so the UCTD can sample the water column while continuously mapping. The ship currently obtains sound velocity profiles using expendable probes (XBTs). XBTs are expensive consumable supplies and leave behind plastic and copper waste in the ocean due to the one-time use of each probe. OER has installed the UCTD in order to minimize the use of XBTs while still gathering essential sound velocity profile data needed every 3-6 hours while mapping in order to accurately collect high quality multibeam sonar data.

Expendable Bathythermographs (XBT):
XBTs are deployed to obtain sound velocity profiles. The profiles are required to calibrate the multi-beam system and ensure accurate bathymetric mapping. The XBT type is the Deep Blue probe produced by Lockheed Martin Sippican. A single Deep Blue XBT is 8.5 in. length x 2 in. width and weighs 2.53 lbs. It consists of a plastic spool, hair thin copper wire (< 1mm width), zinc weight, thermistor (comprised of two short wires (< 8.5 in. length)) and is contained in a clear plastic housing. The Deep Blue XBT contains no chemical solutions. During *Okeanos*24-hour mapping cruises, XBTs or UCTD casts will likely need to be completed once every 4-6 hours to ensure accurate bathymetric data collection (resulting in a maximum of 4-6 total XBT deployments in a 24-hour period). During *Okeanos* cruises that conduct daytime ROV dives and evening/nighttime mapping operations, XBTs will likely be deployed once every 4-6 hours to ensure accurate bathymetric data collection (resulting in a maximum of 2-3 total XBT deployments in a 24-hour period). It is anticipated that UCTD casts will be the preferred and more commonly used method to obtain sound velocity profile data, however XBTs will likely be used when time to obtain the cast data is very limited (e.g. weather windows, vessel traffic, or ship-time constraints) or there is a mechanical or data quality problem with the UCTD.

The very fine wire connecting the XBT probe to the ship is extremely easy to break by hand. The minimal tensile strength of the wire should represent a minimal entanglement risk for species of concern. The potential for XBT deployments to impact ESA-listed species was the topic of an informal consultation request from the PMNM to NMFS during PMNM permit review for the *Falkor* expeditions. The determination was that the *Falkor's* use of XBTs may affect, but is not likely to adversely affect, Hawaiian monk seals, green sea turtles, hawksbill sea turtles, leatherback sea turtles, olive ridley sea turtles, North Pacific loggerhead sea turtles, MHI Insular false killer whales, humpback whales, sperm whales, fin whales, blue whales, sei whales, and North Pacific right whales. We expect the same determination would be made with respect to the deployment of XBTs by the Okeanos Explorer.

Single Beam and Split Beam Sonars:
Kongsberg EK60 sonars are specifically designed to provide *calibrated* quantitative acoustic data useful for interpreting marine life in the water column of the ocean. Additionally, they are now also used to generate gaseous seep flux rates and their contribution to ocean and atmospheric chemistry.In many cases the ability to observe and measure the acoustic backscatter response of different types of marine life (fish, squid, plankton, etc.) is dependent upon the frequency of the sonar. Therefore, the more frequencies that are used for these acoustic surveys, the more complete the picture that can be gained about the marine environment. Recent research results demonstrate that the simultaneous use of multiple echo sounder transducer frequencies is useful for improving estimates of fish stocks, aiding in the discrimination of biological scattering layers or different species (Stanton *et al*., 2012), and mapping the location, density, and relative size of fish aggregations relative to benthic habitatfeatures (Costa *et al*., 2014). OER has received specific feedback from marine scientists in the Pacific region that our EK60 data would be much more useful when collected using multiple frequencies than at just the 18 kHz frequency. Given these benefits, OER intends to gather EK60 data at multiple frequencies as much as possible. The NOAA vessel *Oscar Elton Sette* has 38 kHz, 70 kHz, 120 kHz, and 200 kHz EK60 sonars onboard that are commonly used during scientific expeditions within PMNM. Additional information about EK60 sonars can be found
here: http://www.simrad.com/www/01/nokbg0240.nsf/AllWeb/A25148D8E9F00D0DC12570DE0050A7CB?OpenDocument

The new additional EK60 sonars are all higher frequency than the existing 18 kHz EK60 unit, and thus all have considerably shorter ranges due to the more rapid attenuation of higher-frequency sounds in the ocean. Since the source levels sounders are less than the existing echo sounders, they should not be expected to pose any additional risk to ESA-listed species.

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 subbottomprofiler 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. Collecting this data within the project areas will provide greatly improved insights into the geology of the region, and supplement existing magnetometer and gravity measurements obtained by other vessels.

Acoustic Doppler Current Profilers (ADCPs)
Ship-mounted ADCPs have been used on oceanographic research vessels for over 25 years, and are useful for characterizing current speeds and direction at various depths in the ocean. ADCP measurements are therefore critically useful in characterizing the physical oceanography of an area, identifying small to mesoscale ocean current features, and even contributing to our understanding of the climatology of a region with repeated measurements over time (Firing and Hummon, 2010). In addition to these scientific benefits, the *Okeanos Explorer* is interested in using the new ADCPs to assess currents near ROV dive locations to inform dive planning and ensure safe ROV deployment and recovery operations. Given these benefits, OER would like to use two newly installed ADCPs as a useful data stream contributing to characterizingmarine protected areas, providing new information on ocean currents to scientists and managers, and helping to plan effective and safe ROV exploration dives.

Hull-mounted ADCP transducers project four beams into the water column to record backscatter from the water column and compare the Doppler shift between the 4 beams to generate profiles of water velocity. The *Okeanos Explorer* will be equipped with two new ADCPs: a Teledyne RDI Workhorse Mariner (300 kHz) and an Ocean Surveyor (38 kHz). Technical specifications and descriptions of these instruments are provided in appendix Cproduced by the manufacturer. ADCPs are Doppler sonar systems, which transmit acoustic signals and listen to the echoes of those signals returned from materials floating with the currents throughout the water column. By processing this information, ADCPs provide information about current velocity and direction at various depths through a water column profile. Like other sonars, the depth range of ADCPs is directly related to the frequency of the system – the lower the frequency the greater the range capability of the sonar. However, lower frequencies provide less vertical resolution than higher frequencies. The 300 kHz ADCP has a typical range of approximately 110 meters and a maximum range of 165 meters, while the 38 kHz system has a range between 900-1000 meters depending on operating mode and oceanographic conditions. These same two ADCP systems are

also installed and utilized on the R/V *Kilo Moana* operated by the University of Hawaii Marine Center.

The 300 kHz ADCP is unlikely to interfere with other sonars on *Okeanos Explorer* since its frequency is much higher than the ship's multibeam, sub-bottom profiler, and EK60 sonars. If testing in early 2016 confirms this to be the case, it will probably be run nearly continuously while the ship is underway in order to gather data on currents that can be utilized by oceanographers to refine climatology and ocean current models.

There is a very high likelihood that the 38 kHz ADCP could interfere with the ship's multibeam and/or new 38 kHz EK60 sonar. If interference occurs, it may be possible to correct the problem by syncing the pings in such a way so as to minimize data degradation. If syncing efforts do not minimize interference, the multibeam sonar data will be given higher priority and the 38 kHz ADCP may only be run sporadically in key areas of interest around distinct features (e.g. seamounts, canyon headwalls) or just prior to deployment of the ship's ROVs. Since these issues will need to be figured out in early 2016, we cannot provide further details on how/when we might turn on this sonar. For evaluation purposes it is therefore reasonable to be conservative and assume that it is possible the *Okeanos Explorer* may wish to run the 38 kHz ADCP at all times while conducting its science missions.

The two new ADCPs are designed to gather data out to a maximum depth of 165 m (300 kHz) and 1000 m (38 kHz), so the associated sound source levels will be much less than the ship's existing permitted deep water (8000m and greater) echo sounders (EM320 multibeam, EK60 18 kHz, and Knudsen sub-bottom profiler). The new ADCP sonars are all higher frequency than the existing *Okeanos* sonars, and thus all have considerably shorter ranges due to the more rapid attenuation of higher-frequency sounds in the ocean. Since the source levels and range are less than the existing echo sounders, they should not be expected to pose any additional risk to ESA-listed species.

ROV OPERATIONS:

The purpose of conducting ROV operations is to conduct interdisciplinary site characterization at priority targets in and around monuments, sanctuaries and protected areas. Interdisciplinary site characterization would be achieved by visually surveying priority targets while simultaneously acquiring environmental data with in situ sensors mounted on the ROVs (CTD and DO). ROV targets include seamounts, ridges,drowned reef terraces, guyots (i.e., flat topped tablemounts), submarine canyons, hydrothermal vent sites, mud volcanoes, submerged cultural heritage sites, and other types of topography where deep water coral and sponge communities are likely to occur. The combined dives will enable scientists and managers to have a better understanding of the diversity and distribution of deep water habitats in the monuments, and should contribute

to enhanced protection of these resources. The ROVs 6000m depth capability puts areas of the monuments within reach that have never been seen before.

