



Project Instructions

Date Submitted: April 17, 2019

Platform: NOAA Ship *Okeanos Explorer*

Project Number: EX-19-02

Project Title: 2019 Field Season Shakedown


Project Dates: May 12 - May 24, 2019

Prepared by: Shannon Hoy Digitally signed by Shannon Hoy
Date: 2019.04.16 10:38:00 -04'00' **Dated:** 4/16/2019

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Approved by:  **Dated:** 4/15/2019

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Captain David Zezula, NOAA
Commanding Officer
Marine Operations Center - Atlantic

I. Overview

“America’s future depends on understanding the ocean. We explore the ocean because its health and resilience are vital to our economy and to our lives. We depend on the ocean to regulate weather and climate; sustain a diversity of life; for maritime shipping and national defense; and for food, energy, medicine, and other essential services to humankind.”

- NOAA Office of Ocean Exploration and Research Strategic Plan

A. Brief Summary and Project Period

This document contains project instructions for EX-19-02. This cruise will be conducted 24 hours/day to perform shakedown operations of the deep-sea mapping and ROV systems in preparation for the 2019 field season. The expedition will commence on May 12, 2019 in Pascagoula, Mississippi (30° 20.355'N, 88° 34.499'W) and conclude on May 24, 2019 in Key West, Florida (24° 33.304'N, 81° 46.799'W). Operations are planned in the northeastern Gulf of Mexico along the edge of the west Florida escarpment and off the coast of Key West, FL.

Shakedown of ROV equipment will include a calibration of the ultra short baseline (USBL) positioning system, testing of a new suction sampler device, and three ROV engineering dives. Mapping shakedown will focus on calibrating the EM302 multibeam sonar (including backscatter calibration), calibrating the EK60/EK80 sonars, installing and testing the new Kongsberg K-Sync device, and troubleshooting the UnderwayCTD (UCTD) with the manufacturer’s representative. Some testing may also be completed on the ship’s dynamic positioning (DP) system. This expedition will be divided into 3 transit legs: May 12 - May 18, May 18 - May 22, and May 22 -May 24 (separated by small boat transfers). The first small boat transfer is needed to transfer off ROV Team members and to transfer on mission personnel needed to support EK60/EK80 calibration and Kongsberg equipment testing. The second small boat transfer is needed to drop off the Kongsberg technician and pick up a Teledyne technician.

NOAA’s Office of Ocean Exploration and Research (OER) is the only federal organization dedicated to exploring the global ocean. OER works with partners to identify priority areas for exploration; support innovations in exploration tools and capabilities; and encourage the next generation of ocean explorers, scientists, and engineers to pursue careers in ocean exploration and related fields. The data and information collected during our expeditions and the research we fund gives resource managers, the academic community, and the private sector the information they need to identify, understand, and manage ocean resources for this and future generations of Americans.

NOAA Ship *Okeanos Explorer* is the only U.S. federal vessel dedicated to exploring our largely unknown ocean for the purpose of discovery and the advancement of knowledge. America's future depends on understanding the ocean. We explore the ocean to make valuable scientific, economic, and cultural discoveries; we explore because ocean health and resilience are vital to our economy and to our lives. Exploration supports NOAA mission priorities and national objectives by providing high-quality scientific information about the deep ocean to anyone who needs it.

In close collaboration with government agencies, academic institutions, and other partners, OER conducts deep-ocean expeditions using advanced technologies on the *Okeanos Explorer*. From mapping and characterizing previously unseen seafloor to collecting and disseminating information about ocean depths, this work helps to establish a foundation of information and to fill data gaps. Data collected on the ship follow federal open-access data standards and are publicly available shortly after an expedition ends. This ensures the delivery of reliable scientific data needed to identify, understand, and manage key elements of the ocean environment.

B. Days at Sea (DAS)

Of the 13 DAS scheduled for this project, 8 DAS are funded by an OMAO allocation and 5 DAS are funded by OAR allocation. This project is estimated to exhibit a High Operational Tempo due to 24-hour-per-day ship and science shakedown operations.

C. Operating Area

EX-19-02 is a 24-hour a day mapping and ROV shakedown cruise that will focus operations in the U.S. Gulf of Mexico. The general operating area, approximate ship tracklines, and estimated locations of major testing operations are shown in Figure 1. All locations are approximate and will be adjusted as needed during the cruise to account for weather, vessel traffic, infrastructure safety zones, safety concerns, mapping coverage optimization, and other real-time operational considerations. All daily operational plans will be developed and shared with the Operations Officer and CO to maximize safety and efficiency.

