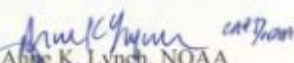




UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
Office of Marine and Aviation Operations  
Marine Operations Center  
439 W. York Street  
Norfolk, VA 23510-1114

May 19, 2016

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

FROM:   
Captain Anne K. Lynch, NOAA  
Commanding Officer, NOAA Marine Operations Center-Atlantic

SUBJECT: Project Instruction for EX-16-05 Leg 2  
CAPSTONE CNMI & Mariana Trench MNM (Mapping)

Attached is the final Project Instruction for EX-16-05 Leg 2, CAPSTONE CNMI & Mariana Trench MNM (Mapping), which is scheduled aboard NOAA Ship *Okeanos Explorer* during the period of May 20 – June 11, 2016. Of the 23 DAS scheduled for this project, 23 days are funded by a Line Office Allocation. This project is estimated to exhibit a Medium Operational Tempo. Acknowledge receipt of these instructions via e-mail to [ChiefOps.MOA@noaa.gov](mailto:ChiefOps.MOA@noaa.gov) at Marine Operations Center-Atlantic.

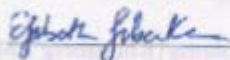




## Ocean Exploration and Research


### Project Instructions

**Date Submitted:** 10 May 2016  
**Platform:** NOAA Ship *Okeanos Explorer*  
**Project Number:** EX-16-05 Leg 2  
**Project Title:** CAPSTONE CNMI & Mariana Trench MNM (Mapping)  
**Project Dates:** May 20 - June 11, 2016




Prepared by: Elizabeth Lohedker, NOAA  
Expedition Coordinator  
Office of Ocean Exploration & Research

Dated: 5/10/16

Approved by:   
Emily Russell  
Program Manager  
Office of Ocean Exploration & Research

Dated: 5/13/2016

Approved by:   
Captain Anne K. Lynch, NOAA  
Commanding Officer  
Marine Operations Center - Atlantic

Dated: 5/19/2016

## I. OVERVIEW

### A. Brief Summary and Project Period

From April to July 2016, NOAA and partners will conduct three telepresence-enabled ocean exploration cruises, EX-16-05 Legs 1, 2, and 3, on [NOAA Ship \*Okeanos Explorer\*](#) to collect critical baseline information in and around the Commonwealth of the Northern Marianas Islands (CNMI) and the Marianas Trench Marine National Monument (MTMNM). These expeditions are part of a three year Campaign ([CAPSTONE](#)) focused on systematically collecting baseline information to support science and management needs within and around the Monuments and other protected places in the Pacific, and serves as an opportunity for NOAA and the Nation to highlight the uniqueness and importance of these national symbols of ocean conservation. NOAA will work with the scientific and management community to characterize unknown and poorly-known areas through telepresence-based exploration. This document contains project instructions for EX-16-05 Leg 2.

EX-16-05 Leg 2 will commence in Mutan, Saipan, CNMI with operations beginning on May 20<sup>th</sup> and conclude in Santa Rita, Guam on June 11<sup>th</sup>. Exploration operations for this cruise will focus on deep-water areas near the northern edge of CNMI and the Trench and Islands units of MTMNM. This expedition will help establish a baseline of information in the region to catalyze further exploration, research and management activities.

Operations will use the ship's deep water mapping systems (Kongsberg EM302 multibeam sonar, EK60 split-beam fisheries sonars, ADCPs, and Knudsen 3260 chirp sub-bottom profiler sonar), CTD rosette, and the ship's high-bandwidth satellite connection for periodic real-time ship to shore communications. Operations for this cruise will include 24 hour mapping, periodic telepresence-based remote participation, and CTD rosette operations. Multibeam and singlebeam 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/or UnderwayCTD (UCTD) 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. CTD casts have been requested during the cruise to collect more environmental information at sites of interest. All mapping data will be fully processed according to standard onboard procedures and will be archived with the National Centers for Environmental Information (NCEI).

NOAA Ship *Okeanos Explorer* systematically explores the ocean every day of every cruise to maximize public benefit from the ship's unique capabilities. With 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, and the ability to transmit new environmental baseline information to shore in near real time.

### B. Days at Sea (DAS)

Of the 23DAS scheduled for this project, 0 DAS are funded by an OMAO allocation, 23DAS are funded by an OAR Line Office Allocation, 0 DAS are Program Funded, and 0 DAS are other agency funded. This project is estimated to exhibit a Medium Operational Tempo due to 24 hour mapping, and possible CTD operations.

### C. Operating Area

EX-16-05 Leg 2 of the CAPSTONE Expeditions is a 24 hour mapping cruise that will focus on previously unmapped sites within the CNMI U.S. Exclusive Economic Zone (EEZ) and MTMNM. All operations are expected to occur in U.S. waters.

Mapping operations will focus in depths generally between 250 and 6,000 meters. CTD rosette operations are

requested at several sites to inform Leg 3 ROV dives, and may be requested opportunistically at selected sites where collecting the data is considered important to understanding the physical or chemical properties of the overlying water column.



# EX-16-05 Leg 2 2016 Deepwater Exploration of the Marianas

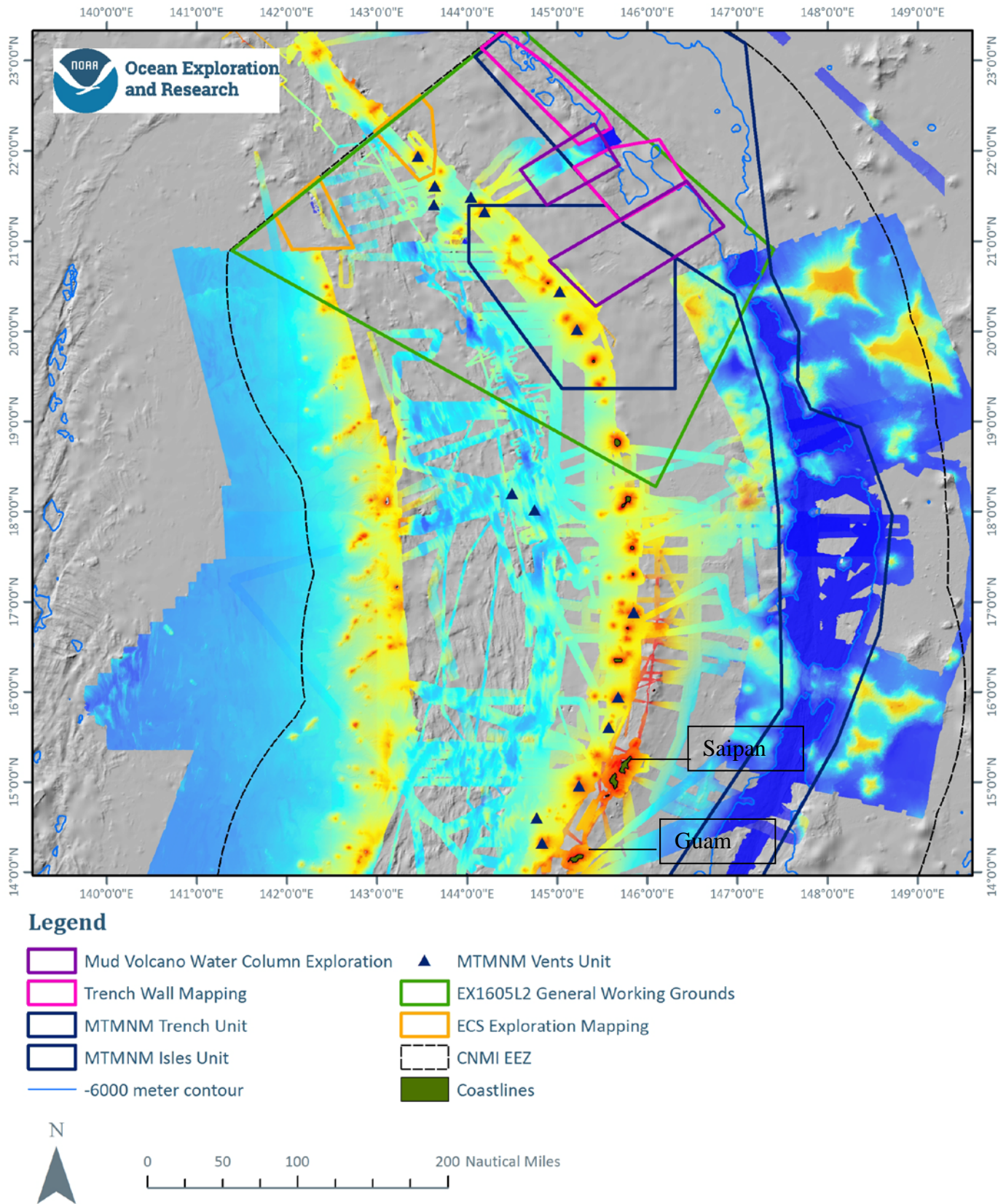


Figure 1: This figure shows overall operations for EX-16-05 Leg 2. The dark green polygon indicates the

overall operating area. The black dashed line shows the CNMI U.S. EEZ, the dark blue lines are the boundaries of the Trench and Islands Units of the MTMNM, and the dark blue triangles are the Vents Unit of MTMNM. The light blue contour lines are 6000m contours. The port calls of Saipan and Guam are labeled. The pink, orange, and purple polygons are focused mapping areas discussed in Figure 2.

<b>Overall Operating Area Bounding Coordinates</b>		
<b>ID</b>	<b>Latitude</b>	<b>Longitude</b>
NW corner	20 54.815N	141 21.867E
NE corner	23 23.981N	144 30.158E
SE corner	20 56.038N	147 20.109E
SW corner	18 20.759N	146 5.526E

Table 1: Bounding coordinates of the general working grounds (dark green polygon) shown in Figure 1.

<b>ID</b>	<b>Latitude</b>	<b>Longitude</b>
SW corner	22 4.32552N	145 14.60556E
NW corner	23 8.6439N	144 9.61434E
NE corner	23 18.63762N	144 21.89238E
SE corner	22 15.21312N	145 35.91744E

Table 2a: Bounding coordinates of Trench Wall Mapping Northern areas.

<b>ID</b>	<b>Latitude</b>	<b>Longitude</b>
SE corner	21 39.16428N	146 24.81534E
SW corner	21 13.2876N	145 41.98506E
NW corner	21 49.33644N	145 11.11152E
N mid point	22 2.00712N	145 35.91744E
NE corner	22 4.86246N	146 7.3263E

Table 2b: Bounding coordinates of Trench Wall Mapping Southern areas.

<b>ID</b>	<b>Latitude</b>	<b>Longitude</b>
SE corner	21 50.73072N	145 41.1879E
SW corner	21 24.12264N	144 53.02716E
NW corner	21 47.53776N	144 35.46582E
NE corner	22 17.87106N	145 24.4248E

Table 3a: Bounding coordinates of Mud Volcano Water Column Exploration Northern Box

<b>ID</b>	<b>Latitude</b>	<b>Longitude</b>
SE corner	21 7.89168N	146 47.17602E
SW corner	20 16.27188N	145 21.49788E
NW corner	20 46.60518N	144 55.15584E
NE corner	21 39.8214N	146 26.15562E

Table 3b: Bounding coordinates of Mud Volcano Water Column Exploration Southern Box

<b>ID</b>	<b>Latitude</b>	<b>Longitude</b>
E mid point	21 45.20874N	143 37.77102E
SW corner	21 40.36374N	143 27.90528E
NW corner	22 12.96246N	142 58.5126E
NE corner	22 37.12314N	143 28.55478E
E mid point	22 27.90528N	143 36.31716E
E mid point	21 59.12844N	143 38.90994E

Table 4a: Bounding coordinates of ECS Exploration Mapping East area

<b>ID</b>	<b>Latitude</b>	<b>Longitude</b>
SE corner	20 55.73364N	142 44.4177E
SW corner	20 54.3933N	142 3.74646E
NW corner	21 18.40422N	141 51.68406E
NE corner	21 42.75096N	142 21.28392E