The *Okeanos Explorer* is equipped with OER's dedicated, fully integrated, two-body ROV system. The first body of the system is the ROV Deep Discoverer (D2), a 10.4ft long x 6.4ft wide x 8.5ft high vehicle weighing approximately 9150 lbs (in air), and capable of diving to 6000 meters. D2's primary data set is high definition video collected by two HD cameras. In addition to the HD video cameras, D2 carries a CTD with dissolved oxygen sensors. The second body of the system is the camera platform Seirios, an 11.5ft long x 3.67ft wide x 4.05ft high vehicle that weighs 2925 lbs and provides additional lighting and an "aerial" view of D2 while she investigates the seafloor. Like D2, Seirios carries two HD cameras, a Sea Bird 9/11+ CTD with DO2 sensors. During operation, the two vehicles are connected to each other by a "soft" electro-optical tether 30 meters in length. Seirios is also attached to the ship by an 8,200-meter armored fiber-optic cable that provides power and telemetry to the vehicles. ROV operations are conducted primarily during daylight hours while the vessel would be stopped and holding station using dynamic positioning.

ROV operations will typically take place within several meters of the seafloor, and are conducted in a way to minimize seafloor disturbances. On occasion, the ROV is set down on the seafloor in order to acquire very close imagery of habitats or features of interest. Common procedure includes visually scanning the seafloor to ensure the area the ROV is set on does not include corals or other animals, however some animals may reside beneath the sediment or may be too small to see. The ROV also has a temperature probe that may be shallowly inserted into the seafloor sediment to measure the depth or temperature of features of interest. Finally, though we try to prevent any unnecessary seafloor disturbance, it is likely that at some point the ROV will inadvertently touch some benthic fauna (e.g., sea whip) or that water moving through the ROV thrusters will stir up small amounts of seafloor sediment. Any disturbance would likely be similar to that seen during normal near bottom SCUBA dives.

As many as 200 deployments of the ROV may occur during the 2016-17 CAPSTONE project, resulting in 1600 hours total dive time (~8 hours for each dive). Currently 4 deployments of the ROV are planned offshore of Oahu or Hawai'i, 20 in PMNM, 19 at the Musicians seamounts, 69 in and around the PRIMNM (15 atJohnston, 18atWake, 12 atJarvis, and 18 atHowland Baker and the Phoenix Islands), 46 in and around the CNMI and MTMNM, and 10 in the Vicinity of American Samoa (including NMSAS and RAMNM).

ROV Sampling:

Sampling operations will be conducted during ROV cruises to collect very selective specimen collections with the ROV that have the potential to contribute significant scientific discoveries. Biological specimen collections will focus on, but are not limited to, corals and sponges (and their incidentally collected commensals). Only biological specimens suspected of being new species or new records for the area will be targeted. When possible, only a subsample will be taken of biological specimens (e.g., only a piece or branch of corals and sponges will be collected, not the entire organism). Selective rock specimens that have the potential to contribute significant scientific discoveries as outlined in the expedition goals will also be targeted. These are expected to include rocks from seamounts and manganese-coated rocks. When possible, rock samples will be selected in a way to minimize the amount of attached organisms.

Ultra Short Base Line Acoustic Navigation (USBL):
The Tracklink TL10000MA system is used to track and record the position of the ROVs during the course of a dive. It functions by the transmission of an acoustic pulse from the surface ship, which travels through the water column and triggers a responding acoustic pulse from the ROV. The measurement of the travel time and direction of arrival of the responding acoustic pulse from the ROV enables calculation of the position of the submerged ROV with respect to the surface ship. Integration of this relative position information with the surface ship position as determined by GPS allows the calculation of the position of the ROV on the seafloor. In this way, observations made by the ROV can be geo-referenced to standard latitude, longitude and depth coordinates. The USBL is used during ROV operations, which are conducted daily and primarily during daylight hours while the ship holds station using dynamic positioning. Although such frequencies are within the hearing range of marine mammals, the USBL navigation system is commonly used by researchers and has no known adverse impact on marine life.

The Tracklink operates at frequencies from 7.5 kHz to 12.5 kHz. Acoustic emissions by the USBL system occur at the surface from the hull of the ship, and at both of the ROVs as they travel through the water column and at the seafloor. The repetition rate of emissions is typically no faster than once every 2 seconds, increasing by 1.33 seconds for every 1000 meters of depth of the ROVs. The character of these emissions is detailed below:

Surface transceiver, *Okeanos Explorer*:
Tracklink model TL10000MA
Frequency of operation: 7.5 kHz - 12.5 kHz Spread Spectrum
Beam width: 120º directed at nadir
Peak electrical power: 100 W
Peak acoustic power: 187db relative to 1 micro Pascal at 1 meter.

ROV transponder, Seirios:
Tracklink model TL10010C
Frequency of operation: 7.5 kHz - 12.5 kHz Spread Spectrum
Beam width: 210º directed at zenith
Peak electrical power: 200 W
Peak acoustic power: 190db relative to 1 micro Pascal at 1 meter.

ROV transponder, Deep Discoverer:
Tracklink model TL10015C
Frequency of operation: 7.5 kHz - 12.5 kHz Spread Spectrum
Beam width: 30º directed at zenith
Peak electrical power: 500 W
Peak acoustic power: 200db relative to 1 micro Pascal at 1 meter.

CTD OPERATIONS:
NOAA Ship *Okeanos Explorer* is outfitted with both an underway CTD (addressed in the Mapping section) and a CTD rosette instrument. The CTD rosette instrument is used to obtain conductivity, temperature, depth and other oceanographic data (dissolved oxygen, light scattering, and oxygen reduction potential). The instrument is attached to an open cylindrical steel frame approximately 1.15 m in diameter and 1.4 m high with a 24-position rosette carousel containing 24 2.5 L niskin bottles for collecting water samples. The system would be lowered to a maximum depth of 6800 m by an embedded scientific winch and wire while the vessel would be stopped and hold station using dynamic positioning. The average time to conduct a CTD casts varies from one to several hours depending on water depth (the CTD is lowered through the water column at 60m/min). CTD casts would be conducted at selected sites including locations where ROV dives are conducted to allow for an improved understanding of the environmental conditions by measuring the physical or chemical properties of the water column overlying or hosting a particular habitat. The CTD would not touch the seafloor.

Analysis of Effects
Our analysis considers potential impacts or stressors to identified marine resources within the PMNM; the marine environment around Oahu, the big island of Hawai'i, and the area south and west of Molokai, Lana'i, and Kaho'olawe; the Geologists and Musicians Seamounts; all of the Pacific Remote Island Areas composing the PRIMNM; the CNMI and the MTMNM; the vicinity of American Samoa and the NMSAS; the RAMNM; and the vessel transit areas between Honolulu, Hawai'i, Guam, Saipan, Kwajalein and Pago Pago on green sea turtles (*Cheloniamydas*), hawksbill sea turtles (*Eretmochelysimbricata*), North Pacific distinct population segment of loggerhead sea

turtles (*Carettacaretta*), olive ridley sea turtles (*Lepidochelysolivacea*), leatherback sea turtles (*Dermochelyscoriacea*), Main Hawaiian Islands false killer whale distinct population segment (*Pseudorcacrassidens*), humpback whales (*Megapteranovaeangliae*), sperm whales (*Physetermacrocephalus*), fin whales (*Balaenopteraphysalus*), blue whales (*Balaenopteramusculus*), sei whales (*Balaenoptera borealis*), North Pacific right whales (*Eubalaena japonica)*, the Indo-West Pacific distinct population segments of the scalloped hammerhead shark (*Sphrynalewini*), Hawaiian monk seals (*Neomonachusschauinslandi*), Hawaiian monk seal critical habitat;andthe coral species*Acropora globiceps, A. jacquelineae, A. retusa, A. speciosa, Euphyllia paradivisa, Isopora crateriformis,* and *Seriatopora aculeata*. We believe that the most likely potential impacts or stressors are:

1. Exposure to elevated noise levels;
2. Temporary disturbance from human activity;
3. Entanglement;
4. Collisions with vessels; and
5. Exposure to waste and discharge.

1. Exposure to elevated noise levels

As described earlier, the proposed action would include the operation of NOAA *Ship Okeanos Explorer's* mapping sonar systems, as well as the underwater positioning systems associated with the ROVs Deep Discoverer and Seirios.