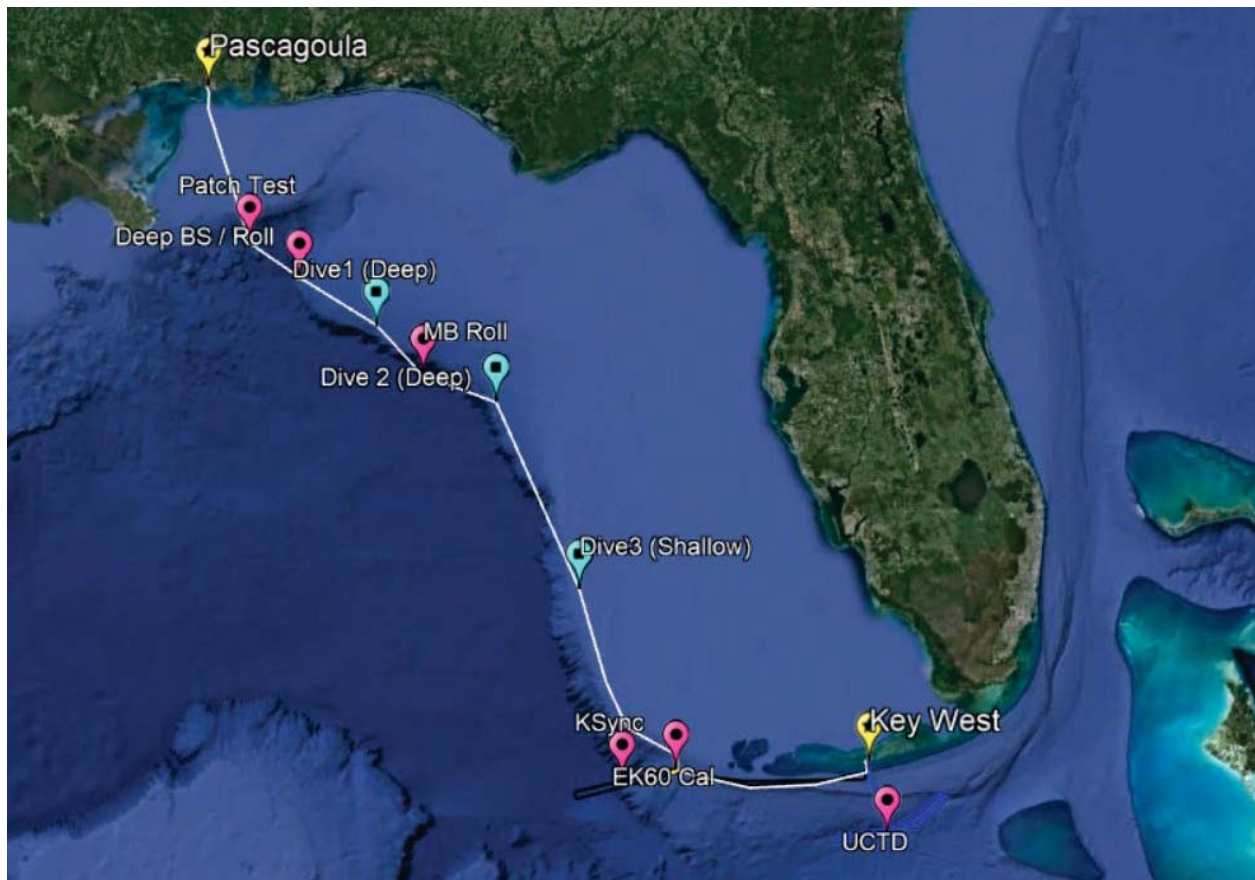


Figure 1: Map showing the general expedition operating area. The lines represent the three informal legs of the cruise: May 12-18 (white), May 18-22 (black), May 22-24 (blue). The yellow placemark demarks ports, pink shows multibeam sonar shakedown locations, and blue shows ROV shakedown locations.

Potential Locations (SUBJECT TO CHANGE)		
ID	Latitude	Longitude
Pascagoula, MS	30° 20.63'N	88° 34.02'W
MB Patch Test	28° 59.04'N	88° 01.63'W
Deep BS Cal	28° 40.88'N	87° 30.05'W
USBL/ROV 1	28° 17.23'N	86° 42.08'W
MB Deep Roll	27° 53.03'N	86° 13.05'W
ROV 2	27° 39.45'N	85° 29.06'W
ROV 3	26° 02.70'N	84° 37.29'W
EK60 Cal/ Shallow BS	24° 28.26'N	83° 39.08'W

KSync	24° 22.52'N	84° 10.14'W
UCTD	23° 53.75'N	81° 35.96'W
Key West, FL	24° 33.25'N	81° 48.63'W

Table 1: Potential site locations for EX-19-02 shakedown items (*SUBJECT TO CHANGE*).

D. Summary of Objectives

May 12 - May 24, (Pascagoula, MS - Key West, FL.) 2019 Field Season Shakedown Cruise

EX-19-02 operations will occur in the waters of the Gulf of Mexico. This cruise will conduct several systems calibration and shakedown operations and will include a combination of ship operations, mapping/operational, and data management objectives:

1. Ship
 - a. Small boat deployment (weather permitting); Develop and maintain proficiency with small boat operations for new and long term crew.
 - b. Conduct personnel transfer by small boat.
 - c. Man overboard / ship handling training.
 - d. Additional safety training.
 - e. Conduct CTD cast(s).

2. EK60 Sonar Objectives
 - a. Acceptance tests on new Kongsberg 38 kHz and 70 kHz wide band transceivers. These tests include speed noise testing of the sonar, as well as calibration using a standard target sphere suspended underneath the ship.
 - b. Perform sonar calibrations. Calibration of the five operational EK 60 sonars (18, 38, 70, 120, 200 kHz) is a top priority of the cruise. Calibration can be conducted while drifting freely in an area with low vessel traffic, no navigational hazards, and a lack of fishing gear. EK60 calibration work is planned to take place during daylight hours only. Visiting OER personnel and a Field Engineer from Kongsberg will provide technical oversight of the calibration process.
 - c. Update and revise the SOP for calibrating the EK sonars using the auto-calibration gear.
 - d. Confirm triggering and synchronization settings.
 - e. Confirm read/write permissions.

3. EM 302 Sonar Objectives
 - a. Conduct multibeam patch test, including deep roll verification lines.
 - b. Collect data for backscatter calibration across all ping modes. This calibration data will be collected at two different depths: around 500-750m for shallower sonar modes, and for deeper modes at 1500-2000m.
 - c. Confirm triggering and synchronization settings.
 - d. Confirm read/write permissions.



4. Sub-bottom profiler sonar objectives
 - a. Confirm navigation and heave inputs are received.
 - b. Confirm triggering and synchronization settings.
 - c. Confirm read/write permissions.

5. K-Sync
 - a. Fully integrate, test, and optimize the new K-Sync sonar synchronization device (with aid of the Kongsberg Technician) for the suite of scientific sonars on the ship.
 - b. Determine operating settings for synchronization of all sonars over a broad range of survey depths and sonar modes.
 - c. Optimize settings to minimize interference across all sonars.

6. Complete the mapping systems readiness report for the 2019 field season.

7. Mapping Sound Velocity Profiling Objectives
 - a. Collect XBT casts, as data quality requires, during mapping operations.
 - b. Assess the feasibility of using Sound Speed Manager to send asvp files to SIS automatically
 - c. Replace the ASVP data acquisition log with the SSM acquisition log for cruise data packages.

8. Troubleshoot the Underway CTD device
 - a. Host a technician from Teledyne to support UCTD system troubleshooting.
 - b. Conduct UCTD casts down to the full instrument rating of about 700 meters. This work is planned to be conducted in approximately 1300 m of water south of Key West in the U.S. EEZ.
 - c. Determine the best data transfer method and file formats for UCTD profiles generated by the device.
 - d. Update and refine the SOP for operating the UCTD and preparing files for input in the multibeam sonar.
 - e. Test using a small “Raspberry Pi” electronic device to make file transfers easier.
 - f. Compare water column profiling casts from the CTD, XBT, and UCTD.

9. Video Engineering (VSAT ~15 mb/sec ship-to-shore; 5 mb/sec shore-to-ship)
 - a. Test terrestrial and high-speed satellite links.
 - b. Verify Global Foundation for Ocean Exploration (GFOE)-managed telepresence systems perform as expected.
 - c. Test all subsea video equipment on Deep Discoverer and Seirios and ensure their proper integration into video system.
 - d. Test all shipboard video equipment (hangar, deck cameras, wire camera, etc) and ensure their proper integration into video system.

10. Data Management

- a. Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.
- b. Verify GFOE-managed data systems perform as expected.
- c. Test / verify and document new Mapping storage and related data management software and workflow changes.
- d. Test / verify and document integration of new EVS video recording system and related data management software and workflow changes.
- e. Evaluate concurrent OMAO/GFOE wifi network operations.
- f. Update SOPs to reflect GFOE-managed network changes.
- g. Confirm mapping data file throughput to shoreside FTP.

11. ROV

- a. Conduct full system checks for both vehicles - including all lights, cameras, thrusters, science equipment, navigation equipment, hydraulics, etc.
- b. Complete integration of new joyboxes in control room and test all commands and functions on both *Deep Discoverer* and *Seirios*.
- c. Test new suction sampler capabilities and simulate typical science collections with sampler.
- d. Conduct typical vehicle and ship movements to simulate normal dive operations.
- e. Calibrate and test the ultra short baseline (USBL) positioning system.