Table 4b: Bounding coordinates of ECS Exploration Mapping West area



# EX-16-05 Leg 2 2016 Deepwater Exploration of the Marianas

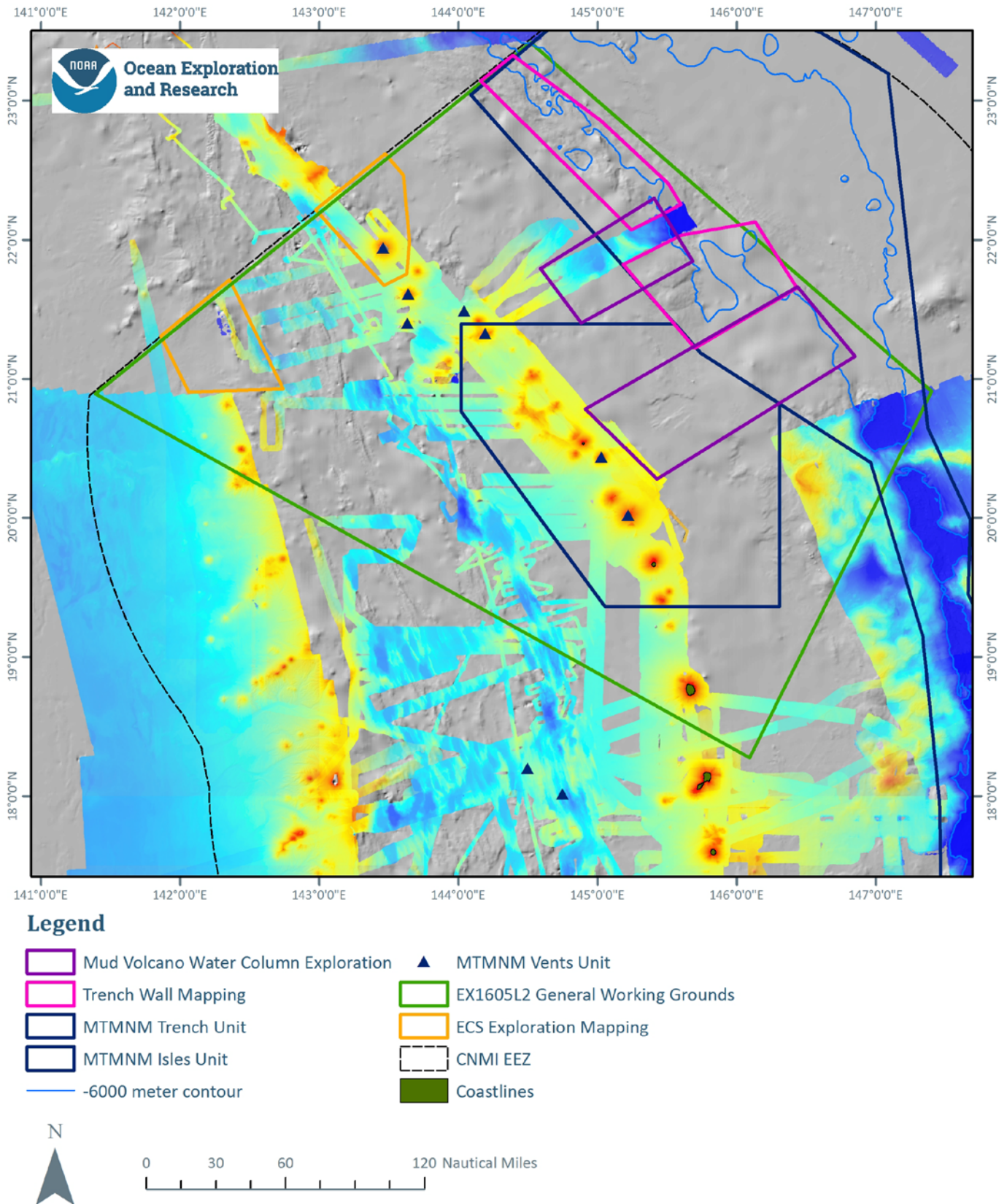


Figure 2: This figure shows the a detail view of locations of focused mapping operations for EX-16-05 Leg 2.

The dark green polygon is the overall area of interest. The pink polygons are priority mapping for MTMNM science and management. The smaller orange polygons indicate areas of priority from US Geological Survey for scientific characterization of the geologic conditions present in the area in partnership with the Extended Continental Shelf (ECS) Project. The two purple rectangles are initial site characterization of potential mud volcano locations. The light blue contours are the 6000 m depth contour. The black dashed boundary is the U.S. EEZ, the dark blue polygon is the boundary of the Trench and Island Units of MTMNM, and the red triangles compose the Vents Unit of the MTMNM. See the Summary of Objectives section for further information on these mapping areas.

Transit line way points are being finalized and will be provided to the ship prior to the cruise.

# EX-16-05 Leg 2 2016 Deepwater Exploration of the Marianas

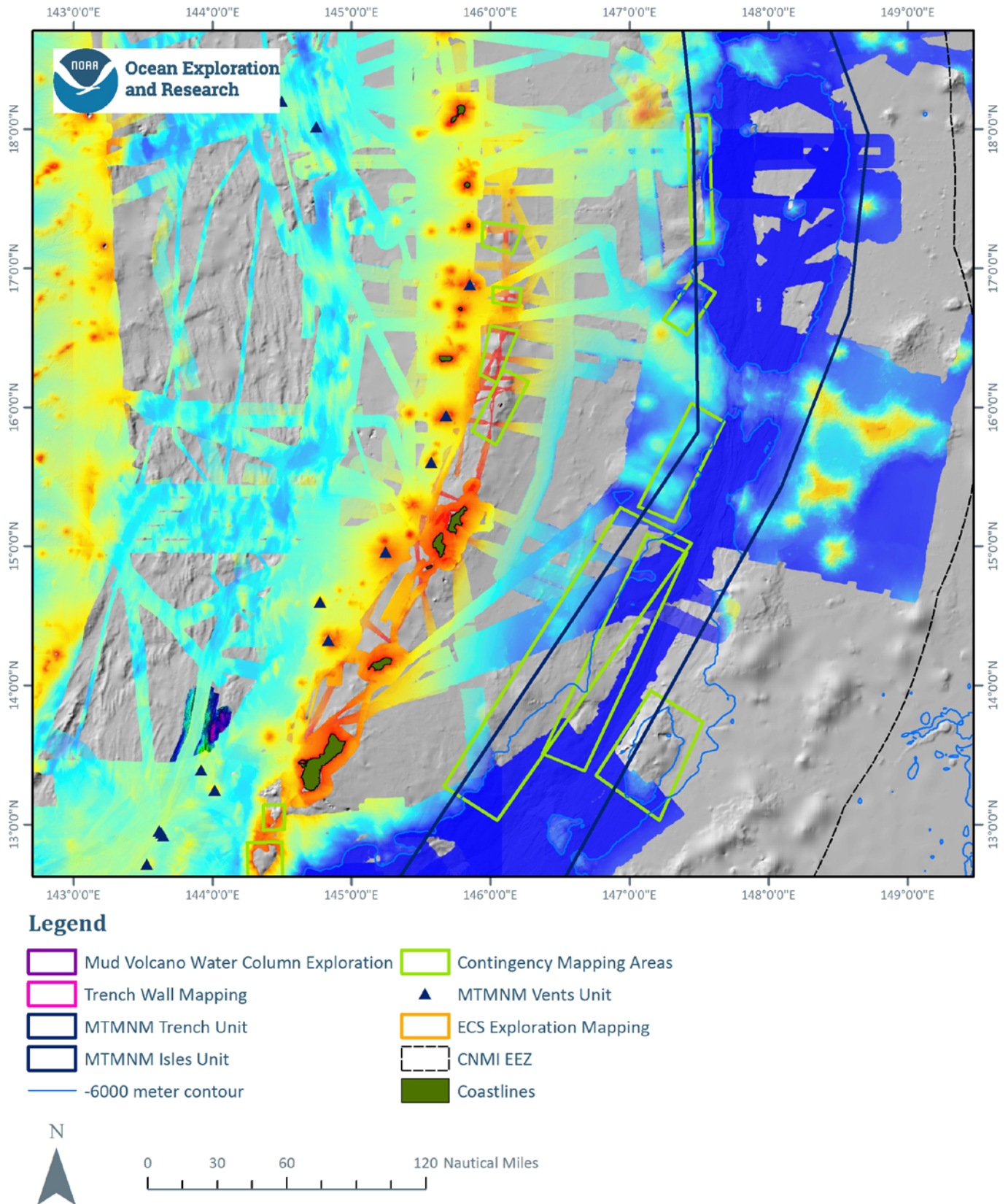


Figure 3. This figure shows contingency mapping areas in light green. These are lower priority for Leg 2 and



will be pursued if weather or unforeseen operational constraints prevent work from occurring in primary mapping areas.

#### **D. Summary of Objectives**

##### **May 20 - June 11 (Saipan, CNMI to Santa Rita, Guam) Telepresence-enabled mapping and CTD operations**

EX-16-05 Leg 2 operations will be focused entirely within the US EEZ near the northern boundary of the Commonwealth of the Northern Mariana Islands, and primarily within Trench and Islands Units of the Marianas Trench Marine National Monument. The primary goal for this cruise is to collect baseline data and information to support priority NOAA science and management needs.

Mission objectives for EX-16-05 Leg 2 include a combination of mapping/operational, science, education, outreach, and data management objectives:

1. Conduct 24 mapping operations for duration of the cruise
  - a. Collect high resolution mapping data from sonars in priority areas as dictated by operational needs as well as science and management community needs
  - b. Collect bathymetric, seafloor backscatter, and water column backscatter data
  - c. Subbottom sonar 24 hour data collection will be at the discretion of the CO
  - d. Conduct a limited, focused ADCP survey west of Marianas Island chain
  - e. Support EX-16-05 Leg 3 ROV operations with baseline mapping of ROV dive sites
  - f. Conduct XBT casts at regular intervals no longer than 6 hours, as data quality requires, during mapping operations
  - g. Create and send to shore daily standard mapping products
  - h. Collection of sun photometer measurements as part of survey of opportunity
  - i. Continue to test the integration of the new EK60 frequencies and the ADCPs.
2. Map previously unmapped areas shallower than ~6000m within and adjacent to Trench and Islands Units of MTMNM and CNMI
  - a. Map northern sections of Trench wall to maximum depth of 6000m which is of interest to biologists and geologists in order to explore biological communities and further characterize geologic context of the area. It is expected that there will be EX-16-05 Leg 3 ROV dive requests along the Trench wall based on this data.
  - b. Map sections of MTMNM which are priority needs for science and management community to explore biological and geological characteristics
  - c. Map areas of likely mud volcanoes in MTMNM which are potential major scientific discovery within monument boundaries. Mud volcanoes found on the forearc are potentially hydrothermally active, with potential for presence of seeps and seep communities.
3. In support of ECS exploration, map previously unmapped northern areas of the Mariana Arc, West Mariana Ridge, and Mariana Basin. Applying the criteria in Article 76 of Law of the Sea Convention requires data on the morphology of the seafloor. This exploration will help to clarify the scientific process by which the break-up of the Mariana Arc has occurred, testing two competing hypotheses about the nature of the crust in the northern part of the wish-bone. It should show young faulting and state of stress - all part of the understanding the evolution of the arc and back arc. Rifting of the arc is the process that separated the western (now extinct) part of the arc from the eastern (now active) part. More mapping in this area within CNMI boundary will potentially resolve whether back arc lavas are considered part of that rifting of the Mariana Arc or that they are part of the seafloor



spreading (sfs) process. Additional information on the ECS project can be found at <http://www.continentalshelf.gov/> (last accessed 3/26/16).

4. Conduct emergency drills. Drills may include some or all of the following as determined by CO:
  - a. Fire/Damage Control
  - b. Abandon Ship
  - c. Man-Over-Board
  - d. Steering Casualty
  - e. Oil Spill/ Hazmat spill.
5. Conduct water column sound velocity profile measurements via XBT.
  - a. Water column sound velocity casts will be collected at regular intervals of no more than 6 hours in support of multibeam sonar operations
  - b. CTD rosette operations may be requested to obtain sound velocity profiles as a back-up for XBT operations, and thus the CTD should be mission-ready prior to the start of the expedition. Additional sensors typically mounted on the rosette including dissolved oxygen, light scattering sensor (LSS), and altimeter should be operationally tested and ready to perform exploration activities as the need arises should water column anomalies be discovered during the cruise.
6. Train personnel in data collection and processing procedures as needed (continuous throughout cruise).
  - a. Train Explorers-in-Training
  - b. Train EPP mapping intern
  - c. Train augmenting Survey Tech or newly hired Survey Tech
  - d. Continue to test Qimera and refine SOPs to replace Caris for primary multibeam data processing.
  - e. Train Watch Leads in preparation for advanced leadership roles to be tested during EX1607.
7. The longstanding NASA marine aerosols network survey of opportunity will continue for the cruise.
8. Telepresence (VSAT 4.7mbps ship to shore; 1.54 mbps shore to ship)
  - a. Maintain single live stream video from ship to shore with a focus on the multibeam mapping display
  - b. Test set up of remote desktop access through NOAA OER laptop in preparation for EX-16-07 Telepresence Mapping
  - c. Ensure that the UNH ECC telepresence equipment is working properly in preparation for EX1607
  - d. Test telepresence mapping workflow with PS's at UNH.
9. Science
  - a. Acquire mapping data to support priority Monument and Sanctuaries science and management needs;
  - b. Collect mapping data to be used to generate baseline characterization maps to explore the diversity and distribution of benthic habitats –including bottom fish habitats, deep sea and precious coral communities, hydrothermal vent communities, mud volcanoes, trench and subduction zone habitats;
  - c. Collect acoustic mapping data at sites to aid the understanding of the geologic history of the Pacific seamounts.
  - d. Successfully conduct operations in conjunction with shore-based Exploration Command Centers and remote science team participants;

- e. Create and provide input into standard science products to provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.