The effects on marine life from exposure to high intensity noise vary with the frequency, intensity, and duration of the sound source, and the physiology and hearing characteristics of the exposed animal. Exposure to very high levels of sound can cause soft tissue injuries that could directly result in fatality. Exposure to lower levels at frequencies within the animal's range of hearing may cause injury in the form of permanent hearing damage, also referred to as permanent threshold shift (PTS). Exposure to even lower levels may cause behavioral effects that include temporary threshold shifts (TTS), temporarily masked communications and/or acoustic environmental cues, alteration of ongoing behaviors, and areal avoidance. *Okeanos Explorer* sonars will be turned on for the entirety of each cruise and will only be turned off during ROV dives or CTD rosette casts. We will minimize turning the system on and off as a precautionary measure to avoid possible startling of animals. When the sonars are powered down for ROV and CTD operations, the flexible "soft start" mode will be used to restart the multibeam first. 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 soft start modes can either be set at -10 or -20 decibels with a 0 to 15 minute ramp up time to the desired power. We can select -10 dB, -20 dB or maximum transmit power. Maximum transmit power is

recommended by Kongsberg for maximizing the mapping swath coverage. In the deepest operating mode the EM302 is 243 dB re 1 microPa. When operating in shallow modes the decibels are 238 dB re 1 microPa. Because the EK60, SBP, and ADCP sonars are of lower intensity than the multibeam, and are 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.

We therefore do not believe the*Okeanos Explorer* mapping activities will have any significant adverse effects on ESA-listed species in the monuments, sanctuaries and the waters around the American Samoa and the Main Hawaiian Islands. Similar opinions regarding the safety of multibeam mapping activities have been expressed by the NMFS Southwest Fisheries Science Center in their draft programmatic environmental assessment. Even so and in order to mitigate impacts to marine mammals, observers on the *Okeanos Explorer's* bridge will carefully monitor for the presence of marine protected species, and permitted personnel would follow established best management practices to minimize disturbance. If cetaceans are present within 400 meters of the ship, the vessel would stop until the animals depart the area. We will try to minimize turning sonar systems on and off to reduce the possibility of startle responses by marine mammals that could be in the vicinity of the ship, particularly at night. Leaving them on also provides marine mammals advanced warning that the ship is in the vicinity, further reducing the possibility of a collision. When the systems have been shut down for any reason, such as during an ROV dive or CTD cast, the multibeam soft start mode – a delay function, starting sonar transmissions at a low output level and gradually increasing - would be used to minimize any impact on cetaceans. Only after the multibeam has been brought from soft start to full power would the SBP sonar then be turned back on.

NMFS Shift Thresholds

The current NMFS-defined threshold for the onset of PTS in cetaceans from exposure to in-water sounds is ≥ 180 dB re 1 µPa. The same threshold for pinnipeds is ≥ 190 dB re 1 µPa. Exposure to impulsive in-water sounds at ≥ 160 dB re 1 µPa is the threshold for the onset of TTS and behavioral disturbance for all marine mammals, whereas the same threshold for exposure to non-impulsive sound (continuous noise) is ≥ 120 dB re 1 µPa. Because the sonar systems to be used in this action are considered impulsive sources, the 160 dB re 1 µPa threshold for the onset of TTS and behavioral disturbance would apply, and significant exposure above that level at a frequency within the animal's hearing range would be considered an adverse impact.

Acoustic Modeling

Accurately predicting the 160 dB re 1 µPa isopleth from any sound source is difficult, but particularly so for multibeam sonar. Using the simplest example, that of an unfocused, omni-directional single point source in unbounded homogenous water, sound will disperse from the source in a spherical pattern. In this example, the equation RL = SL – (20LogR + αR) estimates spherical spreading loss where RL = received level; SL = source level; R = range in meters, and α is the absorption coefficient in water at 1 m as a function of frequency (Lurton &DeRuiter 2011). In addition to source level and frequency, the distance for which different decibel levels are experienced away from the source is also dependent on a number of other factors that include density, salinity, and the amount of suspended solids in the water. Detailed information on these naturally occurring factors in the marine environment is rarely available and consequently they are generally not considered in the equations.

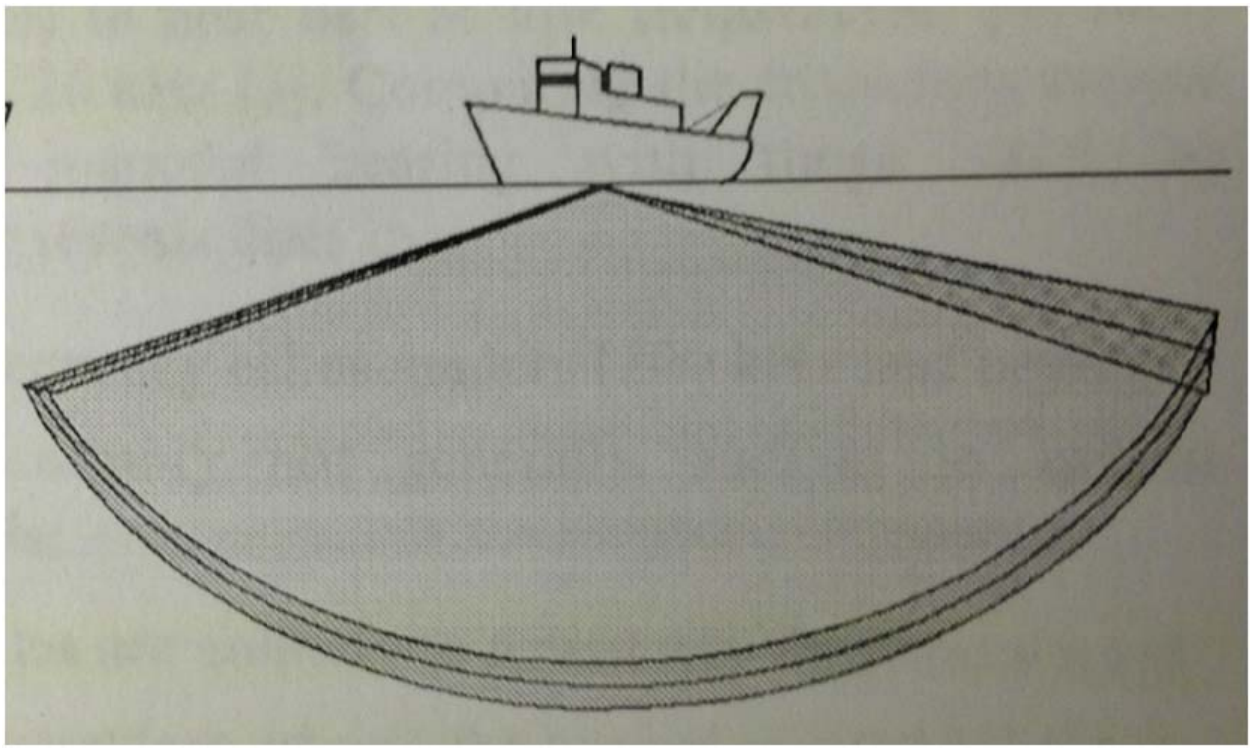
Assuming for the moment that the EM 302 system is a simple omni-directional point source, then the 180 dB and 160 dB re 1 microPa isopleths would fall at approximately 1,000 m and 2,800 m, respectively, based on a α value of 6 dB/km (@30 kHz) as computed from representative CTD casts of local oceanographic conditions in the vicinity of the monuments.

Acoustic Modeling - Generic Multibeam

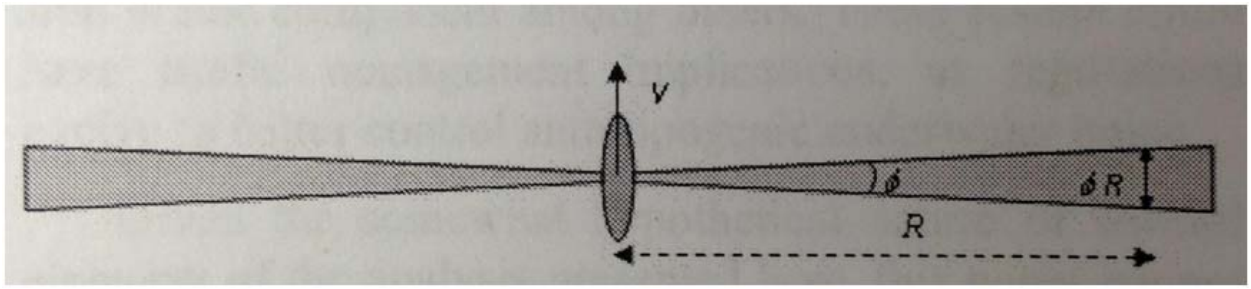
However, multibeam systems are not simple omni-directional point sources but rather are focused sonar arrays that use "selective angular directivity" and furthermore transmit "very short pulses at limited ping rates" (Lurton &DeRuiter 2011). These two characteristics of this type of sonar decrease the potential sound exposure level as well as decrease the probability of the animals being subjected to TTS threshold intensity levels. Figure 1 provides diagrams excerpted from Lurton &DeRuiter (2011) showing the generalized ensonification volume of a generic multibeam sonar system from both horizontal (Fig 1a) and overhead (Fig. 1b) perspectives. Fig 1b also provides the variables used to estimate the exposure time of a stationary animal as the ship passes on its survey track. The exposure time can be estimated by ØR/V where Ø is the longitudinal transmitting lobe aperture in radians, R is the range from the source to the animal, and V is the speed of the ship.