E. Participating Institutions

- National Oceanic and Atmospheric Administration (NOAA), Office of Ocean Exploration and Research (OER)–1315 East-West Hwy, Silver Spring, MD 20910 USA
- NOAA, National Centers for Environmental Information (NCEI), Stennis Space Center MS, 39529 USA
- University Corporation for Atmospheric Research (UCAR) Cooperative Programs for the Advancement of Earth System Science (CPAESS), PO Box 3000 Boulder, CO 80307 USA
- 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
- University of Rhode Island, Graduate School of Oceanography's Inner Space Center, 215 South Ferry Rd. Narragansett, RI 02882 USA
- Global Foundation for Ocean Exploration (GFOE), P.O. Box 417, Mystic, CT 06355
- Teledyne Marine, Oceanscience, Poway, CA 92064
- Kongsberg Underwater Technology, Inc., 19210 33rd Avenue West, Suite A, Lynnwood, WA 98036



F. Personnel (Mission Party)

Table 2: Full list of seagoing mission party members and their affiliations.

#	Name (First, Last)	Title	Date Aboard	Date Disembark	Gender	Affiliation	Nationality
1	Derek Sowers	Co-Expedition Coordinator	5/7/19	5/25/19	M	OER (CNSP)	USA
2	Shannon Hoy	Co-Expedition Coordinator	5/7/19	5/25/19	F	OER (CNSP)	USA
3	Kevin Jerram	Mapping Watch Lead	5/10/19	5/25/19	M	UCAR	USA
4	Neah Baechler	Mapping Watch Lead	5/10/19	5/25/19	F	UCAR	USA
5	Christopher Dunn	LTJG	5/10/19	5/25/19	M	NOAA	USA
6	Adrienne Copeland	EK Lead	5/10/19	5/25/19	F	OER	USA
7	Rachel Medley	E&E Director	5/18/19	5/24/19	F	OER	USA
8	Treyson Gillespie	EiT	5/18/19	5/25/19	M	UCAR	USA
9	Bobby Mohr	GFOE OPS	5/7/19	5/18/19	M	GFOE	USA
10	Fernando Aragon	Data/Software	5/7/19	5/25/19	M	GFOE	Colombia (green card)
11	Joshua Carlson	GFOE OPS	5/7/19	5/18/19	M	GFOE	USA
12	Mark Durbin	Data/VSAT	5/7/19	5/18/19	M	GFOE	USA
13	Jim Meyers	Data/Software	5/7/19	5/18/19	M	GFOE	USA
14	Levi Unema	Electrical	5/7/19	5/18/19	M	GFOE	USA
15	Sean Kennison	Mechanical / OPS Training	5/7/19	5/18/19	M	GFOE	USA
16	Karl McLetchie	Mechanical	5/7/19	5/18/19	M	GFOE	USA
17	Chris Ritter	Mechanical	5/7/19	5/18/19	M	GFOE	USA
18	Lars Murphy	Mechanical	5/7/19	5/18/19	M	GFOE	USA
19	Annie White	Video	5/7/19	5/18/19	F	GFOE	USA
20	Caitlin Bailey	Video	5/7/19	5/18/19	F	GFOE	USA
21	Roland Brian	Video/VSAT	5/7/19	5/25/19	M	GFOE	USA
22	Brian Doros	Video	5/7/19	5/18/19	M	GFOE	USA
23	Tony (Lee) Arnold	Mechanical	5/7/19	5/18/19	M	GFOE	USA
24	Tony Dalheim	Technician	5/18/19	5/22/19	M	Kongsberg	USA
25	Jason Baluyot	Technician	5/22/19	5/24/19	M	Teledyne	USA



G. Administrative

1. Points of Contact:

Ship Operations

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Global Foundation for Ocean Exploration
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**Ocean Exploration
and Research**

Vessel Shipping Address

1. Shipments

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

NOAA Ship Okeanos Explorer
ATTN: Operations Officer
Gulf Marine Support Facility
151 Watts Ave
Pascagoula, MS 39567-4102

2. Diplomatic Clearances

None required

3. Licenses and Permit

Pursuant to the National Environmental Policy Act (NEPA), NOAA OER is required to include in its planning and decision-making processes appropriate and careful consideration of the potential environmental consequences of actions it proposes to fund, authorize and/or conduct. NOAA's Administrative Order (NAO) 216-6A Companion Manual describes the agency's specific procedures for NEPA compliance. Among these is the need to review all proposed NOAA-supported field projects for their environmental effects. An Environmental Review Memorandum has been completed for this survey, in accordance with Section 4 of the Companion Manual. (Appendix C).

II. Operations

The Expedition Coordinators are 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. Locations are approximate. Final dive sites will be delivered to the bridge at night for the next day's dive. Time zone changes from US Central to US Eastern on 5/17.

Date	Activities
5/7	Cruise mobilization day. GFOE Team and Expedition Coordinators arrive. <i>Deep Discoverer</i> , <i>Seirios</i> , and the ROV storage container plan to be loaded onto the <i>Okeanos</i> on the morning. Standard preparation for ROV expeditions is anticipated, which includes hydraulic use, the ability to ping the USBL, and high voltage operations. Roger Davis from UH onboard to set up real-time backscatter mosaic software. K-Sync installation will require ET support; dockside sonar pinging may be requested. Pre-cruise meeting with ECs, OPS, and Command.
5/8	Cruise mobilization day. ROV mobilization will require multiple ROV dockside dives, both tied to the crane and free to extend the length of the tether (beginning May 8th and continuing for the duration of the dockside period). Deck and ROV teams will practice ROV launches, recoveries, and emergency recoveries prior to leaving port. This training schedule is flexible, but all deck crew should be present for at least one launch with pull pin, one recovery with daisy chain, and one emergency recovery. Attendance by all personnel involved with launch and recovery operations (deck, bridge) is encouraged. Roger Davis from UH onboard to set up real-time backscatter mosaic software. K-Sync installation will require ET support, dockside sonar pinging may be requested.
5/9	Cruise mobilization day. Deck and ROV continue training ops as needed. Roger Davis from UH onboard to set up real-time backscatter mosaic software if needed. Dockside sonar pinging may be requested.
5/10	Cruise mobilization day. Deck and ROV continue training ops as needed. Dockside sonar pinging may be requested.
5/11	Cruise mobilization day. Deck and ROV continue training ops as needed. Dockside sonar pinging may be requested. Mission team orientation meeting. Vessel familiarization meeting for any new mission team members and OPS.
5/12	First day underway. Depart Pascagoula, MS. Transit to patch test location. Overnight EM302 patch test.
5/13	0800 CTD Cast, transit to deep backscatter calibration site, another CTD cast upon arrival (~1300). Deep backscatter calibration overnight and transit to USBL/ROV Dive 1 location.
5/14	USBL calibration (0600), followed by ROV Dive 1 (on deck by 1700). Overnight EM302 deep roll verification and transit to ROV Dive 2 site.
5/15	ROV Dive 2 (0800 - 1700). Overnight transit to ROV Dive 3.
5/16	ROV Dive 3 (0800 - 1830). Extended Ops to 18:30 to maximize bottom time. Overnight transit to shallow backscatter calibration location.
5/17	0800 CTD Cast, followed by shallow backscatter calibration. Overnight transit to Key West. ROV demobilization. Minimal de-mobilization is expected. The ROV team will follow normal de-mobilization procedures and will secure all ROV spaces, including high voltage and the winch, before small boat departure on the 18th. Change time zone to EST. Setup EK60 calibration gear as possible given weather conditions (no gear overboard or as tripping hazard).