#### 10. Data Management

- a. Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities;
- b. Provide daily products to shore for operational decision making purposes;
- c. Ensure Marine Archology data protection protocols are followed, if relevant.

#### 11. Outreach

- a. Participate in Reddit AMA with mapping team on June 3 (June 2 Eastern Daylight Savings Time)
- b. Potential June 3 (June 2 EDT) interaction with UNH CCOM staff during Seacoast Science Center member's night at CCOM
- c. Additional minimal live interactions may occur.

#### 12. Ship

- a. Continue to refine SOPs for the New VSAT;
- b. Provide high a high quality stable internet connection with the new VSAT;

#### 13. Contingency Mapping

- a. If weather or other unforeseen operational constraints prevent work in the northern primary mapping areas, contingency mapping will occur along the Mariana Arc island chain, and south of the island chain along the Trench wall, as shown in Figure 3.

### **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

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

NOAA, National Oceanographic Data Center, National Coastal Data Development Center, Stennis Space Center MS, 39529 USA

NOAA, Office of Coast Survey, Hydrographic Surveys Division, Atlantic Hydrographic Branch, 439 W. York St., Bldg 2, Norfolk, VA 23510 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

NOAA National Marine Fisheries Service, Pacific Islands Regional Office, 1845 Wasp Blvd, Honolulu, HI 96818

NOAA National Marine Fisheries Service, Marine National Monuments Program, 1845 Wasp Blvd, Honolulu, HI 96818

NOAA National Marine Fisheries Service, Pacific Islands Fisheries Science Center, 1845 Wasp Blvd, Honolulu, HI 96818

University of Guam, University Dr., Mangilao, Guam 96923

UnderWater World Guam, 1245 Pale San Vitores Rd, Tamuning, Guam 96911

Northern Marianas College, P.O. Box 501250, Saipan, MP 96950

## F. Personnel (Mission Party)

**Table 2: Leg I – Full list of sea going mission party members and their affiliations**

Name (First, Last)	Title	Date Aboard	Date Disembark	Gender	Affiliation	Nationality
Elizabeth 'Meme' Lobecker	Expedition Coordinator	5/16	6/13	F	NOAA OER	USA
Amanda Bittinger	Mapping Watch Lead	5/16	6/13	F	UCAR	USA
Daniel Freitas	Mapping Watch Lead	5/17	6/13	M	UCAR	USA
Melody Ovard	Mapping Watch Lead / Physical Scientist	5/17	6/13	F	NOAA AHB	USA
Shelby Bowden	Intern / Watch Stander	5/16	6/13	M	UCAR	USA
Wilmelie Cruz- Marrero	Intern / Watch Stander	5/16	6/13	F	NOAA EPP	USA
Liana Roberson	Intern / Watch Stander	5/17	6/13	F	UCAR	USA
Devin Resko	Intern / Watch Stander	5/18	6/13	M	UCAR	USA

## G. Administrative

### 1. Points of Contact:

#### *Ship Operations*

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

Chief, Operations Division, Atlantic (MOA)  
LT Joseph Carrier, NOAA  
Telephone: (757) 441-6842  
E-mail: Chiefops.MOA@noaa.gov

#### *Mission Operations*

Elizabeth 'Meme' Lobecker  
Expedition Coordinator / Mapping Lead  
NOAA Office of Ocean Exploration  
and Research (ERT)  
O: (603) 862-1475  
E-mail : [elizabeth.lobecker@noaa.gov](mailto:elizabeth.lobecker@noaa.gov)

CDR Mark Wetzler, NOAA  
Commanding Officer  
NOAA Ship *Okeanos Explorer*  
Phone: (401) 378-8284  
Email: [CO.Explorer@noaa.gov](mailto:CO.Explorer@noaa.gov)

LTJG Aaron Colohan, NOAA  
Operations Officer (Acting)  
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E-mail: [Ops.Explorer@noaa.gov](mailto:Ops.Explorer@noaa.gov)

***Other Mission Contacts***

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C: 202-689-4587  
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E-mail: [Craig.Russell@noaa.gov](mailto:Craig.Russell@noaa.gov)

Kasey Cantwell  
Leg 3 Expedition Coordinator  
NOAA Ocean Exploration & Research  
Phone: 301-734-1050  
E-mail: [Kasey.cantwell@noaa.gov](mailto:Kasey.cantwell@noaa.gov)

**Vessel shipping address:**

*Shipments:*

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

Items sent to Saipan should arrive at the below address prior to COB May 10, 2016.

Saipan address:  
NOAA CNMI Field Office - Okeanos Explorer  
C/O Michael Trianni  
1st Floor D.Y. Building  
Beach Road  
Saipan MP 96950  
Tel: [\(670\) 285-0014](tel:(670)285-0014)

The shipping address for shipments going to Guam to be received at the end of EX-16-05-L2is as follows:

SW3147  
DLA DISTRIBUTION GUAM MARIANAS  
DDGM RECEIVING SUMMAY DRIVE  
WHSE 9 BLDG 2118  
SANTA RITA GU 96915-1000

ATTN: NOAA OKEANOS EXPLORER,

2. Diplomatic Clearances

N/A

The expedition is being planned and conducted by NOAA as an agency of the U.S. Federal government, in partnership with NOAA NMFS Pacific Islands Regional Office Marine National Monument Program. We do not require a permit to work in the MTMNM.

In order to support or conduct Marine Scientific Research within the U.S. EEZ, work funded, authorized and/or conducted by the NOAA must be compliant with the National Environmental Policy Act (NEPA). NOAA Administrative Order (NAO) 216-6 describes NOAA's specific obligations with regard to NEPA compliance. Among these is the need to review all NOAA-supported projects with respect to their environmental consequences. In compliance with NAO 216-6 and NEPA, a memorandum describing the project's scientific sensors' possible effects on the environment has been submitted for the project. As expected with ocean research with limited time or presence in the marine environment, the project has been determined to not have the potential to result in any lasting changes to the environment. As defined in Sections 5.05 and 6.03.c.3 (a) of NAO 216-6, this is a research project of limited size or magnitude or with only short-term effects on the environment and for which any cumulative effects are negligible, and as such, the project is categorically excluded from the need to prepare a full-scale NEPA environmental assessment. The categorical exclusion met the requirements of NOA 216-6 and NEPA, and authorizes the Marine Scientific Research conducted for the project.

Additionally, 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.

**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*)

**Table 4: EX-16-05 Leg 2 Detailed Itinerary**

*This is an approximate itinerary and is subject to change*

<b>Date</b>	<b>Activities</b>
5/16 - 5/18	Mission personnel arrive to ship in Saipan
5/19	Mission personnel safety training and mapping orientation
5/20	Depart Saipan for survey working grounds
5/20	Potentially deploy HARPS buoys (2) near Saipan

5/20 - 5/22	Exploration mapping transit to working grounds in northern section of CNMI EEZ
5/22 - 6/7	Conduct exploration mapping activities in priority mapping areas in northwest corner of CNMI EEZ
6/7	Commence transit exploration mapping to Guam
6/11	Arrive in port, Guam
6/12 & 6/13	Mission personnel disembark ship in Guam

## B. Staging and Destaging

- A. Not applicable.

## C. Operations to be Conducted

### *Telepresence / Outreach Events*

- A. June 3 ship local time (June 2 EDT) Possible telepresence interaction with UNH CCOM  
 B. June 3 ship local time (June 2 EDT) Reddit UAU

### *In-Port Events*

- A. There are no major ship-based inport events scheduled for Leg 2. Meme Lobecker may give a lecture at the University of Guam on June 13.

## D. SCUBA Dive Plan

All dives are to be conducted in accordance with the requirements and regulations of the NOAA Diving Program (<http://www.ndc.noaa.gov/dr.html>) and require the approval of the ship's Commanding Officer. No SCUBA dives are currently planned for this cruise.

## 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 D and E. 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

- 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 (Deep Blue probes)
- Seabird SBE 911Plus CTD
- Seabird SBE 32 Carousel and 24 2.5 L Niskin Bottles
- Light Scattering Sensor (LSS)
- Oxidation – Reduction Potential (ORP)
- Dissolved Oxygen (DO) sensor
- Altimeter Sensor and battery pack

- CNAV GPS
- POS/MV
- Seabird SBE-45 (Micro TSG)
- Kongsberg Dynamic Positioning-1 System
- NetApps mapping storage system
- CARIS HIPS Software
- IVS Fledermaus Software
- SIS Software
- Hypack Software
- Scientific Computing System (SCS)
- ECDIS
- Met/Wx Sensor Package
- Telepresence System
- VSAT High-Speed link (Comtech 20 Mbps ship to shore; 2 Mbps shore to ship)
- Cruise Information Management System (CIMS)
- Three VoIP telephone lines
- NOAA OER 6000 m *Deep Discoverer* ROV
- NOAA *Seirios* Camera Platform

#### **B. Equipment and capabilities provided by the scientists**

- Microtops II Ozone Monitor Sunphotometer and handheld GPS required for NASA Marine Aerosols Network supplementary project.
- Equipment associated with new sampling protocol

### **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

Item	Use	Approx. locations
95% Denatured Ethanol (10 gallons)	Sample preservation	Wetlab, under the chemical hood
10% Buffered Formalin (3 gallons)	Sample preservation	Wetlab, under the chemical hood
Chaos Buffer (0.5 gallons) (4 M guanidine thiocyanate, 0.5% N-laurosyl sarcosine, 25 mMTris pH 8.0, 0.1 M beta-mercaptoethanol)	Sample preservation (genetics)	Wetlab, under the chemical hood
Aqua Shield	Underwater Lubricant	ROV Workshop Fire Cabinet, Pit
Dow Corning 4	Electrical insulating compound	ROV Workshop Fire Cabinet, Pit
Fluid Film Spray	Silicone Lubricant	ROV Workshop Fire Cabinet
Isopropanol Alcohol	Solvent	ROV Workshop Fire cabinet
Scotchkote	Electrical insulating compound	ROV Workshop Fire cabinet
3M Silicone Spray	Silicone Lubricant	ROV Workshop Fire cabinet
Synthetic AW Hydraulic Oil, ISO-22	Amsoil (AWG-05)	Hanger, Pit, Vehicles
Tap Magic Cutting Fluid	Cutting/Machining Lubricant	ROV Workshop Fire cabinet
Tap Magic Heavyweight Cutting Fluid	Cutting/Machining Lubricant	ROV Workshop Fire cabinet
Tuff Coat M	Marine Lubricant	ROV Workshop Fire cabinet
Dow Corning Molykote 111	Valve Lubricant and Sealant	ROV Workshop Fire cabinet, Pit
WD40	Lubricant	ROV Workshop Fire cabinet
Loktite	Bolt adhesive	ROV Workshop Fire cabinet
Mineral Oil	Vitrea	Hanger, Vehicles

Por-15	Paint Kit	ROV Workshop Fire cabinet
Univis HVI 13	Hydraulic Fluid	Hanger, ROV D2
Ultratane	Butane fuel	ROV Workshop fire cabinet
Rust-oleum	Protective Enamel	ROV Workshop fire cabinet
Flux-Off	Soldering Flux remover	ROV Workshop fire cabinet
Propane	Torch Fuel	ROV Workshop fire cabinet

C. Chemical safety and spill response procedures

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

D. Radioactive Materials

*NOT APPLICABLE TO THIS CRUISE*

**V. ADDITIONAL PROJECTS**

**A. Supplementary Projects**

*NASA Maritime Aerosol Network*

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

[[http://www.corporateservices.noaa.gov/ames/administrative\\_orders/chapter\\_212/212-15.html](http://www.corporateservices.noaa.gov/ames/administrative_orders/chapter_212/212-15.html)].