The aperture of the EM 302 on the Okeanos is 0.5° but since it would operate in dual swath mode in shallower water it will be conservatively treated as 1° (same as the Falkor), yielding a Ø value of 0.02 radians. The ship will be mapping at 8 knots (4.116 m/s). At 200m distance, the exposure times for a stationary animal caught in the ensonification plane of the EM 302 are therefore calculated to be 1 second. This exposure

time increases linearly with R so that at 1000 m distance, the exposure time increases to 5 seconds.



1a)



1b)

Figure 1: Diagrams showing a typical multibeamensonification volume from a) the horizontal and b) the overhead prospective (From Lurton &DeRuiter 2011).

Acoustic Modeling - Okeanos Explorer EM 302 Multibeam

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 in Appendix D(Case Study: Okeanos Explorer - EM 302 - Hawaii). 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 PMNM, the PRIMNM, the Main Hawaiian Islands and the Geologists Seamounts.

Figure 1c (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.

Figure 1d (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.

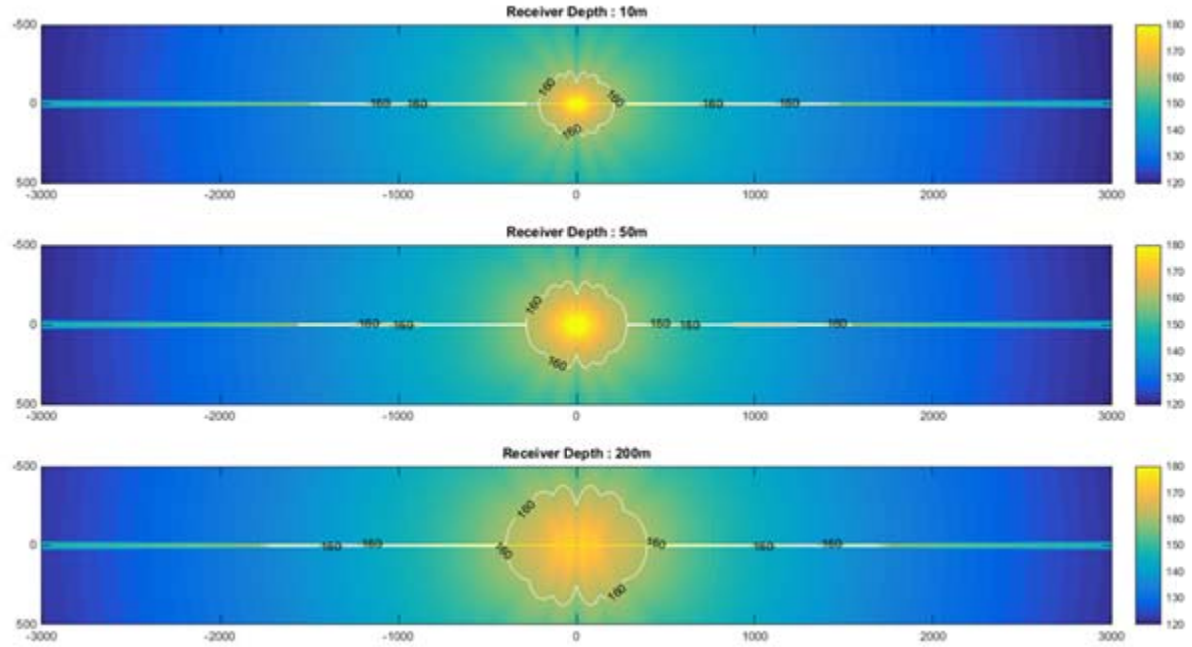


Fig. 1c: Top down view image of the EM302 radiated beam pattern at several depths (10m, 50m and 200m created by Dr. Xavier Lurton (IFREMER). The ship track is straight up, the Y axis is distance in meters while the X axis in distance in meters. The color scale is signal strength in decibels (dB).

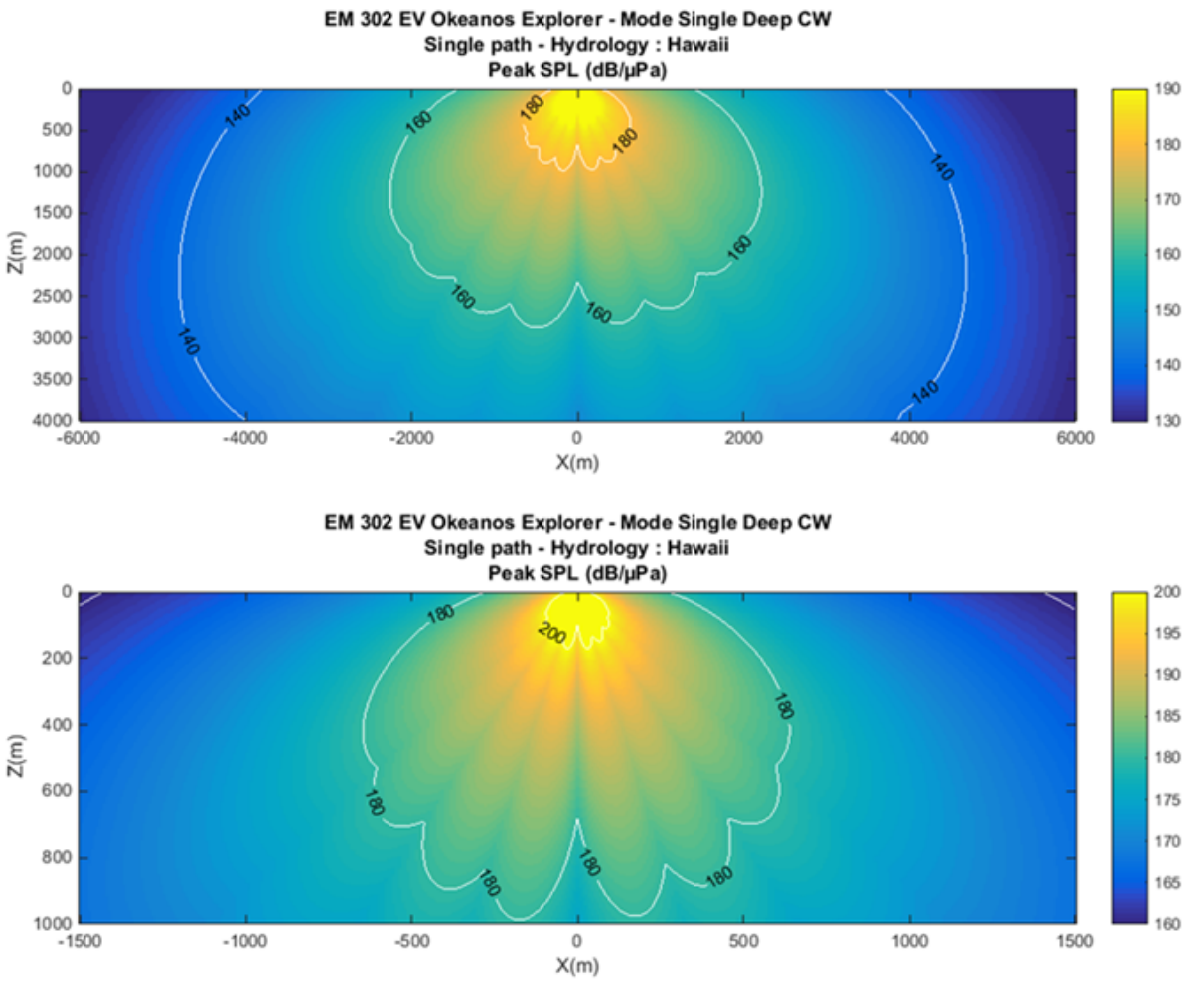


Fig. 1d: Model created by Xavier Lurton (IFREMER) of the EM302 radiated transmission patterns with the 140, 160 and 180 dB/µPa isopleths plotted for the full water column (top) and of the near surface region (bottom) of a single ping, looking forward through the water column in the along track direction. 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).

Additional Considerations Specific to EM 302 Multibeam

Transmit pulse forms and rates are 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.

Another consideration is the hearing range of the various species covered under the ESA. As mentioned earlier, the EM 302 system operates at 30 kHz. Figure 1e provides a general diagram of the hearing ranges of the various groups of marine mammals that was originally presented as Fig 4.2-3 of the Southwest Fisheries Science Center's Draft Programmatic Environmental Assessment released in April, 2013. The frequency range of the EM 302 system was superimposed on the bars. The first observation from this figure is that the system is not expected to produce sound audible to the low frequency cetacean group (baleen whales or Mysticetes) whose hearing range is believed to be below 30 kHz.