5/18	AM Weather-dependent small boat transfer of personnel. Departing 12 members of GFOE, pick up Kongsberg technician, Treyson Gillespie, and Rachel Medley. Transit to K-Sync testing location. Overnight K-Sync test and transit to EK60 calibration site. Setup EK60 calibration gear as possible given weather conditions (no gear overboard or as tripping hazard).
5/19	EK60/80 Calibration. Calibration work requires calm seas, low vessel traffic, gear in the water, and a drifting vessel. Overnight K-Sync testing.
5/20	EK60/80 Calibration. Calibration work requires calm seas, low vessel traffic, gear in the water, and a drifting vessel. Overnight K-Sync testing. Possible EM302 transmit array impedance testing concurrent with EK calibrations.
5/21	EK60/80 Calibration. Calibration work requires calm seas, low vessel traffic, gear in the water, and a drifting vessel. Overnight transit to Key West. Possible EM302 transmit array impedance testing concurrent with EK calibrations.
5/22	AM weather-dependent small boat transfer of personnel. Departing one Kongsberg technician, arriving one Teledyne technician. Transit to UCTD testing location, followed by UCTD testing. Overnight speed noise testing or mapping.
5/23	UCTD testing. Overnight opportunistic mapping and transit to Key West. Post-cruise meeting with ECs, OPS, and Command.
5/24	Arrive at Key West. Demobilization. Data/Video/VSAT demobilization will take place once the ship docks, and will require rack room and drylab power. If necessary, any items will be removed from the ship as support is available from the deck crew. Crane support is not anticipated, but may be required. Departure of some mission personnel.
5/25	Departure of remaining mission personnel.

Table 5: Detailed Cruise Itinerary. This is an approximate itinerary and is subject to change based on objective completion.

B. Staging and Destaging

Deep Discoverer, *Seirios*, and the ROV storage container plan to be loaded onto the *Okeanos* on the morning of May 7th. Standard preparation for ROV expeditions is anticipated, which includes hydraulic use, the ability to ping the USBL, and high voltage operations. Additionally, mobilization will require multiple ROV dockside dives, both tied to the crane and free to extend the length of the tether, likely beginning May 8th and continuing for the duration of the dockside period. Deck and ROV teams will practice ROV launches, recoveries, and emergency recoveries prior to leaving port. This training schedule is flexible, but all deck crew should be present for at least one launch with pull pin, one recovery with daisy chain, and one emergency recovery. Attendance by all personnel involved with launch and recovery operations (deck, bridge) is encouraged.

Minimal de-mobilization is expected. The ROV team will follow normal de-mobilization procedures and will secure all ROV spaces, including high voltage and the winch, before small boat departure on the 18th. Data/Video/VSAT demobilization will take place once the ship

docks and will require rack room and drylab power. If necessary, any items will be removed from the ship as support is available from the deck crew. Crane support is not anticipated but may be required. As well, work aloft is not expected, but may be required should VSAT issues arise during the shakedown.

C. Operations to be Conducted

- 1. Telepresence / Outreach Events**
 - a. No live events are expected
- 2. In-Port Events**
 - a. No port events are expected.

D. SCUBA Dive Plan

All dives are to be conducted in accordance with the requirements and regulations of the [NOAA Diving Program](#) and require the approval of the ship's Commanding Officer. No science dives are planned during EX-19-02, but the ship may plan training, safety drill, or maintenance dives.

E. Applicable Restrictions

Sonar Operations

EM 302, EK 60/80, 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 the appendices of this document. The final decision to operate and collect 24-hour sub-bottom profiler data will be at the discretion of the Commanding Officer.

III. Equipment

A. Equipment and capabilities provided by the ship

- Kongsberg Simrad EM302 Multibeam Echosounder (MBES)
- Kongsberg Simrad EK60 Deepwater Echosounders (18, 38, 70, 120, 200 kHz) and GPTs (18, 120, 200 kHz)
- Knudsen Chirp 3260 Sub-bottom profiler (SBP)
- Teledyne RDI Workhorse Mariner (300 kHz) ADCP
- Teledyne RDI Ocean Surveyor (38 kHz) ADCP



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- LHM Sippican XBT Mark21 System (Deep Blue probes)
- AOML Automated XBT Launcher (Deep Blue probes)
- Seabird SBE 911Plus CTD and deck box
- 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
- POS/MV with serial data feeds provided for the GFOE network
- Seabird SBE-45 (Micro TSG) data feeds provided for GFOE network
- Kongsberg Dynamic Positioning-1 System
- ECDIS
- Met/Wx Sensor Package with serial data feeds provided for GFOE network
- Three VoIP telephone lines
- 1 functioning and seaworthy SOLAS approved fast rescue boat
- 1 functioning and seaworthy work boat to support ROV operations and personnel transfers

B. Equipment and capabilities provided by the OER and partners

- Microtops II Ozone Monitor Sun photometer and handheld GPS required for NASA Marine Aerosols Network supplementary project.
- NOAA OER 6000 m *Deep Discoverer* ROV NOAA *Seirios* Camera Platform
- Teledyne Underway CTD
- Simrad EK80 38 kHz and 70 kHz Wide Band Transceivers
- QPS Fledermaus Software suite
- SIS Software and Kongsberg acquisition computer
- EK 60/80 acquisition computer
- Sub bottom profiler acquisition computer
- CTD acquisition computers
- Hypack Software
- Sound Speed Manager
- GFOE provided VSAT High-Speed link (15 Mbps ship to shore; 5 Mbps shore to ship)
- Backscatter Mosaic computer
- GFOE exploration operations networking infrastructure
- Scientific Computing System (SCS)
- Telepresence System
- NCEI Cruise Information Management System (CIMS)
- GFOE VOIP system
- GFOE provided data storage



IV. Hazardous Materials

A. Policy and Compliance

The Expedition Coordinators are 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
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 (35 gallons)	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	Winch room
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
Adhesive Pliobond 25	General adhesive	Tool room
AP 120 Metal Prep	Degreaser/cleaner for metal surfaces	Pit
Butane Fuel	Torch refill	Tool Room
PVC cement	Adhesive for PFV plastic piping	Tool Room
Phosphoric Acid	Ferrous metal rust removal	Tool room
Pipetite Paste	Plumbing sealant	Tool room/pit



Spindle Oil 10, ROS PT	Lubricant/compensation oil	Tool room
DC557	Silicon grease	Tool room/pit
Tether Potting Catalyst	Two part epoxy catalyst	Pit
Tether Potting Compound	Two part epoxy ingredient	Pit
ThermaPlex Bearing Grease	Lubricant	Pit
Tritech Seaking	Compensator oil for sonar head	Pit

C. Chemical safety and spill response procedures

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

D. Radioactive Materials

NOT APPLICABLE TO THIS CRUISE

V. Additional Projects

A. Supplementary Projects

NASA Maritime Aerosol Network

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

http://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html

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

See Appendix G for full Survey of Opportunity Form.

B. NOAA Fleet Ancillary Projects

No NOAA Fleet Ancillary Projects are planned.