*Ship Responsibilities*

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

## *NOAA OER Responsibilities*

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

### *Deliverables*

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

### *Archive*

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

## **VII. Meetings, Vessel Familiarization, and Project Evaluations**

### Shipboard Meetings

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

- A. Pre-Project Meeting: The Expedition Coordinator and Commanding Officer will conduct a meeting of pertinent members of the scientific party and ship's crew to discuss required equipment, planned operations, concerns, and establish mitigation strategies for all concerns. This meeting shall be conducted before the beginning of the project with sufficient time to allow for preparation of the ship and project personnel. The ship's Operations Officer usually is delegated to assist the Expedition Coordinator in arranging this meeting.
- B. Vessel Familiarization Meeting: The Commanding Officer is responsible for ensuring scientific personnel are familiarized with applicable sections of the standing orders and vessel protocols, e.g., meals, watches, etiquette, drills, etc. A vessel familiarization meeting shall be conducted in the first 24 hours of the project's start and is normally presented by the ship's Operations Officer.
- C. Post-Project Meeting: The Commanding Officer is responsible for conducting a meeting no earlier than 24 hrs before or seven days after the completion of a project to discuss the overall success and short comings of the project. Concerns regarding safety, efficiency, and suggestions for future improvements

shall be discussed and mitigations for future projects will be documented for future use. This meeting shall be attended by the ship's officers, applicable crew, the Expedition Coordinator, and members of the scientific party and is normally arranged by the Operations Officer and Expedition Coordinator.

**D. Project Evaluation Report:**

Within seven days of the completion of the project, a Customer Satisfaction Survey is to be completed by the Expedition Coordinator. The form is available at <http://www.oma.noaa.gov/fleeteval.html> and provides a "Submit" button at the end of the form. Submitted form data is deposited into a spreadsheet used by OMAO management to analyze the information. Though the complete form is not shared with the 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 make-up of the ship's complement. The Expedition Coordinator is responsible for ensuring the scientific berthing spaces are left in the condition in which they were received; for stripping bedding and linen return; and for the return of any room keys which were issued. The Expedition Coordinator is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the cruise and at its conclusion prior to departing the ship.

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

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy dated May 7, 1999 which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels.

### **B. Medical Forms and Emergency Contacts**

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

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

The completed forms should be sent to the Regional Director of Health Services at the applicable Marine Operations Center. The NHSQ and Tuberculosis Screening Document should reach the Health Services Office no later than four weeks prior to the start of the project to allow time for the participant to obtain and submit

additional information should health services require it, before clearance to sail can be granted. Please contact MOC Health Services with any questions regarding eligibility or completion of either form. Ensure to fully complete each form and indicate the ship or ships the participant will be sailing on. The participant will receive an email notice when medically cleared to sail if a legible email address is provided on the NHSQ.

The participant can mail, fax, or email the forms to the contact information below. Participants should take precautions to protect their Personally Identifiable Information (PII) and medical information and ensure all correspondence adheres to DOC guidance

([http://ocio.os.doc.gov/ITPolicyandPrograms/IT\\_Privacy/PROD01\\_008240](http://ocio.os.doc.gov/ITPolicyandPrograms/IT_Privacy/PROD01_008240)).

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

Contact information:

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

Please make sure the [medicalexplorer@noaa.gov](mailto:medicalexplorer@noaa.gov) email address is cc'd on all medical correspondence.

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

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

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

- CTD, ROV (and other pertinent) ORM documents will be followed by all personnel working onboard *Okeanos Explorer*.

- All personnel onboard are in the position of calling a halt to operations/activities in the event of a safety concern.

#### **D. Communications**

A daily situation report (SITREP) on operations prepared by the Expedition Coordinator will be relayed to the program office. Sometimes it is necessary for the Expedition Coordinator to communicate with another vessel, aircraft, or shore facility. Through various modes of communication, the ship is able to maintain contact with the Marine Operations Center on an as needed basis. These methods will be made available to the Expedition Coordinator upon request, in order to conduct official business. The ship's primary means of communication with the Marine Operations Center is via e-mail and the Very Small Aperture Terminal (VSAT) link. VSAT bandwidth at 15Mbps 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: Firstname.Lastname@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

*Okeanos Explorer* Iridium: (808) 659-9179

OER Mission Iridium (dry lab): (808) 851-3827

EX INMARSAT B

Line 1: 011-870-764-852-328

Line 2: 011-870-764-852-329

Voice Over IP (VoIP) Phone:

(541) 867-8932

(541) 867-8933

(541) 867-8934

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

[expeditioncoordinator.explorer@noaa.gov](mailto: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.





# Ocean Exploration and Research

## Project Instructions--APPENDIX

**Date Submitted:** 10 May 2016  
**Platform:** NOAA Ship *Okeanos Explorer*  
**Project Number:** EX-16-05 Leg 2  
**Project Title:** CAPSTONE CNMI & Mariana Trench MNM (Mapping)  
**Project Dates:** May 20 - June 11, 2016

A handwritten signature in blue ink, appearing to read "Elizabeth Lobecker", written over a horizontal line.

Dated: \_\_\_\_\_5/10/16\_\_\_\_\_

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

Approved by: \_\_\_\_\_ Dated: \_\_\_\_\_  
Craig Russell  
Program Manager  
Office of Ocean Exploration & Research

Approved by: \_\_\_\_\_ Dated: \_\_\_\_\_  
Captain Anne K. Lynch, NOAA  
Commanding Officer  
Marine Operations Center - Atlantic

## **Appendix A**

### **EMERGENCY CONTACT DATA SHEET**

#### **NOAA OKEANOS EXPLORER**

Scientists sailing aboard the *Okeanos Explorer* should fill out the form found at the following link location:

[https://docs.google.com/a/noaa.gov/forms/d/1pcoSgPluUVxaY64CM1hJ7511iYirTk48G-lv37Am\\_k/viewform](https://docs.google.com/a/noaa.gov/forms/d/1pcoSgPluUVxaY64CM1hJ7511iYirTk48G-lv37Am_k/viewform) with their emergency contact information

## **Appendix B: Data Management Plan**

Okeanos Explorer (EX1605L2): CAPSTONE CNMI & Mariana Trench MNM (Mapping)



*OER Data Management Objectives*

*Ensure normal data pipelines are operational and data stewardship is completed in a timely manner.*

28-Apr-16

Page 1

### **1. General Description of Data to be Managed**

#### **Name and Purpose of the Data Collection Project**

Okeanos Explorer (EX1605L2): CAPSTONE CNMI & Mariana Trench MNM (Mapping)

#### **Summary description of the data to be collected.**

Operations will use the ship's deep water mapping systems (Kongsberg EM302 multibeam sonar, EK60 split-beam fisheries sonars, ADCPs, and Knudsen 3260 chirp sub-bottom profiler sonar), CTD rosette, and the ship's high-bandwidth satellite connection for periodic real-time ship to shore communications. Operations for this cruise will include 24 hour mapping, periodic telepresence-based remote participation, and CTD rosette operations. Multibeam and singlebeam 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/or UnderwayCTD (UCTD) 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.

#### **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, Commonwealth of the Northern Marianas Islands, CNMI, Marianas Trench, Marianas Trench Marine National Monument, MTMNM, CAPSTONE, Guam, telepresence-enabled exploration, ECS Project, Extended Continental Shelf, mud volcano, Fryer Guyot, hydrothermal vents, Mariana Arc, West Mariana Ridge, Mariana Basin, morphology of the seafloor, crust, fault, tectonic plates, arc lavas, rift, seafloor spreading, NASA Maritime Aerosol Network

#### **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: 5/20/2016 to 6/11/2016

#### **1.6 Planned or actual geographic coverage of the data.**

Latitude Boundaries: 18.34 to 23.4

Longitude Boundaries: 141.36 to 147.31

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

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

**What platforms will be employed during this mission?**

NOAA Ship Okeanos Explorer

**2. Point of Contact for this Data Producing Project**

Overall POC: Elizabeth Lobecker, Multibeam Mapping Expert, Contractor (ERT, Inc.), NOAA Office of Ocean Exploration and Research, elizabeth.lobecker@noaa.gov

Title: Expedition Coordinator, Mapping Lead, Principal Investigator

Affiliation/Dept: Contractor (ERT, Inc.), 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: Operational Data Management, Andy O'Brien; Stewardship Data Management, Susan Gottfried

Title: OER EX Data Managers

E-Mail: andrewparsonobrien@gmail.com; susan.gottfried@noaa.gov

**4. Resources**

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

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

**5. Data Lineage and Quality****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 and are not quality controlled. CTDs are processed into profiles for display only on the Okeanos Atlas.

**6. Data Documentation**

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

Okeanos Explorer (EX1605L2): CAPSTONE CNMI & Mariana Trench MNM (Mapping)

**6.1.1 If metadata are non-existent or non-compliant, please explain:****6.2 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: [www.ncddc.noaa.gov/oer-waf/ISO/Resolved/2016/](http://www.ncddc.noaa.gov/oer-waf/ISO/Resolved/2016/)

Meta Std: ISO 19115-2 Geographic Information with Extensions for Imagery and Gridded Data will be the metadata standard employed; a NetCDF3 standard for oceanographic data will be employed for the SCS data; the Library of Congress standard, MACHine Readable Catalog (MARC), will be employed for NOAA Central Library records.

**6.3 Process for producing and maintaining metadata:**

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

**7. Data Access**

**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.

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

Org: NOAA National Centers for Environmental Information

URL: <https://explore.noaa.gov/digitalatlas>

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

Hold Time: No, data from Okeanos Explorer are made publicly accessible as soon as possible.

Authority: Any data not made publicly accessible is protected by the National Historic Preservation Act of 1966

**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?**

Okeanos Explorer (EX1605L2): CAPSTONE CNMI & Mariana Trench MNM (Mapping)

**8.3 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.

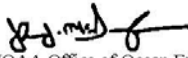
## Appendix C: Categorical Exclusion



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

May 3, 2016

MEMORANDUM FOR: The Record

FROM: John McDonough   
Deputy Director, NOAA Office of Ocean Exploration  
and Research (OER)

SUBJECT: Categorical Exclusion for NOAA Ship *Okeanos Explorer*  
Cruise EX-16-05 Leg 2

NAO 216-6, Environmental Review Procedures, requires all proposed projects to be reviewed with respect to environmental consequences on the human environment. This memorandum addresses NOAA Ship *Okeanos Explorer's* scientific sensors possible effect on the human environment.

### Description of the Project

This project is part of the NOAA Office of Ocean Exploration and Research's "Science Program" and entails ocean mapping activities, and water column profiling using CTD casts designed to increase knowledge of the marine environment. This Categorical Exclusion addresses NOAA Ship *Okeanos Explorer* cruise EX-16-05 Leg 2 "CAPSTONE CNMI & Mariana Trench MNM (Mapping)" led by Elizabeth Lobecker, Expedition Coordinator for NOAA OER. This expedition serves as an opportunity for NOAA and the Nation to highlight the uniqueness and importance of the Pacific Monuments and Sanctuaries, which are national symbols of ocean conservation. Operations conducted during this expedition and the broader 3-year CAPSTONE campaign support NOAA missions to understand and predict changes in climate, weather, oceans and coasts, and share the knowledge and information with others. Much of this year's work will contribute to and complement NOAA's Deep Sea Coral Research and Technology Program's three-year Pacific Islands Regional Initiative.

EX-16-05 Leg 2 is a telepresence-enabled mapping cruise that will be conducted from May 20 to June 11, 2016 in the Commonwealth of the Northern Mariana Islands (CNMI) and Marianas Trench Marine National Monument (MTMNM). Operations will be focused primarily on deep water areas in the northern half of the CNMI Exclusive Economic Zone. The cruise will start in Saipan and end in Guam.





The overarching goal of the project is to extend our breadth of knowledge about the distribution and diversity of deep water habitats within the operating area. The information and data generated by this project will lead to a better understanding of the deep water habitats and ecosystems of the MTMNM and the marine environment around the Mariana Islands, providing basic information about the rich and unique biological resources and habitats of this region. Ideally, the findings from this cruise will spur further exploration and research and ultimately contribute to effective resource management decisions.

#### **Mapping Operations on *Okeanos Explorer***

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 to supplement previous mapping work in the area. In addition to providing additional insight into the geologic regime of an area, these maps form the basis for selecting ROV dive locations, a critical step in baseline habitat characterization. CTD casts may be conducted to collect additional information about the physical and chemical properties of the water column.

The ship will conduct 24 hour sonar mapping operation during non-ROV operations throughout the cruise. Acoustic instruments that will be operational during the project are a 30 kHz multibeam echosounder (Kongsberg EM302), Kongsberg EK60 singlebeam echosounders (18, 70, 120, and 200 kHz), Teledyne Acoustic Doppler Current Profilers (38 and 300 kHz), and a 3.5 kHz sub-bottom profiler (Knudsen Chirp 3260). Additionally, expendable bathythermographs (XBTs) will be deployed at regular intervals in association with multibeam data collection. All of these systems are routinely used by this exploration vessel and have provided invaluable scientific data for marine researchers and manager, including numerous National Marine Sanctuaries, the Bureau of Ocean Energy Management and the U.S. Geological Survey.