The second observation is that the system is also transmitting at the upper portion of the pinniped hearing range. Together, these observations suggest that toothed whales are likely to be the ESA group potentially most affected by the mapping activities. Within the project area, the sperm whale and the false killer whale are the only species of toothed whales that are ESA listed. Observers will therefore pay particular attention to spotting and avoiding these two species.

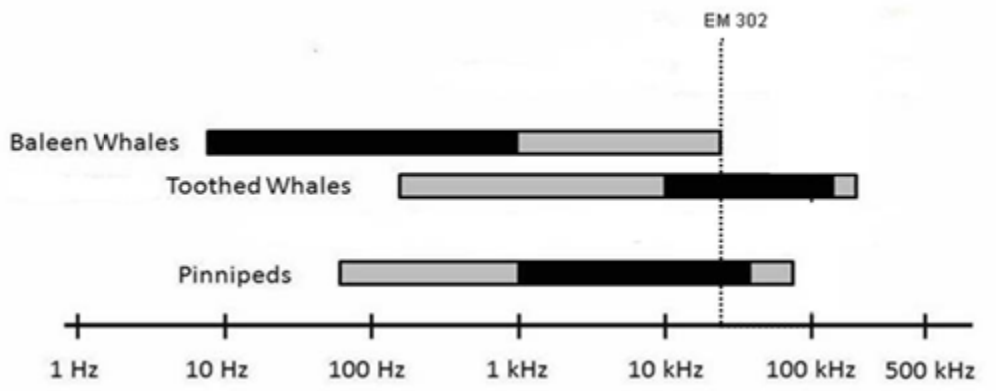


Fig. 1e: Hearing ranges of ESA-listed marine mammals groups in Hawaiian waters. Black bars show the most sensitive portion of these ranges. This figure was modified

from Figure 4.2-3 of NOAA's Southwest Fishery Science Center draft Programmatic EA (see text for more details).

On December 23, 2013, NOAA released for public comment it's new "Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals: Acoustic Threshold Levels for Onset of Permanent and Temporary Threshold Shifts". The second revision of the document, dated July 23, 2015, is available at http://www.nmfs.noaa.gov/pr/acoustics/draft%20acoustic%20guidance%20July%202015.pdf (last accessed 1/13/16).The document is in review and should be finalized in early 2016. Included are updated acoustic threshold levels for the onset of both PTS and TTS that "will replace those currently in use by NOAA." The updates include PTS and TTS levels for both impulsive and non-impulsive sound sources for 5 marine mammal functional hearing groups that include low, mid, and high-frequency cetaceans, phociid pinnipeds, and otariid pinnipeds. In addition, the updates include the addition of a second new metric for assessing acoustic activities: PTS and TTS cumulative sound exposure level (SELcum) thresholds. These thresholds are calculated with and without marine mammal auditory weighting functions. Since SELcum is not as yet being used for ESA recommendations, we only examined what the new sound intensity thresholds will be, now calculated as dB peak values instead of dB rms values. Tables 6a and 7 in that guidance document provide these threshold values. TTS peak decibel levels range from 195 dB re 1 microPa for high frequency cetaceans, 224 dB re 1 microPa for low frequency cetaceans, and 229 dB re 1 microPa for both families of pinnipeds. While dBpeak (maximum value) is calculated differently than dBrms, the rule of thumb is that the latter are generally 3 dB less than the former (Tom Weber, personal communication and see Fig 1f below). These new TTS thresholds are based on the most current science available and suggest that the Okeanos Explorer multibeam system will not exceed these levels for any of the functional groups if they are further than 100 m from the ship at the surface and 300 m from the ship if diving directly below the transducer.

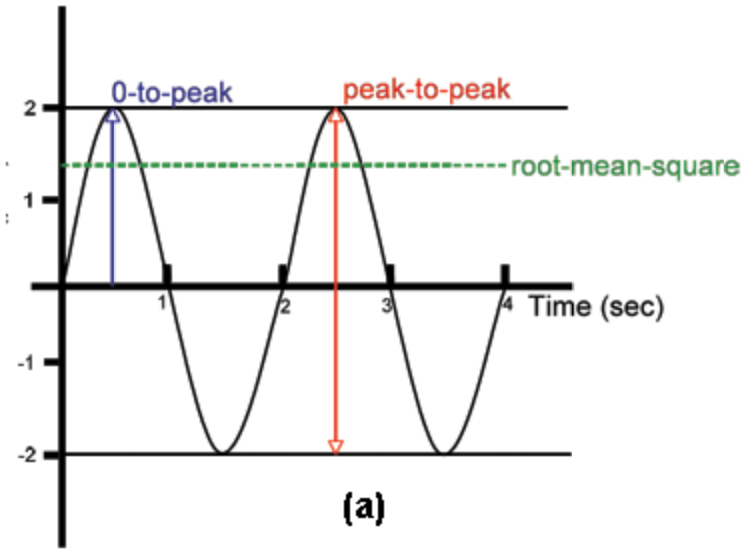


Fig. 1f: Relationship between RMS and Peak dB measurements (from http://www.http://acousticslab.org).

Acoustic Doppler Current Profilers (ADCPs)

Hull-mounted ADCP transducers project four beams into the water column to record backscatter from the water column and compare the Doppler shift between the 4 beams to generate profiles of water velocity. ADCPs are Doppler sonar systems, which transmit acoustic signals and listen to the echoes of those signals returned from materials floating with the currents throughout the water column. Like other sonars, the depth range of ADCPs is directly related to the frequency of the system – the lower the frequency the greater the range capability of the sonar. However, lower frequencies provide less vertical resolution than higher frequencies. The *Okeanos Explorer* is outfitted with two new ADCPs – one high frequency (Teledyne RDI Workhorse Mariner 300 kHz) system, and one lower frequency system (Teledyne RDI Ocean Surveyor 38 kHz). The 300 kHz ADCP has a typical range of approximately 110 meters and a maximum range of 165 meters, while the 38 kHz system has a range between 900-1000 meters depending on operating mode and oceanographic conditions. These same two ADCP systems are also installed and utilized on the R/V *Kilo Moana* operated by the University of Hawaii Marine Center.

The two new ADCPs are designed to gather data out to a maximum depth of 165 m (300 kHz) and 1000 m (38 kHz), so the associated sound source levels will be much less than the ship's existing permitted deep water (8000m and greater) echo sounders (EM320 multibeam, EK60 18 kHz, and Knudsen sub-bottom profiler). The new ADCP sonars are all higher frequency than the existing *Okeanos* sonars, and thus all have considerably shorter ranges due to the more rapid attenuation of higher-frequency sounds in the ocean.

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. The following relevant information has been quoted from this memo:

38 kHz ADCP:
"The acoustic pressure along each beam is estimated at 227 dB re micro-Pascal @ 1 meter, at a center frequency of 38.4kHz with a +/-3dB bandwidth of 37.2-39.6kHz, with a typical pulse duration of 37.0milliseconds, and a typical pulse repetition rate of 3.0 seconds. The acoustic pressure along each beam is estimated at 180.0dB re micro-Pascal @ 182 meters.The acoustic pressure 20 degrees off of the main lobe of each beam is estimated at 180.0dB re micro-Pascal @ 22 meters."

300 kHz ADCP:
"The acoustic pressure along each beam is estimated at 215 dB re micro-Pascal @ 1 meter, at a center frequency of 307.2kHz with a +/-3dB bandwidth of 268.8-345.6kHz, with a typical pulse duration of 5.7milliseconds, and a typical pulse repetition rate of 0.75 seconds. The acoustic pressure along each beam is estimated at 180.0dB re micro-Pascal @ 40 meters.The acoustic pressure 20 degrees off of the main lobe of each beam is estimated at 180.0dB re micro-Pascal @1.8 meters."

To put these values in perspective, the EM302 multibeam system has a source level of 243 dB re 1µPa, and the 180 dB/µPa isopleth is located at a range of approximately 1000 meters away from directly below the transducer array. This means the sound pressure from the 38 kHz ADCP is 180 dB/µPa at only 182 meters, compared to 1000 meters for the 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.

Background Information: NSF 2011 Programmatic EIS
The National Science Foundation's 2011 document "Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey" provides a detailed analysis of potential impacts of seismic, multibeam, and sub-bottom sonars on sea turtles and marine mammals and provides useful information. The document evaluates deep water multibeam systems ranging from 12-95 kHz. The EM302 operates at 30 kHz so falls within the frequency, source levels, pulse lengths and beam widths evaluated by this report. The SBP on the *Okeanos*is of the

same type evaluated in the report. With respect to multibeamechosounders (MBES) and sub-bottom profilers (SBP), the following direct excerpts are conclusions of this document regarding the potential impact on sea turtles, mysticetes, odontocetes, and pinnepeds:

Sea Turtles

"Operation of the MBES, SBP, or pingers is not expected to affect sea turtles, because the associated frequency ranges are above the known hearing range of sea turtles. The SBP operates at 3.5 kHz with a maximum source output of 222 dB re 1 µPa-m. Thus, the frequency range of the SBP is outside the known detection range of sea turtles based on available data. As a result, sea turtles are not expected to be capable of hearing the higher frequency sounds produced by SBPs. Furthermore, the intermittent and narrow downward-directed nature of the MBES and SBP as emitted from the transiting seismic vessel would result in no more than one or two brief ping exposures."