VI. Disposition of Data and Reports

A. Data Responsibilities

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

Ship Responsibilities

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

NOAA OER Responsibilities

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

Deliverables

1. At sea
 - a. Daily plans of the Day (POD)
 - b. Daily situation reports (SITREPS)
 - c. Summary forms for each CTD rosette cast
 - d. Daily summary bathymetry data files
 - e. Raw sonar files (EM 302, EK 60, Sub-bottom, ADCP)
2. Post cruise
 - a. Refined SOPs for all pertinent operational activities
 - b. Assessments of all activities
3. Science
 - a. Multibeam raw and processed data (see appendix B for the formal cruise data management plan)
 - b. XBT raw and processed data
 - c. EK 60 raw data
 - d. Knudsen 3260 sub-bottom profiler raw data
 - e. ADCP raw data
 - f. Mapping data report
 - g. 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.



**Ocean Exploration
and Research**

VII. Meetings, Vessel Familiarization, and Project Evaluations

A. Shipboard Meetings

A safety brief and overview of POD will occur on the Bridge each morning at 0800. Daily Operations Briefing meetings will be held at a time and location determined by Operations Officer based on watch schedule, 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. OER Daily Situation Reports (SITREPS) will be produced by onboard Expedition Coordinator (EC). OMAO related information in SITREPS will be discussed during either safety or operations meetings. Additionally, EC and OPS will meet as needed to discuss OMAO related information in SITREPS. The OPS Officer will be cc'd on SITREPS sent to shore to provide additional clarification as needed.

1. Pre-Project Meeting:

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

2. Vessel Familiarization Meeting:

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

3. Post-Project Meeting:

The Commanding Officer is responsible for conducting a meeting no earlier than 24 hours before or seven days after the completion of a project to discuss the overall success, challenges, and shortcomings of the project. Concerns regarding safety, efficiency, and suggestions for future improvements shall be discussed and mitigations for future projects will be documented for future use. This meeting shall be attended by the applicable ship's officers, applicable crew, the

Expedition Coordinator, and members of the scientific party and is normally arranged by the Operations Officer and Expedition Coordinator.

4. Project Evaluation Report:

Within seven days of the completion of the project, a Customer Satisfaction Survey is to be completed by the Expedition Coordinator. The form is available at https://docs.google.com/a/noaa.gov/forms/d/1a5hCCkgIwaSII4DmrHPudAehQ9HqhRqY3J_FXqbJp9g/viewform and provides a “Submit” button at the end of the form. Submitted form data is deposited into a spreadsheet used by OMAO management to analyze the information. Though the complete form is not shared with the ship, specific concerns and praises are followed up on while not divulging the identity of the evaluator.

VIII. Miscellaneous

A. Meals and Berthing

The ship will provide meals for the scientists listed above. Meals will be served 3 times daily beginning one hour before scheduled departure, extending throughout the project, and ending two hours after the termination of the project. Since the watch schedule is split between day and night, the night watch may often miss daytime meals and will require adequate food and beverages (for example a variety of sandwich items, cheeses, fruit, milk, juices) during what are not typically meal hours. Special dietary requirements for scientific participants will be made available to the ship’s command at least 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 Coordinators. The Expedition Coordinator and Operations Officer will work together on a detailed berthing plan to accommodate the gender mix of the scientific party taking into consideration the current makeup of the ship’s complement. The Expedition Coordinators are 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 Coordinators are 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 30 days 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 must be accompanied by [NOAA Form \(NF\) 57-10-02 - Tuberculosis Screening Document](#) in compliance with OMAO Policy 1008 (Tuberculosis Protection Program).

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

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

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

Contact Information:

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

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

Prior to departure, the Expedition Coordinators 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 OER 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 OMAO Very Small Aperture Terminal (VSAT) link.

Specific information on how to contact NOAA Ship *Okeanos Explorer* and all other fleet vessels can be found at <https://www.oma.noaa.gov/learn/marine-operations/ships/okeanos-explorer/contact>

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
 Email: 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



**Ocean Exploration
and Research**

Voice Over IP (VoIP) Phone:

(541) 867-8932

(541) 867-8933

(541) 867-8934

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

Email: 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

There will be no Foreign National Guests on this cruise.



**Ocean Exploration
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Appendix A

EMERGENCY CONTACT DATA SHEET–NOAA SHIP *OKEANOS EXPLORER*

Scientists sailing aboard *Okeanos Explorer* shall fill out the form found at the following link location: <https://docs.google.com/forms/d/e/1FAIpQLSfuDrKAdhyvlthnmrZMdL-Qtz-vFT4lff5TnJlagi0PRI9eIQ/viewform?c=0&w=1> with their emergency contact information



**Ocean Exploration
and Research**

Appendix B: Data Management Plan

Data Management Plan
Okeanos Explorer (EX1902): 2019 Field Season
Shakedown



OER Data Management Objectives

Data targeted for the NOAA archives will be documented and stewarded according to the normal standard operating procedures in place for Okeanos Explorer missions.

27-Mar-19

Page 1

1. General Description of Data to be Managed

1.1 Name and Purpose of the Data Collection Project

Okeanos Explorer (EX1902): 2019 Field Season Shakedown

1.2 Summary description of the data to be collected.

Data from three ROV engineering dives, EM302 multibeam sonar data including backscatter, EK60 and EK80 sonar data

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

expedition, exploration, explorer, marine education, noaa, ocean, ocean discovery, ocean education, ocean exploration, ocean exploration and research, ocean literacy, ocean research, OER, science, scientific mission, scientific research, sea, stewardship, systematic exploration, technology, transformational research, undersea, underwater, Davisville, mapping survey, multibeam, multibeam backscatter, multibeam sonar, multi-beam sonar, noaa fleet, okeanos, okeanos explorer, R337, Rhode Island, scientific computing system, SCS, single beam sonar, singlebeam sonar, single-beam sonar, sub-bottom profile, water column backscatter, shakedown, UCTD, EK80, suction sampler, Key West, Pascagoula, oceans

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

Okeanos Mapping Cruises

1.5 Planned or actual temporal coverage of the data.

Dates: 5/12/2019 to 3/24/2019

1.6 Planned or actual geographic coverage of the data.

Latitude Boundaries: 24.55 to 30.34

Longitude Boundaries: -88.57 to -81.81

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

Cruise Summary, Data Management Plan, Bottom Backscatter, Dive Summaries, EK60 Singlebeam Data, EK80 Echosounder, Multibeam (image), Multibeam (processed), Multibeam (product), Multibeam (raw), Raw Video (digital), Sample Logs, SCS Output (compressed), SCS Output (native), Water Column Backscatter

1.8 What platforms will be employed during this mission?

NOAA Ship Okeanos Explorer, Deep Discoverer ROV, SEIRIOS Camera Sled



2. Point of Contact for this Data Producing Project

Overall POC: Shannon Hoy

Title: Physical Scientist

Affiliation/Dept: NOAA Office of Ocean Exploration and Research

E-Mail: shannon.hoy@noaa.gov

Phone:

3. Point of Contact for Managing the Data

Data POC Name: Megan Cromwell

Title: Okeanos Explorer Data Manager

E-Mail: megan.cromwell@noaa.gov

4. Resources

- 4.1 Have resources for management of these data been identified? True
- 4.2 Approximate percentage of the budget devoted to data management. (specify % or "unknown")
unknown

5. Data Lineage and Quality

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

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

5.2 What quality control procedures will be employed?

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

6. Data Documentation

True

6.1 Does the metadata comply with the Data Documentation Directive?

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

not applicable

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.