Bridge Officers and Watch Standers will be on watch during all hours and will look for marine mammals and other observable species potentially sensitive to the sound of the sonars. If cetaceans are sighted, knowledgeable personnel would follow established best management practices to minimize disturbance. If a cetacean is observed, the Mapping Watch Lead and Expedition Coordinator are notified, and if appropriate, the ship will slow down or stop until the animal has departed the area. If cetacean species are present within 400 m of the ship, the vessel will stop until the animals depart the area. When marine mammals are able to be identified by Bridge Officers or Watch Standers, these observations are noted in the NOAA fleet marine mammal observation log as part of standard practice.

#### *Multibeam Sonar*

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 important biological habitats and ecological connections in the Monuments, and the geology of the NWHI. 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.

#### *Sound velocity -Expendable Bathythermographs (XBTs):*

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 obtain these essential data, the *Okeanos Explorer* will use XBTs to obtain sound speed profiles.

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

#### *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. 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.

#### *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. 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 the new ADCPs within the CNMI and MTMNM as a useful data stream contributing to characterizing the area, providing new information on ocean currents to scientists and managers, and helping to plan effective and safe ROV exploration dives.

#### *Sub Bottom Profiler*

The primary purpose of this Knudsen Chirp 3260 (3.5 kHz) sonar is to provide echogram images of surficial geological sediment layers underneath the seafloor to a maximum depth of about 80 meters below the seafloor. The Sub Bottom Profiler is normally operated to provide information about the sedimentary features and the bottom topography that is simultaneously being mapped by the multibeam sonar. The data generated by this sonar is fundamental in helping geologists

interpret the shallow geology of the seafloor. Collecting this data in the Leg II operating area will provide greatly improved insights into the geology of the region, and supplement existing magnetometer and gravity measurements obtained by other vessels.

#### **CTD Rosette Operations**

The CTD rosette instrument is used to obtain conductivity, temperature, depth and other oceanographic data (dissolved oxygen, light scattering, oxygen reduction potential). 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 and would have limited time and presence in the marine environment.

#### **Permits**

OER has completed an informal consultation with NOAA's National Marine Fisheries Service (NMFS) under section 7 of the Endangered Species Act of 1973 that addresses the potential impacts of project activities to ESA-listed species and critical habitat for all operations to be conducted as part of the 2016-2017 CAPSTONE expeditions. A Letter of Concurrence was received from NMFS on February 7, 2016, concurring with OER's determination that CAPSTONE Expedition activities are not likely to adversely affect ESA-listed marine species, and would have insignificant effects on designated or proposed critical habitat.

#### **Effects of the Project**

As expected for ocean research with limited duration or presence in the marine environment, this project will not have the potential for significant impacts. Knowledgeable experts who are aware of the sensitivities of the marine environment will conduct the at-sea portions of this project. The potential gains or beneficial effects of the project seem to outweigh any potential adverse effects. This expedition will provide baseline characterization of poorly understood deep water habitats, including within marine protected areas, contained within the U.S. Exclusive Economic Zone (EEZ). This work will provide essential information for further research, exploration, and conservation of marine habitats within the CNMI and MTMNM.

As defined in Sections 5.05 and 6.03.c.3 (a) of NAO 216-6, this is a research project of limited size or magnitude and will not result in individually or cumulatively significant impacts on the quality of the human environment. Specifically, this research cruise would have only short-term effects with the principle goals of natural resource inventories and environmental monitoring over a wide geographic area. Furthermore, this action would not be subject to any of the exceptions for categorical exclusion provided at NAO 216-6 section 5.05c. As such, this project is categorically excluded from the need to prepare a NEPA environmental assessment.

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**Appendix D: Permit to conduct research activities in CNMI-managed waters**



Commonwealth of the Northern Mariana Islands  
Division of Fish & Wildlife  
Department of Lands and Natural Resources  
Lower Base, P.O. Box 10007  
Saipan, MP 96950



Phone: 670-664-6000  
Fax: 670-664-6060

April 8<sup>th</sup>, 2016

Ms. Kelley P. Elliott  
NOAA Office of Ocean Exploration & Research  
1315 East-West Hwy  
SSMC3 Room 10236  
Silver Spring, MD 20910

Dear Ms. Elliott:

Your application for a Scientific Research License from the Department of Lands and Natural Resources, Division of Fish and Wildlife (DFW) has been approved. Your permit will begin on April 20, 2016 and will expire on July 27, 2016. Please note that as the Principal Investigator, you must be present during all collection events and research activities. You are also responsible in supervising other team members appropriately. This Conditions Letter and permit must be present on board the *Okeanos Explorer* during the time of collections and other research activities. A fee is required for the main permit request and for collections.

This license has the following conditions:

- 1) You are only allowed to collect species/families listed in your application in the quantities noted.
- 2) You must provide the Division of Fish and Wildlife with a list of all species collected including amount collected, and location within 30 days after your permit expires, but no later than September 1, 2016. A general description of specimen is acceptable if species identification is not possible. Images of samples are also encouraged.
- 3) You must provide DFW with copies of data and any reports and/or publications stemming from the work performed and specimens collected under this license.
- 4) You or your team members must **not** collect **any** specimens (live/dead) or disturb any habitat within any Marine Protected Area(s) in the CNMI. The exception to this is the work performed within the Marianas Trench Marine National Monument.
- 5) You must acquire all pertinent federal and state permits for research and/or collections where applicable.

- 6) CNMI DFW Enforcement personnel shall be allowed to inspect collections whenever possible.

These conditions will be in effect for the term of the collection permit provided by the Division of Fish and Wildlife. Non-compliance of these conditions may result in revocation of permits and the assessment of fines.

*I, Kelley Elliott, agree to adhere to the conditions of this Scientific Research License. I understand that failure to do so could result in the immediate revocation of my Scientific Research License and denial of future Scientific Research License applications, and it may result in other penalties/fines.*

  
Applicant

Date: 04/15/2016

Thank you,

  
Manuel Pangelinan  
DFW, Director



COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS  
DIVISION OF FISH & WILDLIFE  
SCIENTIFIC RESEARCH LICENSE APPLICATION



Pursuant to 2 CMC §85.30.1-205, all scientific research, attempts to gain or collect data, and/or exploratory studies for academic or commercial purposes in the CNMI are regulated activities. A permit is therefore required to ensure the integrity and conservation of wildlife, fisheries, and habitat; personal and public safety; the legitimacy of project, best practice methodology, qualifications of participants; due diligence, identification of responsible and liable parties; compliance with local and federal laws, regulations, and customs; and that CNMI's scientific, ecological, cultural, and economic interests are considered, represented, and advanced.

**Printed Name and Affiliation of Principal Investigator (PI):** Kelley P. Elliott, NOAA Office of Ocean Exploration & Research

**Position Title of PI:** Expedition Manager

**Contact Address for PI:** 1315 East-West Hwy, SSMC3 Room 10236, Silver Spring, MD 20910

**Printed Names and Affiliations of Co-Investigators:**

Shirley Pomponi, *Harbor Branch Oceanographic Institute, Florida Atlantic University*

Deborah Glickson, *Harbor Branch Oceanographic Institute, Florida Atlantic University*

Patty Fryer, *Hawai'i Institute of Geophysics & Planetology, University of Hawai'i*

Diva Amon, *Department of Oceanography, University of Hawai'i*

Chris Kelley, *Department of Oceanography, University of Hawai'i*

Elizabeth "Meme" Lobecker, *NOAA Office of Ocean Exploration and Research (ERT, Inc.)*

Kasey Cantwell, *NOAA Office of Ocean Exploration and Research (Collabralink)*

**Name of Project:** 2016 CAPSTONE CNMI & Mariana Trench Marine National Monument Exploration

**Date Project Will Begin:** April 20, 2016

**Date Project Will End:** July 27, 2016 (when the ship will depart Guam for Kwajalein)

Assurance: Through the voluntary submission of this application, I hereby certify that I am familiar with applicable state and federal regulations pertaining to my research activities. I further certify that the information submitted in this application is complete and accurate to the best of my knowledge and belief. I understand that failure to follow the regulations or any false statement submitted in this application may subject me to penalties under applicable state and federal Laws. Furthermore, I understand that the License I may receive on the basis of this application will be accompanied by conditions that I agree to follow in full. I understand that failure to do so may also subject me to the penalties and/or revocation and non-renewal of the license.

**Signature of PI:**

Handwritten signature of Kelley P. Elliott in black ink.

**Date:** March 8, 2016

**Project Description:**

Provide a summary for each project you intend to perform. If habitat will be modified, then specify what type of and how much (in m<sup>2</sup>) vegetation will be modified. For marine studies and especially corals, be specific about where divers and equipment will come into contact with the bottom substrate. The project description should explicitly address the following concerns:

- What is your research question?
- What are your hypotheses?
- How will you test your hypotheses?
- Is the species you propose working with locally or federally protected, or is it closely associated with protected species, habitats, or resources? If so, then what local and federal permits do you have (or need) that will allow you to work with this species?
- Will your proposed work occur in or affect a protected area or habitat? If so, then how will you ensure that the area or habitat will not be damaged by your activities?
- What training do you have to work with the species or in the conditions that you propose?
- How might your proposed actions affect the species of concern?
- How might your proposed actions affect non-target species, habitats, or resources in the area?
- How might your proposed actions affect your personal safety or well-being?
- How might your proposed actions affect public safety and best interest?
- What actions will you take to minimize or avoid negative consequences of your proposed actions?
- What insurance or bonding do you have that would provide for an emergency response or compensation for unanticipated "take" of animals and/or habitat?
- What are the anticipated uses of your data and benefits of your proposed project?
- What will you do to ensure these anticipated benefits are realized?
- Will specimens (including tissue and genetic material) be collected? If so, where will they be stored? What will their ultimate fate be?
- What will be done with the results and conclusions you generate as an outcome of your research?
- What is your source of funding, what is the total amount of the award, and approximately what portion (in dollars or percent) of the total award will be spent in the CNMI?
- Will there be any commercial applications of your research, or the knowledge or materials produced by it?

Submission of Application: A completed application form, the Project Description, all relevant permits and licenses, all supporting documents, and proof of fee payment should be submitted physically or electronically in a single document to:

Office of the Director  
Division of Fish & Wildlife  
Box 10007, Lower Base  
Saipan, MP 96950

Applications are reviewed for merit and completeness. The review process could be lengthy and include both internal and external reviewers. Amendments and revisions could be requested. Applications become the property of CNMI Division of Fish & Wildlife upon submission.



**Fees:** Fees for Scientific Research License applications are published in the Division of Fish & Wildlife Fee Schedule (available by request or online). Fees must be paid to the CNMI Treasury.

## PROJECT DESCRIPTION

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 2016 CAPSTONE Commonwealth of the Northern Mariana Islands (CNMI) and Mariana Trench Marine National Monument (MTMNM) Exploration project is a part of 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 the [CAPSTONE project](#) is to extend and improve the understanding of the distribution and diversity of deepwater habitats within the MPAs, and collect data and information to support priority monument and sanctuary science and management needs. The multi-year 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 Expeditions will provide a foundation of publicly-accessible baseline information to improve management and spur further exploration and research; [these are not hypothesis-driven Expeditions](#). Like previous expeditions in the Gulf of Mexico, western Atlantic, Hawai'i 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.

We propose to conduct activities in and around the MTMNM and CNMI to explore and improve understanding of the distribution and diversity of deep water habitats. The activity would occur during three cruises from April 20 to July 10, 2016. Operations will be focused in 500 m and deeper, with the potential for limited work at high priority sites as shallow as 250 m. No activities would occur on land.

- **Leg 1** (April 20 – May 11) is a ROV, mapping and telepresence-enabled cruise with full shore-based science participation. The ship will conduct 24-hour operations consisting of daytime ROV dives and overnight mapping operations including during transit. Operations will focus on priority ROV dive sites and mapping areas in the southern half of the CNMI and MTMNM. ROV dive sites are expected to include hydrothermal vent sites and sites of interest to Fisheries including deep-sea coral and bottom fish habitats. CTD rosette operations may also be conducted.
- **Leg 2** (May 20 – June 11) is a 24-hour mapping cruise that will focus on the northern half of the CNMI and MTMNM. Mapping priorities include previously unmapped areas of the CNMI Exclusive Economic Zone and MTMNM, trench/subduction zone areas, and areas likely to host mud volcanoes. CTD rosette operations may also be conducted.
- **Leg 3** (June 17 – July 10) is another ROV, mapping and telepresence-enabled cruise with full shore-based science participation. The ship will conduct 24-hour operations consisting of daytime ROV dives and overnight mapping operations including during transit. Operations will focus on priority ROV dive sites in the northern half of the CNMI and MTMNM, including areas that are mapped during Leg 2. Therefore some ROV dive locations will be further refined after mapping data is acquired during Leg 2. ROV dive sites are expected to include mud volcanoes, trench/subduction zone areas and seamounts. CTD rosette operations may also be conducted.
- **Port call in Guam:** July 11 to 27, 2016

The overarching goal of the project is to extend and improve the understanding of the distribution and diversity of deepwater habitats in and around the CNMI and MTMNM. Data and information from the cruises will build on previous work, 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.