Mysticetes

"During the proposed marine seismic surveys, the pings from the MBES, SBP, and pingers would be very short (<1-64 ms) (Table 2-5).

Table 2-5. Acoustic Parameters of MBESs, SBPs, ADCPs, Pingers, and Acoustic Releases Used by NSF-Funded or USGS Research Vessels Conducting Marine Seismic Research.

Acoustic Source		*Frequency (kHz)*	*Source Level (dB re 1 µPa-m)*	*Pulse Length (ms)*	*Beam Width**	
					Fore-aft	*Athwart.*
MBES	Seabeam 2000	12	234	7-20		
	Seabeam 2100/12	12	237	<1 – 12	2^o x 2^o	
	Kongsberg EM122	12	242	2-15	1^o x 2^o	150^o
	Simrad EM 120/122	12	242	2, 5,15	1^ox1^o, 1^ox2^o	150^o
	Simrad EM 300	30	237 (1^o), 231 (2^o)	0.7, 2,15	1^ox1^o, 1^ox2^o	
	Simrad EM 1002	95	225 (3^o)	0.2, 0.7, 2	2^o x 2^o	
	Krupp-AtkasHydroSweep DS	15.5	237		2.3^o	
SBPs		3.5	222	64	27^o	
ADCPs		38-1,200	224		30^o	
Pingers		55-110	183			
Pingers		12	192	0.5, 2, 10		
Acoustic Releases		9-15	187	8		

Notes: *The beams of all acoustic sources would be directed downward from the research vessel. Athwart = athwartship.*Sources:* USCG 2001; L-DEO and NSF 2003e; SIO and NSF 2003; University of Washington 2003; SIO and NSF 2004; SIO 2005a, b; UAF and NSF 2005; University of Hawaii 2005; WHOI.

Thus, a given mammal would not receive many of the downward-directed MBES or SBP pings as the vessel passes by. In the case of the MBESs that operate at 30 kHz or higher, their operating frequencies are too high to have any effects on mysticete behavior. Source levels of the SBPs, another type of echosounder, are lower (maximum source level 222 dB re 1 microPa [rms]) than those of the MBES discussed above (Table 2-5). Thus, there is even less likelihood of TTS occurring through exposure to SBP sounds, even in an animal that is briefly near the source. The SBP is usually operated simultaneously with other higher-power acoustic sources. Many marine mammals, particularly mysticetes, move away in response to the approaching higher-power sources or the vessel itself before the mammals are close enough for there to be any possibility of effects from the SBP's less-intense sounds. The possibility of PTS through exposure to MBES or SBP sounds is considered negligible and PTS is not expected to occur. Burkhardt et al. (2008) concluded that immediate direct injury was possible only if a cetacean dived under the vessel into the immediate vicinity of the transducer. Furthermore, PTS (or any injury or pathological effect) has never been demonstrated for any marine mammal exposed to echosounders such as the proposed MBESs and SBPs."

Odontocetes

"In summary, sounds from all the MBESs would be readily audible to most and possibly all odontocetes when animals are within the narrow angular extent of the intermittent sound beam. As with baleen whales, odontocete communications will not be masked appreciably by MBES, SBP, or pinger signals given their low duty cycles, the brief period (i.e., seconds) when an individual mammal would potentially be within the downward-directed MBES or SBP beam from a transiting vessel, and the relatively low source level of a pinger. Operation of MBESs, SBPs, and pingers is not likely to impact odontocetes. The project MBESs, SBPs, and pingers are not expected to induce TTS. The possibility of PTS through exposure to MBES or SBP sounds is considered negligible."

Pinnipeds

"The SBPs associated with the proposed marine seismic activities operate in the MF range of approximately 3.5 kHz with a maximum source output of 222 dB re 1 µPa-m (rms). The frequency range of the SBPs is within the frequency band audible to pinnipeds. Masking effects due to MBES, SBP, or pinger signals are expected to be minimal or non-existent. Thus, brief exposure of pinnipeds to small numbers of signals from the MBES or SBP would not result in a ―take by harassment as defined by NMFS and the ESA. The project MBESs, SBPs, and pingers are not expected to induce TTS. Although the MBESs, SBPs, and pingers can presumably be heard by pinnipeds, their operation is not likely to affect pinnipeds. The intermittent and narrow downward-directed nature of the MBESs and SPBs would result in no more than one or two brief ping exposures of any individual pinniped given the movement and speed of the vessel

and animal; such brief exposure to this sound is not expected to cause injury or PTS based on results of limited studies of some pinniped species."

As described above, no marine mammals or turtles would be exposed to sound intensity at or above the levels required for the onset of TTS or PTS, but those species exposed may experience behavioral responses as the result of exposure to the project's sonar noise. Based on the best information available, including the motility of free-ranging marine mammals and turtles in the water column, the propensity for these species (especially marine mammals) to avoid obtrusive sounds, and the proposed mitigation measures, mild alert and startle responses, avoidance of the survey vessel are the most probable responses to exposure. No measurable impacts are expected to occur on the ability of marine mammals and turtles exposed to forage, shelter, navigate, reproduce, and avoid predators and other threats such as vessels. Therefore, the expected behavioral responses expected to result from exposure to the project's sonar noise would have insignificant effects on ESA-listed marine mammals or turtles that may be in the area.

Acoustic Information Related to Elasmobranchs

A sound source produces both pressure waves and actual motion of the medium particles. In fish, particle motion is detected using the inner ear, while pressure signals are initially detected by the gas-filled swim bladder or other bubble of air in the body.These air filled spaces vibrate and serve as a medium to "reradiate" (or resend) the signal to the inner ear as a near field particle motion (Popper, 2008) in those species where a connection exists between the swim bladder and the inner ear.

While the air bladder in fish may play a role in sound detection, its primary purpose is for buoyancy. Elasmobranchs (sharks and rays) on the other hand do not have air bladders. Instead elasmobranchs have developed overly large livers which provide buoyancy. Because of this lack of an air bladder elasmobranchs are unable to detect pressure waves, instead sharks detect the kinetic stimulus rather than the acoustic pressure wave. Unlike acoustic pressure, the kinetic stimulus is inherently directional, but its magnitude rapidly decreases as it propagates outward from the sound source in the near field (Corwin,1981).

Although research has shown that the upper range of behavioral sensitivity to this kinetic stimulus is 600 to 800 Hz in both scalloped hammerheads, *Sphrynalewini* (Olla, 1962), and the lemon shark, *Negaprionbrevirostris* (Nelson, 1967); sharks are more low frequency sensitive, with the most effective spectral range occurring from 40 Hz to 300 Hz (Myrberg, 1978). Above these frequencies both the behavioral sensitivity and the sensitivity of the ear fall off rapidly (Corwin, 1981).

As previously described, the NOAA Ship *Okeanos Explorer's*scientific sonars operate at 30 kHz (the multibeam system), 18, 38, 70, 120, 200, and 333kHz (split-beam fisheries

sonars), 3.5 kHz (the chirp sub-bottom profiler sonar), and 38 kHz and 300 kHz (ADCPs).All of these frequency ranges are well above the hearing sensitivity ranges for elasmobranchs based on the research that has been done to date.

Based on thebest available scientific information which indicates that the multibeam, split-beam and chirp sub-bottom profiler operate and frequencies above the hearing ability for all elasmobranchs (including scalloped hammerheads), and the propensity for the speciesto avoid human activities; no measurable impacts are expected to occur on the ability of the species to forage, navigate, reproduce, and avoid predators and other threats such as vessels. Therefore, the expected behavioral responses expected to result from exposure to the project's sonar noise would have insignificant effects on the ESA-listed Indo-Pacific distinct population segment of the scalloped hammerhead shark.

2. Temporary disturbance from human activity

Nearly all the activities associated with ROV dives and vessel operations in the PMNM; the marine environment around Oahu and the big island of Hawai'i; the Geologists and Musicians Seamounts; all of the Pacific Remote Island Areas composing the PRIMNM; the CNMI and the MTMNM; the vicinity of American Samoa and the NMSAS; the RAMNM; and the vessel transit areas between Honolulu, Hawai'i, Guam, Saipan, Kwajalein and Pago Pagoinvolve work in the marine environment where ESA-listed species are known to occur. Marine species may experience a startle reaction and resulting stress should they encounter human activities in the water. The reaction could range from one extreme where an animal calmly approaches and investigates the person or gear, to a panicked response in which the animal flees, which could result in injury or reduce vitality.