Okeanos Explorer (EX1902): 2019 Field Season Shakedown

URL: <https://www.ncddc.noaa.gov/oer-waf/ISO/Resolved/2019>
 Meta Std: ISO 19115-2 Geographic Information with Extensions for Imagery and Gridded Data will be the metadata standard employed.

6.3 Process for producing and maintaining metadata:

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

7. Data Access

True

7.1 Do the data comply with the Data Access Directive?

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

Not Applicable

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

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

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

Org: NOAA National Centers for Environmental Information

URL: <https://www.ncei.noaa.gov>

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

Hold Time: none

Authority: not applicable

7.4 Prepare a Data Access Statement

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

8. Data Preservation and Protection

8.1 Actual or planned long-term data archive location:

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

8.2 If no archive planned, why?

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

60-90 days

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

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

Okeanos Explorer (EX1902): 2019 Field Season Shakedown



8.5 Prepare a Data Use Statement

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

Okeanos Explorer (EX1902): 2019 Field Season Shakedown

Appendix C: Categorical Exclusion

Form Version: September 2017

Categorical Exclusion (CE) Evaluation Worksheet

Project Identifier: EX1902

Date Review Completed: 3/14/2019

Completed by: Shannon Hoy (Physical Scientist)

OAR Functional Area: OER

Worksheet File Name: 2019-03-OER-CE-EX1902

Step 1. CE applicability

- 1. Is this federal financial assistance, including via grants, cooperative agreements, loans, loan guarantees, interest subsidies, insurance, food commodities, direct appropriations, and transfers of property in place of money?**

no

- 2. What is the proposed federal action?**

The proposed action is to perform multiple calibration procedures of NOAA Ship Okeanos Explorer's systems to prepare for the upcoming field season. These actions include confirming operational status and calibrating the ship's sonars, sound velocity profiling equipment, and the remotely operated vehicles: Seirios and Deep Discover. The EX1902 expedition will conduct operations in the U.S. exclusive economic zone (EEZ) in the Gulf of Mexico, beginning in Pascagoula, Mississippi and ending in Key West, Florida. The expedition is currently scheduled to depart from Pascagoula, Mississippi (30° 20.36'N, 88° 34.50'W) on May 12, 2019, and end in Key West, Florida (24° 33.304'N, 81° 46.799'W) on May 24, 2019. See EX1902 project instructions for more details.

- 3. Which class of CE in Appendix E of the NAO 216-6A Companion Manual is applicable to this action and why?**

- a. G3: Topographic, bathymetric, land use and land cover, geological, hydrologic mapping, charting, and surveying services that do not involve major surface or subsurface land**



disturbance and involve no permanent physical, chemical, or biological change to the environment.

- b. The topical scope of this action is consistent with CE number G3 in Appendix E of the Companion Manual to NOAA Administrative Order (NAO) 216-6A: Topographic, bathymetric, land use and land cover, geological, hydrologic mapping, charting, and surveying services that do not involve major surface or subsurface land disturbance and involve no permanent physical, chemical, or biological change to the environment. The EX1902 expedition will conduct calibrations of sonars which will involve no permanent physical, chemical or biological change to the environment.

Step 2. Extraordinary Circumstances Consideration

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

No. The NOAA Ship Okeanos Explorer will be operating in remote deep-sea areas of the Gulf of Mexico. Expedition EX1902 will conduct post dry-dock ship shakedown operations. All operation areas are underwater and therefore have no human presence, (see Figure 1 of EX1902 project instructions for generalized operating locations). This action does not involve any procedures or outcomes known to result in impacts on human health and safety more than would be negligible.

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

This expedition will not occur in areas of the Gulf of Mexico with unique environmental characteristics such as sanctuary boundaries or within historically or culturally significant areas. Furthermore, any effects caused by sonar calibration and ROV testing during this expedition will negligible on the seabed and water column.

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

OER has taken measures to ensure that any effects on species or habitats protected by the ESA, MMPA, MSA or NMSA meet the definition of negligible. In 2018, an 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 NOAA Ship Okeanos Explorer operations conducted during the 2018-2019 field seasons, including those to be undertaken during the EX1902 expedition, are not likely to adversely affect ESA-listed marine species. The informal consultation was completed on August 8, 2018 when OER received a signed Letter of Concurrence from the Chief ESA Interagency Cooperation

Division in the NOAA Office of Protected Species, stating that NMFS concurs with OER's determination that operations conducted during NOAA Ship Okeanos Explorer 2018-2019 field seasons are not likely to adversely affect ESA-listed marine species. The ESA section 7 letter of concurrence is provided as an appendix D in the EX1902 project instructions.

Given the offshore focus of most of our proposed work, it is improbable that we will encounter marine mammals protected under the MMPA or sea birds protected under the MBTA. If we did encounter any such protected animals, our impacts would be negligible because of the best management practices to which we adhere to avoid or minimize environmental impacts. These best management practices are outlined in the appendices of the EX1902 project instructions.

OER also initiated a request for an abbreviated essential fish habitat (EFH) consultation for expeditions by NOAA Ship Okeanos Explorer in 2018-2020 to the Greater Atlantic Region, including the operating area of EX1902. On July 19, 2018 OER received a letter from the Assistant Regional Administrator for the NOAA Office of Habitat Conservation stating that these expeditions will not adversely impact EFH. This letter is provided in appendix E of the EX1902 project instructions.

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

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

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

The proposed action will not result in adverse effects that cannot be resolved through applicable regulatory processes since we will not be operating within listed or eligible properties, lands, resources or sites coming under the umbrella of protections referenced above.

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

No, the NOAA Ship Okeanos Explorer will be operating in remote and offshore areas of the Gulf of Mexico during EX1902 (see Figure 1 in EX1902 project instructions for map of planned locations). There are no communities within or near the geographic scope of the cruise and the cruise does not involve actions known or likely to result in adverse impacts on human health.

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

No. During EX1902, NOAA Ship Okeanos Explorer will not make landfall in areas other than commercial ports in Pascagoula, Mississippi and Key West, Florida. The ship and OER mission team will comply with all applicable local and federal regulations regarding the prevention or spread of invasive species. At the completion of every ROV dive or CTD cast, the equipment will be thoroughly rinsed with fresh water and completely dried to prevent spreading organisms from one site to another. Also the Engineering Department aboard the NOAA Ship Okeanos Explorer attends yearly Ballast Management Training in accordance with NOAA Form 57-07-13 NPDES VGP Annual Inspection and Report to prevent the introduction of invasive species.

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

The proposed action will not result in a potential violation of Federal, State, or local law or requirements imposed for protection of the environment. The expedition coordinator obtained authorizations for this expedition via several consultations on ESA Section-7 and EFH outlined in sections 4-7 above.