- Acquire data to support priority Monument science and management needs;
- Explore the diversity of benthic habitats and features (e.g. hydrothermal vents, mud volcanoes, seamounts, trench/subduction zones, deep-sea coral habitats, bottom fish habitats);
- Engage a broad spectrum of the scientific community and public in telepresence-based exploration;
- Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.

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 and water column 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.

Site characterization involves detailed exploration of a specific site or region, including taking measurements of chemical and physical seawater properties. CTD casts would be conducted at selected sites to collect data of the chemical and physical properties of the water column (i.e., temperature, salinity, dissolved oxygen, sound velocity, light scattering, oxygen reduction potential). This may include 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. 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 geology of the CNMI and MTMNM. It is this understanding that enables effective management decisions, and provides continuous support for the monuments and their protection of these resources. The collective understanding established from the multi-year CAPSTONE expeditions will increase understanding of deep-sea biogeographic patterns across the Central and Western Pacific.

## OPERATIONS OVERVIEW

### What is your research question?

The fundamental driver of this three-leg expedition is better understand unknown and poorly known areas of our ocean which include diverse living marine resources, and unique geologic phenomena. This expedition will focus on collecting critical baseline information in and around CNMI and MTMNM. As part of the CAPSTONE effort, these cruises will systematically collect

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.

#### 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 subbottom profiler is normally operated to provide information about the sedimentary features and the bottom topography that is simultaneously being mapped by the multibeam sonar. The data generated by this sonar is fundamental in helping geologists interpret the shallow geology of the seafloor. 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* will use the ADCPs to assess currents near ROV dive locations to inform dive planning and ensure safe ROV deployment and recovery operations.

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* is equipped with two ADCPs: a Teledyne RDI Workhorse Mariner (300 kHz) and an Ocean Surveyor (38 kHz). 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. 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.

#### ROV Operations:

The purpose of conducting ROV operations is to conduct interdisciplinary site characterization at priority targets in the CNMI and MTMNM. 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, rift zone ridges, hydrothermal vents, mud volcanoes, trench/subduction zone areas, habitats at the top of the trench, and bottom fish habitats. The combined dives will enable scientists and managers to have a better understanding of the diversity and distribution of deep water habitats in the CNMI and MTMNM, and should contribute to enhanced protection of these resources.

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 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. Currently 46 deployments are planned in and around the CNMI and MTMNM.

#### ROV Sampling:

During these dives, limited sampling operations are planned to collect very selective specimens with the ROV that have the potential to contribute significant scientific discoveries. Biological specimen collections will focus on potential new species or new records for the region, and the dominant morphotype animal (such as a coral or sponge) in a habitat. When possible, only a sub-sample 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; manganese-coated rocks; and rock samples in support of the United States Extended Continental Shelf Project. When possible, rock samples will be selected in a way to minimize disturbance to the surrounding environment and to minimize the take of attached organisms.

#### CTD Operations

Aside from the UCTD as addressed in the Mapping Operations section, *Okeanos Explorer* is outfitted with a CTD rosette instrument. The CTD rosette instrument is used to obtain conductivity, temperature, depth and other oceanographic data (dissolved oxygen, light scattering, oxygen reduction potential). 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 and would have limited time and presence in the marine environment.

#### **What training do you have to work with the species or in the conditions that you propose?**

I have helped to plan and execute numerous deep sea submersible cruises during more than a decade working with NOAA, including a dozen mapping and telepresence-enabled ROV cruises with NOAA Ship *Okeanos Explorer*. The biggest reason for past successes are the very competent science and operations team that we assemble for all major expeditions. Among those involved in the Expedition is Dr. Patty Fryer who has been working in the Marianas for decades and has been Chief

Scientist or Co-Chief scientist on 18 geophysical/geological research cruise; Dr. Shirley Pomponi who has led numerous research expeditions worldwide and has made more than 300 dives in submersibles; Dr. Diva Amon who has participated in more than a dozen cruises including expeditions to investigate hydrothermal vents, cold seeps, mud volcanoes, organic falls and to conduct ecological baseline surveys in areas of high manganese-nodule density in the Pacific, Atlantic, Caribbean and Southern Ocean; and Dr. Deborah Glickson who has led and participated in more than a dozen research cruises in the Atlantic, Pacific and Indian ocean and has a PhD focused on hydrothermal vents. Also, David Lovalvo, our ROV Team Lead, has decades of experience safely building and operating both manned and unmanned submersibles around the globe, many of which have been in areas of particular cultural and natural significance.

**How might your proposed actions affect your personal safety or well-being?**

Safety of our crew is of the utmost importance to the *Okeanos Explorer* team. We conduct safety drills weekly and comply with all safety standards of the United States.

**How might your proposed actions affect public safety and best interest?**

The actions covered by this research license have no direct effect on public safety and are carried out on behalf of the greater science and management communities as well as the general public. It is in the best interest of all stakeholders to fully understand the extent of living marine resources that exist in the largely unexplored deep sea. As with all operations onboard *Okeanos Explorer*, ROV dives and mapping operations during this expedition will be broadcast live to the OER website and to shore based scientists participating from their home institutions and Exploration Command Centers around the world. Past expeditions have inspired the public through countless media articles, popular Reddit Ask Me Anything events, and social media engagement, all of which are anticipated to continue during this expedition. Data collected will inform resource managers and discoveries may inspire the public for years to come.

**What are the anticipated uses of your data and benefits of your proposed project?**

The information and data generated by this project will take the next major step in baseline characterization of deepwater areas within the CNMI and MTMNM. The acquisition of high-resolution seafloor mapping data is an essential precursor to making significant biological, geological, archaeological and oceanographic discoveries in the monument. Though the *Okeanos Explorer* cruises will collect additional multibeam data to supplement previous work, the biggest benefit will be the high resolution video data collected with the ship's ROV systems. These dives will be the next step in a baseline habitat characterization, and directly contribute to a better understanding of the deep water habitats, ecosystems and geology of the CNMI and MTMNM. The dives will enable scientists and managers to have a better understanding of the diversity and distribution of deepwater habitats. It is this understanding that enables effective management decisions, and provides continuous support for the monuments and their protection of these resources. The collective understanding established from the multi-year CAPSTONE expeditions will increase understanding of deep-sea biogeographic patterns across the Central and Western Pacific.

These data are both expensive and difficult to acquire. A large research vessel and ROV generally cost approximately \$42,000/day. A conservative estimate for the cost of all three cruises is over \$3.6 million.

In addition, the ROV cruises will likely provide tremendous education and outreach opportunities. Due to high speed ship-to-shore satellite communications, anyone with an internet connection will be able to [watch live video](#) of ROV dives and other seagoing operations and listen to the scientific dialogue in real time. Past expeditions have inspired the public through countless media articles, popular Reddit Ask Me Anything events, and social media engagement, all of which are anticipated to continue during this expedition. These are all opportunities to bring attention to the incredible deep-water habitats and resources in the CNMI and MTMNM.

**What will you do to ensure these anticipated benefits are realized?**

This expedition is being conducted in partnership with the NOAA Pacific Islands Regional Office (PIRO) Marine National Monuments Program. All data will be provided to the [National Centers for Environmental Information](#) within 30-90 days of cruise completion to enable scientists and managers access as soon as possible. Many of the scientists and managers with interest in the data have been engaged in the cruise planning process and will participate via telepresence, so are aware of the data to be collected and that it will be publicly accessible. Furthermore, the OER team and scientists engaged who work with the data will present summaries of findings at major ocean science conferences to get the word out to the broad community.

Partnership with NOAA NMFS PIRO, Pacific Islands Fisheries Science Center and Marine National Monuments Program includes partnering to plan and execute education both the online expedition presence and education and outreach activities in Guam and Saipan. These plans include efforts to ensure we engage and share the expedition with local communities and universities before, during and after the expedition.

**Will specimens (including tissue and genetic material) be collected? If so, where will they be stored? What will their ultimate fate be?**

These expeditions will be conducted in unexplored areas where mapping and collections of small numbers of samples will result in site characterizations that are intended to provide a foundation for research. The intent of exploration sampling is to acquire a minimum number of specimens that can provide a general representation of (for example) the biological and geological settings for a dive or an area of interest. For biological samples, this would include the dominant morphotype of a habitat, potential new species and potential new records for the region. Rock samples will include samples for use in dating seamounts, and to determine manganese content. Although the actual number of samples recovered during a dive will be dependent on the specific circumstances for that dive, except in unusual circumstances, there will be a limit of 1-3 specimens (each) of biological and geological samples per dive.

Once a sample is brought onboard, it will be photographed, documented, and information entered into a sample database. Rocks will be dried and photographed. Aliquots of coral and sponge specimens will be preserved for taxonomic analysis (ethanol), genetic analysis (CHAOS or other buffer), and in some cases, histological examination (10% buffered formalin). All other animals will be preserved in either formalin or ethanol, depending on which preservative is more desirable for the particular taxa.

An additional small tissue sample will be taken of all biological specimens when doing so will not be overly destructive to the specimen. This tissue sample will be preserved onboard for later genomic DNA and RNA extraction at the Ocean Genome Legacy Center (OGL) in Northeastern University.



All samples will remain on the ship until it returns to Honolulu, HI. The samples will then be taken to OER Science Advisor, Dr. Chris Kelley's lab at the University of Hawaii at Manoa for temporary storage. There they will be prepared for transfer to a repository (with preliminary identification provided along with photographs and a deed of gift).

Selected coral and sponge specimens will be split, with one piece going to [Bishop Museum](#) in Hawaii, and the other to the [Smithsonian](#) to ensure access to as many researchers as possible. If it is determined that splitting will be too destructive to a particular specimen, it will be provided to the Smithsonian Institution intact in order to provide public access to as many researchers as possible. Crustaceans and any other organisms found on the corals and sponges will be provided to the Smithsonian. All other animals will be provided to the Smithsonian.

Tissue samples will be provided to the [Ocean Genome Legacy Center](#) (OGL) at Northeastern University. The results of genomic analysis are made publicly available through OGLs website.

All geological samples will be sent to the Oregon State University's [Marine Geology Repository](#) to be made publicly accessible.

**What will be done with the results and conclusions you generate as an outcome of your research?**

A standard suite of data and information products are generated for each cruise. Standard data and products include: a cruise plan, multibeam and XBT raw and processed data (including seafloor bathymetry and backscatter, and water column backscatter data), EK60 raw data, ADCP raw data, Knudsen 3260 sub-bottom profiler raw data, summary forms for each ROV dive and sample collections, summary file with all sample data, summary forms for each CTD rosette cast, data from CTD casts and XBT firings, summary suite of files from ROV dives, high resolution video clips from ROV dives, high resolution full recording of ROV dives, still image frame grabs from ROV video, still images of samples, mapping data report, and the cruise report.

These data and products are made publicly accessible to ANYONE through the [National Centers for Environmental Information](#) and NOAA OER's [Digital Atlas](#) within 30-90 days of cruise completion. Once these data are publicly available, we will notify key management groups and scientists interested in the data, including DLNR's Division of Fish & Wildlife. Furthermore, our team develops and presents expedition summaries and key findings in various venues including by not limited to: our [oceanexplorer.noaa.gov](#) website, an annual Oceanography Supplement publication and major ocean science conferences.

The goal of NOAA Ship *Okeanos Explorer* operations is to provide a foundation of publicly accessible data and information products to enable follow-on exploration, research and management activities. The vast majority of scientists who participate in our expeditions are volunteers, and many further analyze and publish on the results of their findings at conferences and in peer-reviewed publications.

**What is your source of funding, what is the total amount of the award, and approximately what portion (in dollars or percent) of the total award will be spent in the CNMI?**

NOAA Ship *Okeanos Explorer* is a public vessel of the United States of America. Funding for *Okeanos Explorer* originates from the federal budget of the United States of America, specifically the Department of Commerce and the National Oceanic and Atmospheric Administration. NOAA has



agreed to provide the ship, multibeam and ROV systems, and their own technicians required for this cruise. A large research vessel and ROV generally cost ~\$42,000/day. A conservative estimate of the cost of all three cruises is over \$3.6 million. All three cruises, for a total of 69 days at sea (DAS), are planned to focus within the CNMI Exclusive Economic Zone.

**Will there be any commercial applications of your research, or the knowledge or materials produced by it?**

The goal of NOAA Ship *Okeanos Explorer* operations is to provide a foundation of publicly accessible data and information products to enable follow-on exploration, research and management activities. The data and information we collect is made publicly accessible as soon as possible after the cruise to enable interested students, scientists and managers to access and use the data. Anyone can use the data once available through the National Centers for Environmental Information.