The following guidelines for in-water work in the presence of marine protected species and other marine wildlife have been provided by NOAA's National Marine Fisheries Service and Office of National Marine Sanctuaries:

1) A distance of at least 100 yards from humpback whales will be maintained and at least 50 yards from other marine mammals and sea turtles (e.g., dolphins, turtles and Hawaiian monk seals).
   a) All in-water work shall be postponed when these ESA-listed marine species are within these distances of the proposed work, and shall only begin after the animals have voluntarily departed the area.
   b) If ESA-listed marine species other than humpback whales are noticed within 50 yards after work has already begun, that work may continue only if, in the best judgment of the chief scientist, that there is no way for the activity to adversely affect the animal(s). No work shall occur unless at least 100 yards from humpback whales;

2) No attempt will be made to touch, ride, feed, or otherwise interact with any marine protected species:

Sea turtles, marine mammals and sharks usually avoid human activity. The most likely effect on this interaction will be a moderate to high energy avoidance behavior resulting in the animal temporarily leaving the immediate area unharmed. Considering this avoidance behavior, in combination with the nature of the activities, and implementation of the above mentioned guidelines, we have determined that disturbances related to vessel operations and ROV dives will be infrequent, would be temporary in nature and never reach the scale where it would affect the individual's health, and thus are expected to result in insignificant effects on ESA-listed marine species discussed in this biological evaluation.

3. Entanglement

The planned cruise would include the deployment of a CTD or UCTD, which would be deployed over the side of the vessel with a cable; and a ROV, whichwould be tethered to the vessel; creating the potential for entanglement of the marine species considered in this consultation should any of those animals encounter the cable or tether. However, in addition to compliance with the guidelines listed above, which would require maintaining watch for and avoiding protected marine species, we propose to postpone deployment of these devices when 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 the expected compliance with the required protective measures, and the expectation that protected marine species would 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.

4. Collisions with vessels

Sea turtles and marine mammals must surface to breathe, and they are known to rest or bask at the surface. Therefore, when at or near the surface, these animals are at risk of being struck by the vessel or its propellers during small boat operations and vessel transits to and from the monuments. Potential injuries and their severity will depend on the speed of the vessel, the part of the vessel that strikes the animal, and the body part impacted. Injuries may include bruising, broken bones or carapaces, and lacerations that can often result in death.

Existing information about sea turtle sensory biology suggests that sea turtles rely more heavily on visual cues, rather than auditory, to initiate threat avoidance. Research also suggests that sea turtles cannot be expected to consistently notice and avoid vessels that are traveling faster than 2 knots (kts) (Hazel et al., 2007). Vanderlaan and Taggart (2007) report that the severity of injury to large whales is directly related to vessel speed. They found that the probability of lethal injury increased from 21%, for vessels traveling at 8.6 kts, to over 79% for vessels moving at 15 kts or more. Additionally, since collisions with whales have been reported for both slow and fast moving craft, it appears that, in at least some situations, whales may either be unaware of a vessel's presence or unable to resolve the vessel's proximity and/or vector of approach based on available acoustic cues. Consequently, vessel operators must be responsible to actively watch for and avoid sea turtles and marine mammals, and to adjust their speed based on expected animal density and on lighting and turbidity conditions to allow adequate reaction time to avoid marine animals.

The following guidelines for vessel operation in the presence of marine protected species and other marine wildlife have been provided by NOAA's National Marine Fisheries Service and Office of National Marine Sanctuaries:

1) A distance of at least 100 yards from humpback whales will be maintained and at least 50 yards from other marine mammals and sea turtles (e.g., dolphins, turtles and Hawaiian monk seals).
2) Vessel speed will be reduced to 10 knots or less when operated in the vicinity of marine mammals or sea turtles; Operators shall be particularly vigilant to watch for turtles at or near the surface in areas of known or suspected turtle activity, and if practicable, reduce vessel speed to 5 knots or less.
3) Marine mammals and sea turtles shall not be encircled or trapped between boats or shore;
4) If approached by a marine mammal or turtle while on a boat, the vessel's engine shall be placed in neutral and the animal allowed to pass. If approaching a marine protected species, vessel movement should be from the rear of the animal.
5) No attempt to pursue marine mammals or sea turtles shall be made;
6) A vessel shall be operated in a predictable manner in the presence of marine wildlife, and when leaving an area where marine life is observed, will be slowly maneuvered; and
7) No attempt to herd, chase, or separate groups of marine mammals or females from their young shall be made.
8) All vessels operating in areas where ESA-listed species are present will continue to follow MARPOL discharge protocols, but will postpone any authorized discharge if any protected species are within 100 yards of the vessel.

The scalloped hammerhead shark is a circum-global species that lives in coastal warm temperateand tropical seas. It occurs over continental and insular shelves, as well as adjacent deep waters,but is seldom found in waters cooler than 22° C (Compagno 1984, Schulze-Haugen

and Kohler2003). It ranges from the intertidal and surface to depths of up to 450-512 m (Sanches 1991, Klimley 1993), with occasional dives to even deeper waters (Jorgensen et al. 2009). Tagging studies indicate that the species rarely makes long-distance oceanic migrations, but instead disperses along continuous coastlines, continental margins, and submarine features, such as seamounts (Miller et al., 2013).

Although the species is present in much of the Pacific, ranging from Japan and China to New Caledonia in the west, to the Gulf of California to Ecuador in the east; the species range in the central Pacific Ocean is primarily comprised of the Hawaiian Archipelago, which includes the main islands and the Northwestern Hawaiian Islands (Miller et al, 2013). Johnston Atoll is also included in this range due to its proximity to the Hawaiian Archipelago (Miller et al., 2013). Individuals of the species may be found alone, in pairs, or in schools. Adult aggregations may be found offshore over seamounts and near islands, but are most common near the Galapagos, Malpelo, Cocos and Revillagigedo Islands, and within the Gulf of California (Compagno 1984, CITES 2010, Hearn et al. 2010, Bessudo et al. 2011).

Based on the low number of trips, expected adherence to established guidelines, the expectation that protected marine species would be widely scattered throughout the proposed areas of operation, and the limited populations of the protected species in these areas; we have determined that the risk of a vessel collision with a protected marine species would be discountable.

5. Vessel waste and discharge

While operating within the PMNM, all vessels are required to comply with the following regulations (71 FR 51134, 50 CFR Part 404) with regards to permitted types of discharge:

- Discharging or depositing any material or other matter into the Special Preservation Areas (SPAs) or the Midway Atoll Special Management Area (MASMA) except vessel engine cooling water, weather deck runoff, and vessel engine exhaust;
- Discharging or depositing any material or other matter into the Monument, or discharging or depositing any material or other matter outside the Monument that subsequently enters the Monument and injures any resources of the Monument, except fish part used in and during authorized fishing operations, or discharges incidental to vessel use such as deck wash, approved marine sanitation device effluent, cooling water, or engine exhaust.

While an accidental release of waste or discharge may occur which might put protected species at risk to exposure, based on the low number of vessels that operate within the waters of the monuments, expected adherence to above mentioned discharge regulations

during all project operations, the expectation that protected marine species are widely scattered throughout the project area and the limited populations of ESA-listed species in these areas, we have determined that the risk of protected species being exposed to vessel waste and discharge would be insignificant.

6. *Determination for ESA-Listed Corals*

The action area for the 2016 – 2017 field season of the *Okeanos Explorer*has an operational minimum depth for both mapping and ROV operations of 250 m, with the majority of the activity occurring in waters greater than 500 m. The only times the vessel will be in water shallower than those depths is entering and leavingport. The planned ports of call for the upcoming field season will include Honolulu, Guam, Saipan, Kwajalein, and Pago Pago.

The expanded operation area for the 2016 -2017 fieldseason of the *Okeanos Explorer* includes the distribution ranges of seven species of corals that were listed under the ESA in September of 2014, the species are: *Acropora globiceps, A. jacquelineae, A. retusa, A. speciosa, Euphyllia paradivisa, Isopora crateriformis,* and *Seriatopora aculeata*.

Most species of corals are found in relatively shallow water where light intensity is strong enough for the symbiotic algae, which provide much of the nutrients that corals survive on, are able to effectively use the light.The distribution and habitat for each of these seven listed species found in the operational area is below:

Acropora globiceps - Reported within federal waters in the Pacific Remote Islands Marine National Monument (Palmyra and Kingman), National Park of American Samoa, Ofu Island unit, and the Rose Atoll Marine National Monument. Habitat has been reported as located in intertidal, upper reef slopes and reef flats in water depths ranging from 0 to 8 m.

A. jacquelineae - Species has not been recorded in federally protected waters, but unconfirmed reports have indicated the species may occur in American Samoa. Habitat has reported as located on subtidal walls, ledges on walls, and shallow reef slopes protected from wave action in depths ranging from 10 to 35 m.