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

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

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

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

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

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

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

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

CE Determination

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

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

Signature: CANTELAS.FRANK.J.1
365855087

Digitally signed by
CANTELAS.FRANK.J.1365855087
Date: 2019.03.25 12:23:12 -0400

Signed by: Frank Cantelas, Deputy Director (Acting)

Date Signed: March 25/2019



Appendix D: ESA Section 7 Concurrence Letter



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

AUG 08 2018

Refer to NMFS No: FPR-2018-9276

Commander William Mowitt
Deputy Director
Office of Ocean Exploration and Research
1315 East West Highway
Silver Spring, Maryland 20910

RE: Concurrence Letter for the National Oceanic and Atmospheric Administration's Office of Ocean Exploration and Research's Marine Operation Activities on the National Oceanic and Atmospheric Administration Ship *Okeanos Explorer* for the 2018 through 2019 Field Seasons

Dear Mr. Mowitt:

On July 6, 2018, the National Marine Fisheries Service (NMFS) received your request for a written concurrence that the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration and Research's marine operations activities on the NOAA Ship *Okeanos Explorer* for the 2018 through 2019 field seasons under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.) is not likely to adversely affect species listed as threatened or endangered or critical habitats designated under the ESA. This response to your request was prepared by NMFS pursuant to section 7(a)(2) of the ESA, implementing regulations at (50 C.F.R. §402), and agency guidance for preparation of letters of concurrence.

We reviewed the consultation request document and related materials submitted by your office. We requested that your office update the acoustic thresholds submitted in the biological evaluation to match NMFS's 2018 acoustic technical guidance (NMFS 2018a). This assisted NMFS's ESA Interagency Cooperation Division to determine the total amount of disturbance from acoustic sources during the 2018 through 2019 field season on the NOAA Ship *Okeanos Explorer* is not likely to adversely affect ESA listed species within the action area. In addition, our assessment considered prior analyses and determinations on recent ESA informal consultations which had the same activities in similar geographic locations and the implementation of all mitigation measures included in your biological evaluation (NMFS 2017; 2018b). Based on our knowledge, expertise, and the materials submitted in your request for informal consultation, we concur with the Office of Ocean Exploration and Research's conclusions that the proposed action is not likely to adversely affect ESA-listed species and/or designated critical habitat.

This concludes consultation under the ESA for species and/or designated critical habitat under NMFS's purview on the NOAA Office of Ocean Exploration and Research's marine operation activities on the NOAA Ship *Okeanos Explorer* for the 2018 through 2019 field seasons.

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Reinitiation of consultation is required and shall be requested by the NOAA Office of Ocean Exploration and Research or by NMFS where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) take occurs; (b) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this consultation; (c) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not previously considered in this consultation; or (d) if a new species is listed or critical habitat designated that may be affected by the action (50 C.F.R. §402.16).

We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation, please contact me at (301) 427-8495 or by email at cathy.tortorici@noaa.gov or Jonathan Molineaux at (301) 427-8440 or by email at jonathan.molineaux@noaa.gov.

Sincerely,



Cathryn E. Tortorici
Chief, ESA Interagency Cooperation Division
Office of Protected Resources

Literature Cited

- NMFS. (2017). *Concurrence letter for activities to be conducted for National Centers for Coastal Ocean Science-led activities as part of the Southeast Deep Coral Initiative in 2017 through 2019*. Silver Spring, Maryland: National Marine Fisheries Service, Office of Protected Resources.
- NMFS. (2018a). *2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0)*. NOAA Technical Memorandum. U.S. Department of Commerce.
- NMFS. (2018b). *ESA Section 7 Consultation regarding to the proposed issuance of an Incidental Harassment Authorization to Garden State Offshore Energy for upcoming surveys*. Gloucester, Massachusetts: National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office.



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Appendix E: EFH Concurrence Letter



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

JUL 19 2018

MEMORANDUM FOR: Daniel Wagner, Ph.D.
Expedition Coordinator, Cherokee Nation Strategic Programs
NOAA Office for Ocean Exploration and Research

FROM: Louis A. Chiarella 
Assistant Regional Administrator, Habitat Conservation Division

SUBJECT: Essential Fish Habitat (EFH) Consultation for Deep-Sea
Exploration Activities occurring within the Greater Atlantic
Region aboard NOAA Ship *Okeanos Explorer* in 2018-2020

This responds to your request for an abbreviated EFH consultation for the field activities to be conducted aboard the NOAA Ship *Okeanos Explorer* in the Greater Atlantic Region between July 2018 and December 2020. During this time, up to 33 different research expeditions will be undertaken to collect critical baseline information in unknown or poorly known areas of the region at depths of 250 m or deeper through telepresence-based exploration. Specific activities to be undertaken include the use of deep-water mapping systems such as multi-beam, single beam, sub-bottom profiler and acoustic Doppler current profiler (ACDP) sonar systems, and the use of remotely operated vehicles (ROV), the ship's conductivity-temperature-depth (CTD) rosette, underway CDT, and high-bandwidth satellite connection for real-time ship to shore communications. New technologies and novel applications may be tested during the research expeditions. These technology demonstration projects are still under development at this time and will be evaluated individually for environmental impact. Your consultation request supplements a previously completed EFH consultation between NOAA's National Centers of Coastal Ocean Science (NCCOS) and NOAA Fisheries Southeast Regional Office (SERO) for research activities to be conducted in U.S. federal waters of the Gulf of Mexico, South Atlantic Bight and Caribbean in 2017-2019 using NOAA ships *Okeanos Explorer* and *Nancy Foster*.

As specified in the Magnuson Stevens Fishery Conservation and Management Act (MSA), EFH consultation is required for federal actions that may adversely affect EFH. We have reviewed information provided on the proposed activities as well as the protective measures and best management practices incorporated into the action and have determined that adverse impacts have been minimized to the extent practicable. As such, we have no EFH conservation recommendations to provide pursuant to Section 305(b)(2) of the MSA. Further EFH consultation on this action is not necessary unless future modifications are proposed that would change the basis of our determination.

cc: GAR/HCD- K.Greene
SERO/HCD-V. Fay, D. Dale



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Appendix F: Summary of Mitigation Measures and Best Management Practices

Protective Measures and Best Management Practices (BMPs) Incorporated into the Action. BMPs are required to be incorporated within project instructions, cruise plans and NEPA documentation including financial assistance awards and environmental review memoranda. All applicable BMPs must be communicated to the science leads, boat operators and field staff, and as necessary between ship's crew (Commanding Officer/Master or designee(s), as appropriate) and scientific party in order to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures.

Bridge Watchstanders 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 (BMPs) to minimize disturbance.

1. Minimize Exposure to Elevated Noise Levels

- a. Maintain watch for the presence of marine protected species. Immediately notify the survey department of the proximity of cetaceans and sea turtles. 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.
 - i. If a sea turtle is present within 400 m of the ship, the survey department will respond by stopping the pinging of the sub-bottom sonar. The sub-bottom shall remain off until the sea turtle has departed the 400 m safety zone.
 - ii. If cetaceans are present within 400 m of the ship (460 m/500 yards for North Atlantic Right Whales), the vessel would stop if the animal is in danger of colliding with the ship but the mapping sonars would continue transmitting to avoid startle responses. If an observed animal is unable or unwilling to depart the immediate area, sonars will be secured and the ship will slowly move away from the area if feasible.
 - iii. If the cetacean is within 400 m (460 m/500 yards for North Atlantic Right Whales) and is not in danger of collision, reduce speed and seek to avoid the animal as much as possible.
 - iv. The Survey Department will respond by stopping the pinging of the sub-bottom sonar and switching the multibeam sonar into "mammal protection" mode (keeps it pinging but at a source level reduced by 20 decibels). No change will occur to the EK 60s. Note: the ADCPs are never run simultaneously with the multibeam and sub-bottom, so



they would already be off. The ADCPs are mostly run when the ship is stationary at a dive site and risk to marine mammals is minimal.