**ENVIRONMENTAL COMPLIANCE AND MINIMIZING IMPACTS**

**Is the species you propose working with locally or federally protected, or is it closely associated with protected species, habitats, or resources? If so, then what local and federal permits do you have (or need) that will allow you to work with this species?**

Mapping and ROV operations will be conducted within the Exclusive Economic Zone of the Commonwealth of the Northern Mariana Islands (CNMI), including within the Marianas Trench Marine National Monument. Operations will be focused on areas 500m and deeper, however may include limited work as shallow as 250m if identified as high priority. Our focus is on exploring and conducting interdisciplinary habitat characterization at unknown and little-known seafloor habitats including at suspected new hydrothermal vent sites, mud volcanoes, manganese-encrusted seamounts, bottomfish habitat areas, and around trench/subduction zone areas.

The expedition is being planned and conducted by NOAA as an agency of the U.S. Federal government, in partnership with NOAA NMFS Pacific Islands Regional Office Marine National Monument Program. We do not require a permit to work in the MTMNM. We have also reached out to local CNMI agency representatives at the Department of Lands and Natural Resources, Division of Fish and Wildlife, and the Bureau of Environmental Quality, to request input on priority data needs or operations request that could be addressed by our capabilities.

In order to support or conduct Marine Scientific Research within the U.S. EEZ, work funded, authorized and/or conducted by the National Oceanographic Atmospheric Administration (NOAA) must be compliant with the National Environmental Policy Act (NEPA). NOAA Administrative Order (NAO) 216-6 describes NOAA's specific obligations with regard to NEPA compliance. Among these is the need to review all NOAA-supported projects with respect to their environmental consequences. In compliance with NAO 216-6 and NEPA, a memorandum describing the project's scientific sensors' possible effects on the environment has been submitted for the project. As expected with ocean research with limited time or presence in the marine environment, the project has been determined to not have the potential to result in any lasting changes to the environment. As defined in Sections 5.05 and 6.03.c.3 (a) of NAO 216-6, this is a research project of limited size or magnitude or with only short-term effects on the environment and for which any cumulative effects are negligible, and as such, the project is categorically excluded from the need to prepare a full-scale NEPA environmental assessment. The categorical exclusion met the requirements of NAO 216-6 and NEPA, and authorizes the Marine Scientific Research conducted for the project.

Additionally, 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, 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 (*Eubalaenajaponica*), the Indo-West Pacific and Central Pacific distinct population segments of the scalloped hammerhead shark (*Sphyrna 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*. 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.

**How might your proposed actions affect the species of concern? How might your proposed actions affect non-target species, habitats, or resources in the area?**

The impact of our operations to marine mammals and ESA-listed species was well addressed in our ESA Section 7 Biological Evaluation, which is included with this request.

In compliance with NAO 216-6 and NEPA, a memorandum describing the project's scientific sensors' possible effects on the environment has been submitted for the project. As expected with ocean research with limited time or presence in the marine environment, the project has been determined to not have the potential to result in any lasting changes to the environment. As defined in Sections 5.05 and 6.03.c.3 (a) of NAO 216-6, this is a research project of limited size or magnitude or with only short-term effects on the environment and for which any cumulative effects are negligible.

**Will your proposed work occur in or affect a protected area or habitat?**

We propose to work within the CNMI Exclusive Economic Zone and in the Marianas Trench Marine National Monument. We do not propose to work in other marine protected areas within CNMI unless requested by a CNMI agency representative.

**How will you ensure that the [marine protected] area or habitat will not be damaged by your activities? What actions will you take to minimize or avoid negative consequences of your proposed actions?**

Aboard *Okeanos Explorer* we have a set of best practices for our standard set of operations to minimize the impact of our actions. These best practices ensure we are minimizing our impact both to the environment being explored, and ESA-list species. An overview of how we approach operations is below:

Mapping Operations

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 WatchStander 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.

In order to collect the most accurate multibeam data, *Okeanos Explorer* can either use an XBT or the new underway CTD (UCTD) equipped with a sound velocity probe. The *Okeanos Explorer* plans to use the UCTD during the 2016-17 field seasons as much as possible as rather than conducting XBTs, since UCTD does not leave anything in the ocean after gathering the measurements. The UCTD 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 operating at survey speed.

When XBT operations are conducted instead of UCTD, there is minimal risk of entanglement with regards to species of concern. The very fine wire connecting the XBT probe to the ship is extremely easy to break by hand.

#### ROV Operations

ROV operations 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.

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 or to aid in habitat characterization. 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. Although the actual number of samples recovered during a dive will be dependent on the specific circumstances for that dive, except in



unusual circumstances, there will be a limit of 1-3 specimens (each) of biological and geological samples per dive.

#### CTD Operations

Both UCTD and CTD rosette operations have minimal impact to the surrounding environments as they are mostly passive sensors and have no impact with the seafloor.

#### **What insurance or bonding do you have that would provide for an emergency response or compensation for unanticipated “take” of animals and/or habitat?**

NOAA Ship *Okeanos Explorer* is a public vessel of the United States of America. Funding for *Okeanos Explorer* originates from the federal budget of the United States of America, specifically the Department of Commerce and the National Oceanic and Atmospheric Administration. NOAA has agreed to provide the ship, multibeam and ROV systems, and their own technicians required for this cruise. The U.S. government is self-insured.

#### **REFERENCES**

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**Appendix E: ESA Section 7 Initiation Letter, Biological Evaluation and Letter of Concurrence**

January 14, 2016

AnnGarrett  
AssistantRegionalAdministrator  
ProtectedResourcesDivision  
NMFSPacificIslandsRegionalOffice  
1845WaspBlvd.,Building176  
Honolulu,HI 96818

Re:RequesttoInitiateConsultationunderSection7oftheEndangeredSpeciesActfor the Campaign to Address Pacific Monument Science, Technology and Ocean Needs (CAPSTONE Project)

**DearMs.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 (*Sphyrna 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](mailto:Kelley.Elliott@noaa.gov), 301-734-1024) with questions regarding this consultation request.

Respectfully,  
Kelley Elliott

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**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 the [CAPSTONE project](#) is to extend and improve the understanding of the distribution and diversity of deepwater habitats within 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 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 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 measurements and 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 their protection 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 kHz Simrad EK60 split-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); a Knudsen 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 the PMNM, 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 obtain these 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 seasons as 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 habitat features (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 subbottom profiler is normally operated to provide information about the sedimentary features and the bottom topography that is simultaneously being mapped by the multibeam sonar. The data generated by this sonar is fundamental in helping geologists interpret the shallow geology of the seafloor. 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 characterizing marine 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 C produced 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 at Johnston, 18 at Wake, 12 at Jarvis, and 18 at Howland 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: 120° 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: 210° 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: 30° 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 (*Cheloniemydas*), 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 (*Pseudorcaerassidens*), humpback whales (*Megapteranovaeangliae*), sperm whales (*Physetermacrocephalus*), fin whales (*Balaenoptera physalus*), blue whales (*Balaenoptera musculus*), 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 (*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 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  $\geq 180$  dB re 1  $\mu$ Pa. The same threshold for pinnipeds is  $\geq 190$  dB re 1  $\mu$ Pa. Exposure to impulsive in-water sounds at  $\geq 160$  dB re 1  $\mu$ Pa 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  $\geq 120$  dB re 1  $\mu$ Pa. Because the sonar systems to be used in this action are considered impulsive sources, the 160 dB re 1  $\mu$ Pa 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  $\mu$ Pa 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  $RL = SL - (20\text{Log}R + \alpha R)$  estimates spherical spreading loss where RL = received level; SL = source level; R = range in meters, and  $\alpha$  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

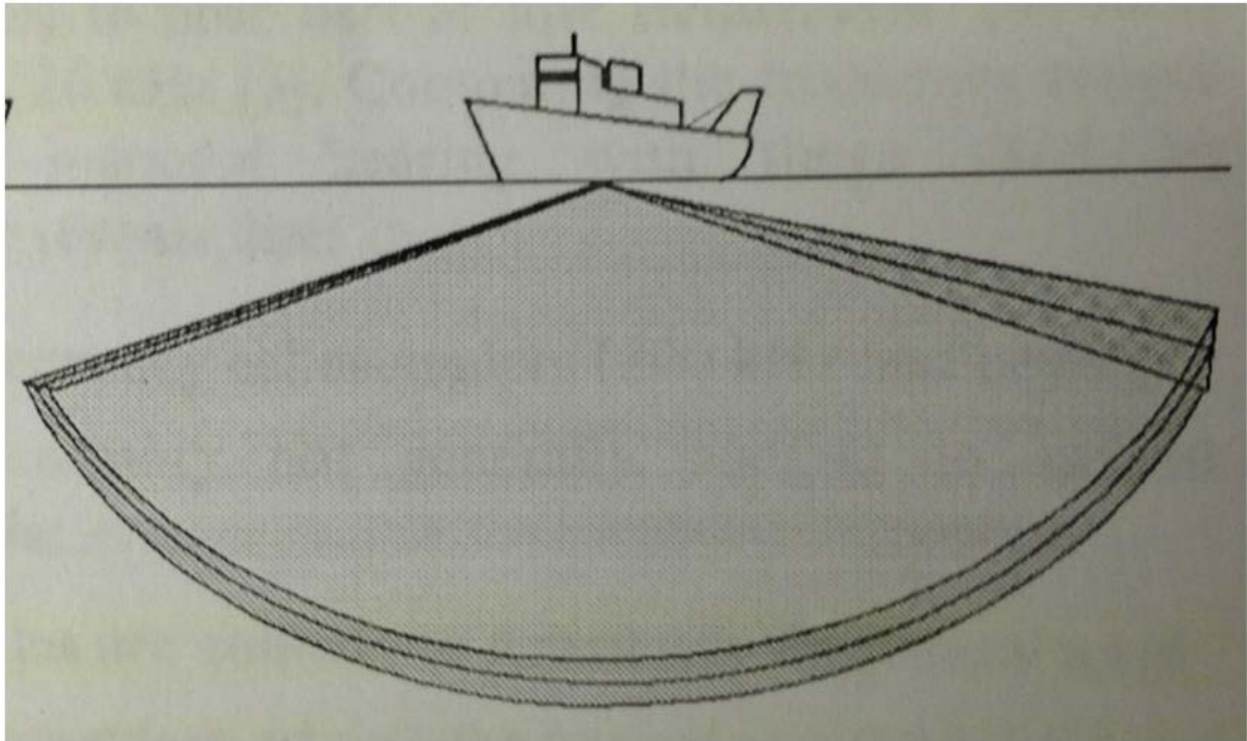
the amount of suspended solids in the water. Detailed information on these naturally occurring factors in the marine environment is rarely available and consequently they are generally not considered in the equations.

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  $\alpha$  value of 6 dB/km (@30 kHz) as computed from representative CTD casts of local oceanographic conditions in the vicinity of the monuments.