A. retusa - Reported within federal waters in the Pacific Remote Islands Marine National Monument (Johnston, Howland and Kingman), National Park of American Samoa, Ofu Island unit, and the Rose Atoll Marine National Monument. Habitat has been reported as located on upper reef slopes and tidal pools in depths ranging from 1 to 5 m.

A.speciosa - Reported within federal waters in the Pacific Remote Islands Marine National Monument (Kingman Atoll). Habitat has been reported as located in protected environments with clear water and steep slopes or deep, shaded waters in depths ranging from 12 to 40 m.

Unconfirmed reports by Bare et al (2010) indicates the species presence in mesophotic assemblages in American Samoa.

Euphyllia paradivisa - The species has not been recorded in federally protected waters, but unconfirmed reports have indicated the species may occur in American Samoa. Habitat has been reported as located on shallow or mid-slope reef environments protected from wave action in depths ranging from 5 to 20 m.

Isopora crateriformis - Reported within federally protected waters in the National Park of American Samoa, Tutuila and Ofu Islands units, and Fagetele Bay National Marine Sanctuary, Tutuila. Habitat has reported as located in shallow, high-wave energy environments in waters depths ranging from low tide to at least 12 m. Unconfirmed reports by Bare et. al. (2010) indicates the species presence in mesophotic assemblages in American Samoa.

Seriatopora aculeata - The species has not been recorded from federally protected waters. Habitat has been reported as located in shallow reef environments in water depths ranging from 3 to 40 m.

There is potential for some listed corals to be found either adjacent to or within the harbors where the *Okeanos Explorer* will be making port of calls during the 2016 – 2017 field season. Based on the strict adherence to Boating Guidelines in place by NMFS and ONMS, the excellent safety record of NOAA vessels around the world, the strict adherence to the MARPOL protocols, and the low densities and widely scattered nature of the listed corals in the operational area, we have determined the risk to listed corals from a collisions with vessels, from temporary disturbance of human activity and the impact from waste and discharge would be discountable.

Based on the known distribution limits and the preferred habitat types in comparison to the proposed minimum operational limit for the *Okeanos Explorer*, we have concluded that listed corals will not be found in the operation area for the 2016 – 2017 field season, and are not at risk from day-to-day operation of the vessel and are not at risk from the exposure to elevated noise levels or from entanglement.

7. Effects to designated & proposed Hawaiian monk seal critical habitat

Critical habitat for the Hawaiian monk seal was designated under the ESA (53 FR 18990) on April 30, 1986 and revised on May 26, 1988 (53 FR 18988). In the PMNM, critical habitat for monk seals includes all beach areas, lagoon waters, and ocean waters out to a depth of 20 fathoms around Kure Atoll, Midway Islands (except Sand Island), Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island.On June 2, 2011, NMFS proposed revising critical habitat for monk seals (76 FR 32026) by extending the current

designation out to the 500 meter depth contour and including Sand Island at Midway Island. Using the best available scientific information, the proposed revision to critical habitat identifies six essential features for the conservation of monk seals that may require special management consideration or protection:

1. Areas With Characteristics Preferred by Monk Seals for Pupping and Nursing;
2. Shallow, Sheltered Aquatic Areas Adjacent to Coastal Locations Preferred by Monk Seals for Pupping and Nursing;
3. Marine Areas From 0 – 500 m in Depth Preferred by Juvenile and Adult Monk Seals for Foraging;
4. Area With Low Levels of Anthropogenic Disturbance;
5. Marine Area With Adequate Prey Quantity and Quality; and
6. Significant Areas Used by Monk Seals for Hauling Out, Resting, or Molting.

The proposed actions include activities that would occur within three essential features (numbers 3,4 and 5 above) of existing and proposed critical habitat, but the level of human activity that may occur annually in these areas is minimal and any disturbances caused by human presence would be temporary. Also, all permitted personnel are required to adhere to established Monument BMPs that mirror the NOAA guidelines previously described that effectively prevents or minimizes interactions with monk seals and with critical habitat essential features. There is no Hawaiian monk seal critical habitat designated for the PRIMNM, MTMNM, RAMNM, the CNMI, American Samoa or the NMSAS.

Based on adherence to proposed guidelines, no known record of previous impacts to monk seal critical habitat, and the temporary introduction of human presence to conduct activities that would have minimal impact to the environment, we expect the likelihood of destruction or adverse modification to the current Hawaiian monk seal critical habitat and those habitats that are proposed to be insignificant

Effects Determination

We have evaluated the effects of the proposed actions on the following ESA-listed marine species: green sea turtle, hawksbill sea turtles, leatherback sea turtles, North Pacific loggerhead sea turtle distinct population segment (DPS), olive ridley sea turtles, Main Hawaiian Islands false killer whale DPS, blue whales, fin whales, humpback whales, North Pacific right whales, sei whales, sperm whales, the Indo-West Pacific distinct population segments 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*. Based on our

analysis of the potential effects of the proposed action on ESA-listed marine species presented above the proposed action would have insignificant effects on the ESA-listed species under consideration, or the likelihood of exposure would be discountable. Therefore, we have determined that the proposed activities are not likely to adversely affect those species. We have also determined that the proposed activities would have insignificant effects on the essential features of designated and proposed critical habitat for Hawaiian monk seals, and therefore is not likely to adversely affect critical habitat. Therefore, we request informal consultation per Section 7(a)(2) of the ESA, and your concurrence with our determination that the proposed action may affect, but is not likely to adversely affect, green sea turtles, hawksbill sea turtles, leatherback sea turtles, North Pacific loggerhead sea turtle DPS, olive ridley sea turtles, Main Hawaiian Islands false killer whale DPS, blue whales, fin whales, humpback whales, North Pacific right whales, sei whales, sperm whales, the Indo-West Pacific distinct population segments of the scalloped hammerhead shark, Hawaiian monk seals or existing or proposed Hawaiian monk seal critical habitat;and the coral species*Acropora globiceps, A. jacquelineae, A. retusa, , A. speciosa, Euphyllia paradivisa, Isopora crateriformis,* and *Seriatopora aculeata*.

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Appendix G: Data Management Plan

Data Management Plan
Okeanos Explorer (EX1707): Musician Seamounts (Telepresence Mapping)

Ocean Exploration and Research

OER Data Management Objectives
Ensure post-mission data management pipelines are working as expected. Maintain the Okeanos Atlas during the mission.

1. General Description of Data to be Managed

Name and Purpose of the Data Collection Project

Okeanos Explorer (EX1707): Musician Seamounts (Telepresence Mapping)

Summary description of the data to be collected.

Operations for this cruise will include 24 hour mapping, and continuous telepresence-based remote participation in mapping operations. Multibeam and splitbeam mapping operations will be conducted 24 hours a day throughout the cruise. Sub-bottom profile mapping will be conducted 24 hours a day at the discretion of the CO. XBT and Underway CTD 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. All mapping data will be fully processed according to standard procedures and will be archived with the National Centers for Environmental Information (NCEI).

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, oceans

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

Okeanos Mapping Cruises

Planned or actual temporal coverage of the data.

Dates: 8/8/2017 to 8/31/2017

Planned or actual geographic coverage of the data.

Latitude Boundaries:	20	to	35
Longitude Boundaries:	-167	to	-154

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

Multibeam (product), Multibeam (raw), SCS Output (compressed), SCS Output (native), Side Scan Sonar (raw), Sub-Bottom Profile data, Water Column Backscatter, XBT (raw), Cruise Plan, Cruise Summary, Data Management Plan, Highlight Images, Quick Look Report, ADCP, Bottom Backscatter, CTD (processed), CTD (product), CTD (raw), EK60 Singlebeam Data, Floating Point GeoTIF, GSF, HDCS, Mapping Summary, Multibeam (image),

Multibeam (processed)

What platforms will be employed during this mission?

NOAA Ship Okeanos Explorer

2. Point of Contact for this Data Producing Project

Overall POC:

Title:	Expedition Coordinator
Affiliation/Dept:	NOAA Office of Ocean Exploration and Research
E-Mail:	Elizabeth.Lobecker@noaa.gov
Phone:	603-862-1475

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

Have resources for management of these data been identified? True

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

unknown

5. Data Lineage and Quality

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

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

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

Where will the metadata be hosted?

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:	https://www.ncddc.noaa.gov/oer-waf/ISO/Resolved/2017/
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.

Process for producing and maintaining metadata:

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

7. Data Access

Do the data comply with the Data Access Directive? True

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

Not Applicable

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.

Name and URL of organization or facility providing data access.

Org: National Centers for Environmental Information

URL: https://www.ncei.noaa.gov/access

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

Hold Time: not applicable

Authority: not applicable

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

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.

If no archive planned, why?

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

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.

Prepare a Data Use Statement

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