- b. Minimize turning all sonar sound sources on and off as a precautionary measure to avoid possible startling of animals.
- c. When the systems have been shut down for any reason, the multibeam mammal protection mode would be used to turn the multibeam back on first. Only after the multibeam has been brought from mammal protection mode to full power would the sub-bottom profiler and EK 60 sonars then be turned back on.
- d. 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 to essentially mimic the approach of the “mammal protection” mode of the multibeam.

2. Minimize Temporary Disturbance from Human Activity

- a. All in-water work will be postponed when whales are within 100 yards, or other protected species are within 50 yards;
 - i. This includes postponing start-up of the USBL in preparation for an ROV dive.
- b. Should a marine protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s); and
- c. No attempts will be made to feed, touch, ride, or otherwise intentionally interact with any marine protected species.

3. Minimize Entanglement

- a. Maintain watch for and avoid the presence of marine protected species. Notify the department heads of the proximity of animals;
- b. All in-water work will be postponed when whales are within 100 yards, or other protected species are within 50 yards of the vessel;
- c. Should a marine protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s); and
- d. Individuals participating in the activity will closely monitor the instrument cables at all times while they are deployed.

4. Minimize Collisions with Vessels

The [following guidelines](#) for vessel operation in the presence of marine protected species and other marine wildlife are provided by the Bureau of Ocean Energy Management in a Notice to Lessees and Operators, and NOAA Fisheries as part of a Biological Opinion:

a. Vessel Strike Avoidance

Vessel operator and crew must maintain a vigilant watch for all marine mammals and sea turtles and slow down or stop the vessel or alter course, as



appropriate, to avoid striking any marine mammal. These requirements apply when the vessel is in transit and do not apply in any case where compliance will create an imminent and serious threat to a person or vessel or to the extent that a vessel is restricted in its ability to maneuver and, because of the restriction, cannot comply. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel according to the parameters stated below. Visual observers monitoring the vessel strike avoidance zone can be either third-party visual protected species observers or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena. Vessel strike avoidance measures shall be followed during sonar surveys and while in transit.

Vessel personnel should do the following in order to avoid causing injury or death to marine mammals and sea turtles:

- i. Maintain a vigilant watch for marine mammals and sea turtles and slow down or stop their vessel to avoid striking protected species.
- ii. When whales are sighted, maintain a distance of 100 yards (91 meters) or greater from the whale. If the whale is believed to be a North Atlantic right whale, vessel personnel should maintain a minimum distance of 500 yards (460 meters) from the animal (50 CFR 224.103).
- iii. When sea turtles or small cetaceans are sighted, attempt to maintain a distance of 50 yards (45 meters) or greater whenever possible.
- iv. When cetaceans are sighted while a vessel is underway, attempt to remain parallel to the animal's course. Avoid excessive speed or abrupt changes in direction until the cetacean has left the area.
- v. Reduce vessel speed to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel when safety permits. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity of the vessel; therefore, precautionary measures should always be exercised.
- vi. Whales may surface in unpredictable locations or approach slowly moving vessels. When vessel personnel sight animals in the vessel's path or in close proximity to a moving vessel, reduce speed and shift the engine to neutral. Do not engage the engines until the animals are clear of the area.

The vessel must maintain a minimum separation distance of 100 m (328.1 ft) from large whales (i.e. sperm and baleen whales). The following avoidance measures must be taken if a large whale is within 100 m (328.1 ft) of the vessel.

- The vessel must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the

vessel's path and the minimum separation distance has been established.

- If the vessel is stationary, the vessel must not engage engines until the whale(s) has moved out of the vessel's path and beyond 100 m (328.1 ft).

b. Additional Requirements for the North Atlantic Right Whale

- i. If a sighted whale is believed to be a North Atlantic right whale, federal regulation requires a minimum distance of 500 yards be maintained from the animal (50 CFR 224.103 ©).
- ii. Vessels entering North Atlantic right whale critical habitat are required to report into the Mandatory Ship Reporting System.
- iii. Mariners shall check with various communication media for general information regarding avoiding ship strikes and specific information regarding North Atlantic right whale sighting locations. These include NOAA weather radio, U.S. Coast Guard NAVTEX broadcasts, and Notices to Mariners. Commercial mariners calling on United States ports should view the most recent version of the NOAA/USCG produced training CD entitled "A Prudent Mariner's Guide to Right Whale Protection" (contact the NMFS Southeast Region, Protected Resources Division for more information regarding the CD).
- iv. Injured, dead, or entangled right whales should be immediately reported to the U.S. Coast Guard via VHF Channel 16.
- v. Adherence to seasonal vessel speed restrictions of 10 knots or less as [designated locations](#) along the U.S. east coast.
- vi. Adherence to NOAA Compliance Guide for Right Whale Ship Strike Reduction Rule.

5. Minimize Vessel Waste and Discharge & Prevent Invasive Species

- a. 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.
- b. Meet all EPA Vessel General Permits and Coast Guard requirements.
- c. Avoid discharge of ballast water in designated critical habitat.
- d. Use anti-fouling coatings.
- e. Clean hull regularly to remove aquatic nuisance species.
- f. Avoid cleaning of hull in critical habitat.
- g. Avoid cleaners with nonylphenols.

6. Avoid or Minimize Impacts to Essential Fish Habitat

- a. The vessel would employ the use of dynamic positioning during ROV dives (no anchoring);
- b. ROVs would be operated in a manner to avoid seafloor disturbance, and setting the ROV on the seafloor will be held to a minimum. For those



situations when the ROV does make contact with the seafloor, visual observations will be made to confirm that the area the ROV is set down on does not include corals or other fragile animals that can reasonably be avoided;

- c. Sample collections would be limited (typically 4 - 6 total rocks and primary biological specimens per dive) that represent new species, new records, the dominant morphotype animal in a community, or species to support connectivity studies. These specimens would be collected using the ROV's manipulator arms or scoop. Whenever possible, sample collections will be made using the cutting implementation tool on the ROV, and only portions of organisms (<50 cm) will be collected to avoid mortality. Clonal biological specimens (corals, sponges) would be subsampled;
- d. 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.;
- e. After each ROV dive, the vehicles are brought back onboard and thoroughly sprayed with freshwater and allowed to air dry before the next dive. Though marine organisms should not survive this process, the ROV is thoroughly inspected prior to every dive and checked for the presence of biological organisms to prevent the spread of invasive or non-endemic species from one location to another;
- f. Instruments deployed to collect water samples and current data (except for expendable instruments) would not be allowed to contact the seafloor;
- g. The use detergents and other pollutants which may be washed into the marine environment will be avoided or held to a minimum;
- h. The vessel will adhere to MARPOL discharge regulations at all times during the proposed cruises;
- i. Except in an emergency, the vessel will not anchor while at sea.



Appendix G: NASA Maritime Aerosols Network Survey of Opportunity

Survey or Project Name

Maritime Aerosol Network

Lead POC or Principle Investigator (PI & Affiliation)

POC: Dr. Alexander Smirnov

Supporting Team Members Ashore

Supporting Team Members Aboard (if required)

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

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



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