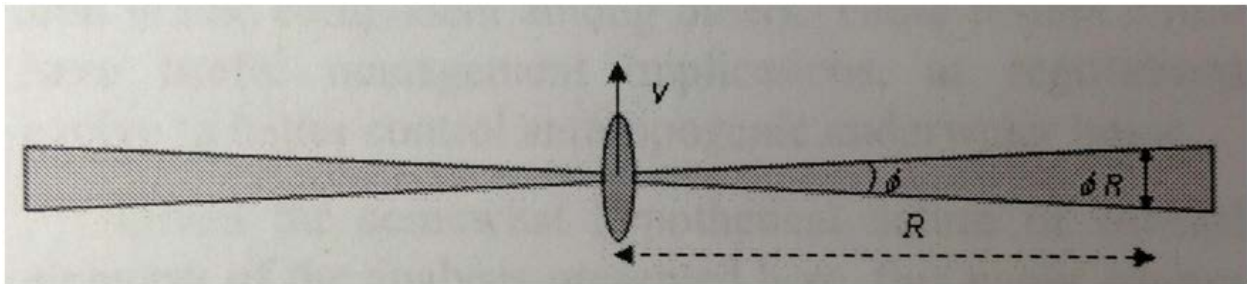
### **Acoustic Modeling - Generic Multibeam**

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  $\emptyset R/V$  where  $\emptyset$  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  $0.5^\circ$  but since it would operate in dual swath mode in shallower water it will be conservatively treated as  $1^\circ$  (same as the Falkor), yielding a  $\emptyset$  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 multibeam sonification volume from a) the horizontal and b) the overhead perspective (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

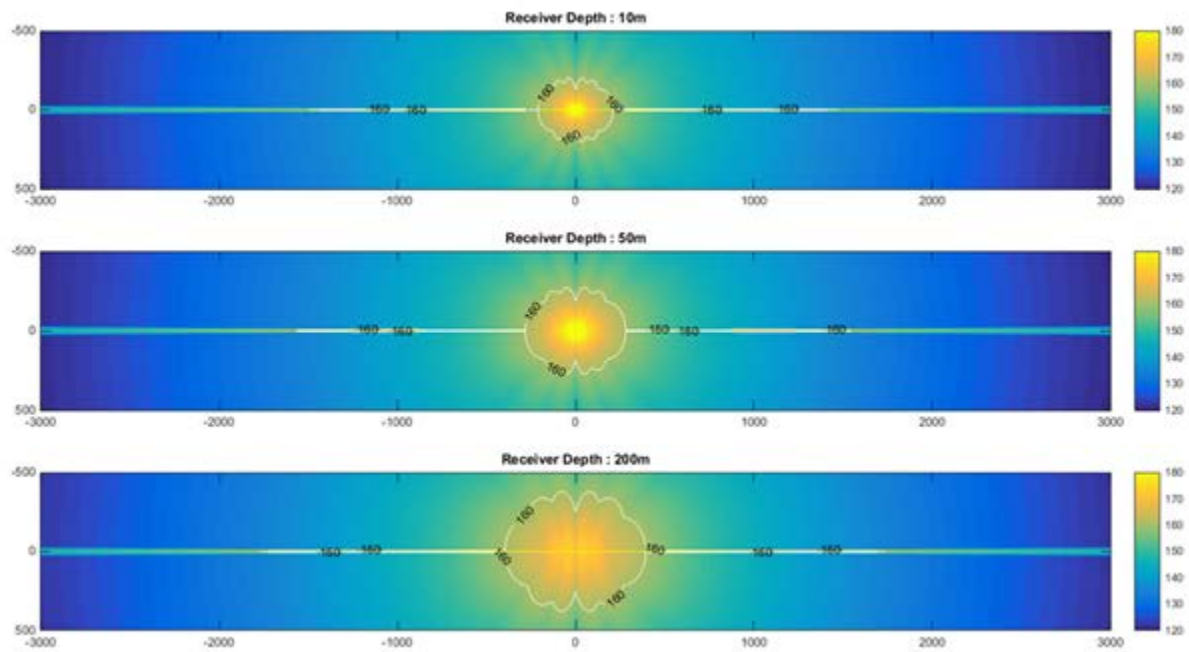
of radiated sound levels given the current configuration of the sonar. The assumptions behind the model are:

- 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.

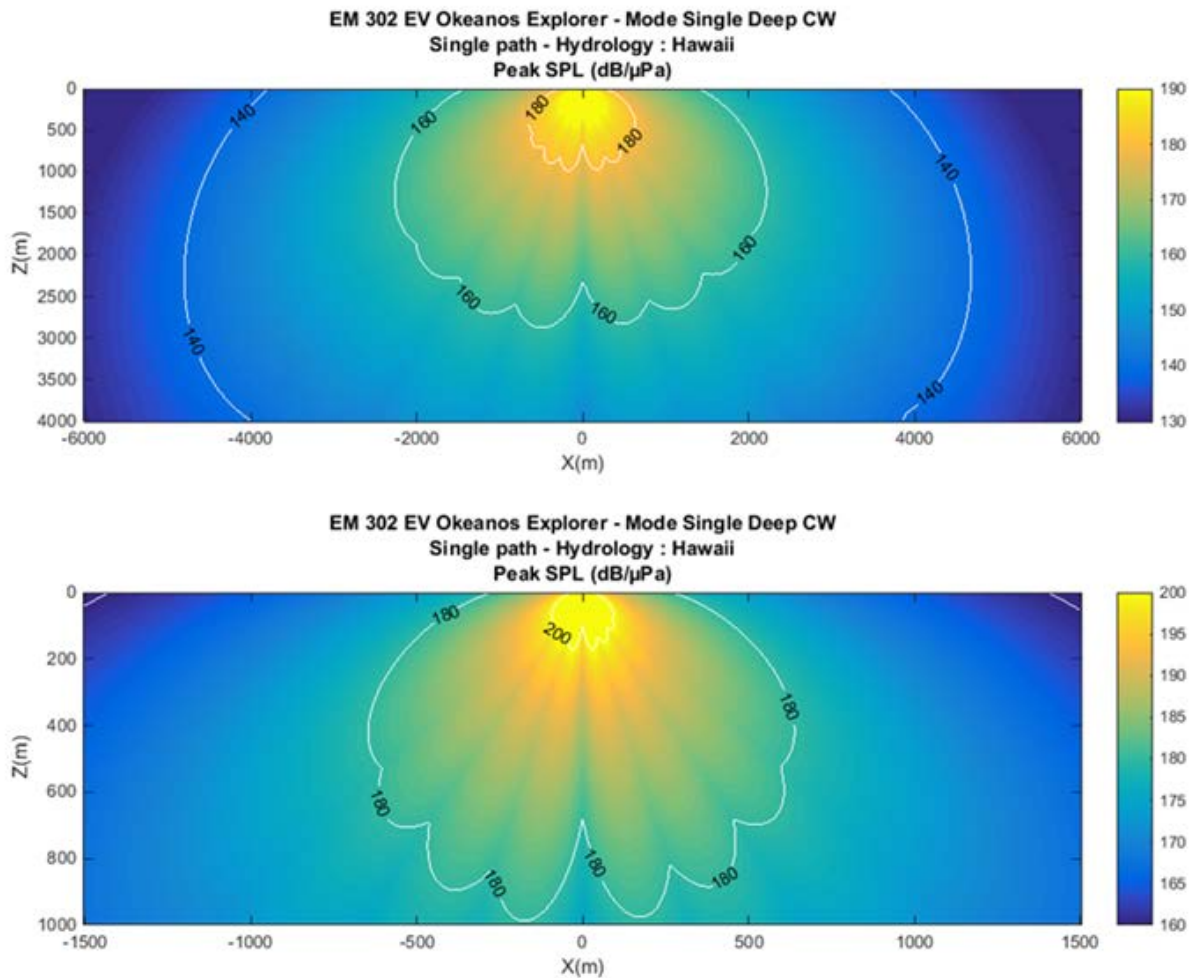
Figure 1c (below) shows horizontal plane (top-down) views of sound pressure levels at three different receiving depths within the water column directly below the transducer: 10m, 50m, and 200m. These figures demonstrate the remarkably narrow zone of ensonification in the along-track direction. Note the difference in the 160 dB/ $\mu$ Pa 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/ $\mu$ Pa 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/ $\mu$ Pa 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.

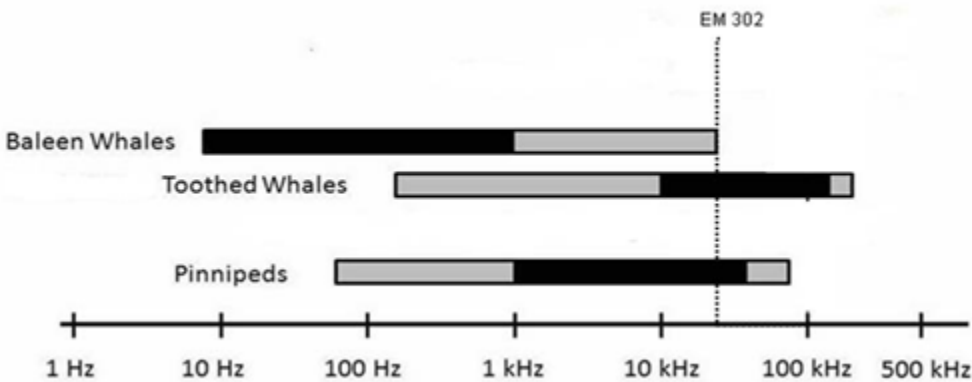


Fig. 1e: Hearing ranges of ESA-listed marine mammals groups in Hawaiian waters. Black bars show the most sensitive portion of these ranges. This figure was modified from Figure 4.2-3 of NOAA’s Southwest Fishery Science Center draft Programmatic EA (see text for more details).

On December 23, 2013, NOAA released for public comment its 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.

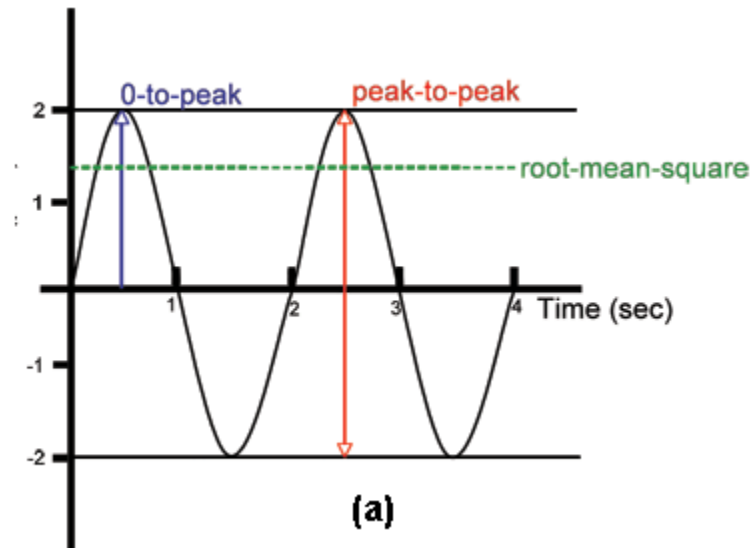


Fig. 1f: Relationship between RMS and Peak dB measurements (from <http://www.http://acousticlab.org>).

### 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* of the same type evaluated in the report. With respect to multibeam echosounders (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  $\mu$ Pa-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.**

<i>Acoustic Source</i>		<i>Frequency (kHz)</i>	<i>Source Level (dB re 1 <math>\mu</math>Pa-m)</i>	<i>Pulse Length (ms)</i>	<i>Beam Width*</i>	
					<i>Fore-aft</i>	<i>Athwart.</i>
MBES	Seabeam 2000	12	234	7-20		
	Seabeam 2100/12	12	237	<1 – 12	2° x 2°	
	Kongsberg EM122	12	242	2-15	1° x 2°	150°
	Simrad EM 120/122	12	242	2, 5, 15	1°x1°, 1°x2°	150°
	Simrad EM 300	30	237 (1°), 231 (2°)	0.7, 2, 15	1°x1°, 1°x2°	
	Simrad EM 1002	95	225 (3°)	0.2, 0.7, 2	2° x 2°	
	Krupp-AtkasHydroSweep DS	15.5	237		2.3°	
SBPs		3.5	222	64	27°	
ADCPs		38-1,200	224		30°	
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  $\mu$ Pa-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 SBPs 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, *Negaprion brevirostris* (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 the best available scientific information which indicates that the multibeam, split-beam and chirp sub-bottom profiler operate at frequencies above the hearing ability for all elasmobranchs (including scalloped hammerheads), and the propensity for the species to 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 Pago involve 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, which would 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

temperate and 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 Kohler 2003). It ranges from the intertidal and surface to depths of up to 450-512 m (Sanchez 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 leaving port. 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 field season 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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**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 (*Sphyrna 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](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, Papahānaumokuākea Marine National Monument  
Aaron Nadig, ESA Section 7 Program, USFWS, Honolulu

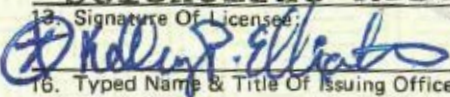

NMFS File No.: PIR-2016-9774  
PIRO Reference No.: I-PI-16-1347-AG

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Appendix F: CNMI Fish and Game License

CNMI FISH AND GAME LICENSE 03345			
1. License Number	2. Fire Arm Permit No.	3. Date Issued	4. Date Expired
03345-2016		04/20/16	07/27/16
5. Issued To: Ms. Kelley P. Elliott (NOAA)			
6. Address: 1315 East-West Hwy SSMC3 Room 10236 Silver, Spr. MD20910			
7. Date of Birth	8. Weight	9. Height	10. Eye Color
08/20/83	155 lbs.	5'4"	Blue
11. Location: Southern Islands / <input checked="" type="checkbox"/> / Northern Islands / <input checked="" type="checkbox"/> / Other / /			
12. Type of License: Scientific Research			
13. Signature Of Licensed:		14. U.S. S.S. No.:	15. Fee Paid
		A24623713	\$10.00
16. Typed Name & Title Of Issuing Officer:		17. Signature Of Issuing Officer:	
Frank R. Rasa-Enf. Supervisor			



**Appendix G: NASA Maritime Aerosols Network Survey of Opportunity**

**Survey or Project Name**

**Maritime Aerosol Network**

**Points of Contact (POC)**

<i>Lead POC or Principle Investigator (PI &amp; Affiliation)</i>	<i>Supporting Team Members ashore</i>
<b>POC: Dr. Alexander Smirnov</b>	<i>Supporting Team Members aboard (if required)</i>

**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.**