

Ocean Exploration and Research

Cruise Report: EX-18-03, Gulf of Mexico 2018 (ROV/Mapping)

Remotely Operated Vehicle (ROV) and Mapping Exploration of the U.S. Exclusive Economic
Zone (EEZ) in and around the Gulf of Mexico

April 11, 2018, to May 3, 2018
Pascagoula, Mississippi, to Key West, Florida

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Abstract

Between April 11 and May 3, 2018, the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration and Research (OER) and partners conducted a 22-day, telepresence-enabled expedition on NOAA Ship *Okeanos Explorer* to collect critical baseline information about unknown and poorly understood deepwater areas surrounding the Gulf of Mexico. The goal of the expedition was to use remotely operated vehicle (ROV) dives in combination with mapping operations to increase scientific understanding of deep-sea ecosystems of this region, as well as to provide a foundation of publicly-accessible data to spur further exploration, research, and management activities.

Using OER's dual-body ROV, the expedition conducted 15 ROV dives that ranged in depth from 500 to 3,010 meters, and included midwater exploration ranging in depth from 300 to 2,100 meters. Hundreds of species were observed, including first-time *in situ* observations of some species and previously unseen behaviors of others; several significant range extensions were also documented. Sixty-five (65) biological samples were collected during the expedition (21 primary and 44 associated and commensal taxa), some of which may be undescribed species. At least five high-density communities of deep-sea corals were documented, including one at ~2,600 meters, the deepest known from the Gulf of Mexico, and two previously unknown chemosynthetic habitats were discovered. Twelve rock samples were collected for geochemical composition analysis and age dating. The expedition surveyed two previously unexplored shipwrecks, producing 3D photogrammetry of both sites. Over 22,099 square kilometers of seafloor were mapped over the course of the expedition, including areas around Perdido Canyon that had never before been mapped using high-resolution sonars.

All data collected during the expedition, including video, environmental, mapping, oceanographic, and meteorological data, are publically available through the national archives. Highlight images, videos, educational materials, and descriptions of the accomplishments of the expedition are available via the expedition website <https://oceanexplorer.noaa.gov/okeanos/explorations/ex1803/welcome.html> (Last accessed June 2020). There were 173 scientists from 35 institutions in six countries who participated remotely in this expedition via telepresence technology.

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1. Introduction

By leading national efforts to explore the ocean and make ocean exploration more accessible, the NOAA Office of Ocean Exploration and Research (OER) is filling gaps in basic understanding of deep waters and the seafloor, providing deep-ocean data, information, and awareness. Exploration within the U.S. Exclusive Economic Zone (EEZ) and international waters, as part of the Seabed 2030 efforts to produce a bathymetric map of the world ocean floor by 2030, supports key NOAA, national, and international goals to better understand and manage the ocean and its resources.

Using the latest tools and technology, OER explores unknown areas of the deep ocean. NOAA Ship *Okeanos Explorer* is one such tool. Working in close collaboration with government agencies, academic institutions, and other partners, OER conducts deep-sea exploration expeditions using advanced technologies on NOAA Ship *Okeanos Explorer*, mapping and characterizing areas of the ocean that have not yet been explored. Collected data about deep waters and the seafloor—and the resources they hold—establishes a foundation of information and fills gaps in the unknown.

All data collected during *Okeanos Explorer* expeditions adhere to 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.

Exploring, mapping, and characterizing the U.S. EEZ are necessary to a systematic and efficient approach for advancing the development of ocean resources, promoting the protection of the marine environment, and accelerating the economy, health, and security of our nation. As the only federal program dedicated to ocean exploration, OER is uniquely situated to lead partners in delivering critical deep-ocean information to managers, decision makers, scientists, and the public—leveraging federal investments to meet national priorities.

2. Expedition Overview

From April 11 through May 3, 2018, NOAA and partners conducted the final cruise of a three-part, telepresence-enabled ocean exploration expedition on NOAA Ship *Okeanos Explorer* to collect critical baseline information and improve knowledge about unexplored and poorly understood deepwater areas of the Gulf of Mexico. The *Gulf of Mexico 2018* (<https://oceanexplorer.noaa.gov/okeanos/explorations/ex1803/welcome.html>) cruise was part of a series of expeditions incorporating both at-sea and shore-based teams to explore unknown and poorly known areas of this region, which helped to build on data collected in 2017.

2.1 Rationale for Exploration



The Gulf of Mexico is home to a wide diversity and distribution of deep-sea habitats and associated marine communities in the Gulf of Mexico basin. This expedition was the final exploration effort planned in the Gulf of Mexico before the ship transitioned back to the East Coast. As part of the planning for this expedition, NOAA collaborated with the scientific and management communities to assess the exploration needs and data gaps in unknown and poorly known deepwater areas in these largely unexplored U.S. waters.

Data and information from this expedition will help to improve scientific understanding of the deep-ocean habitats of the Gulf of Mexico and the connections between communities throughout the Gulf of Mexico basin. It will also inform deep-sea management plans for habitat areas of particular concern (HAPCs), marine protected areas (MPAs), and national marine sanctuaries; support local scientists and managers seeking to understand and manage deep-sea resources; and stimulate subsequent exploration, research, and management activities.

This expedition also contributed to the ongoing collaborations with the NOAA Office of National Marine Sanctuaries Maritime Heritage Program, the Bureau of Ocean Energy Management (BOEM), the U.S. Geological Survey (USGS), and the NOAA National Marine Fisheries Service (NMFS) Deep Sea Coral Research and Technology Program (DSCRTP) Southeast Deep Coral Initiative (SEDCI).

This expedition used the ship's deepwater mapping systems (Kongsberg EM 302 multibeam sonar, Simrad EK60 split-beam fisheries sonars, Knudsen 3260 chirp sub-bottom profiler [SBP] sonar, and Teledyne Acoustic Doppler Current Profiler [ADCP]), NOAA's dual-body deepwater remotely operated vehicles (ROVs), and a high-bandwidth satellite connection for real-time ship-to-shore communications. ROV dives included high-resolution visual surveys of water column and seafloor habitats as well as biological and geological sampling.

2.2 Objectives

NOAA Ship *Okeanos Explorer* cruises, in general, have a large number of objectives that can be categorized as being either scientific or programmatic in nature. Typically, science objectives are specific to a particular cruise or set of cruises, whereas programmatic objectives (i.e., operations, telepresence, data management, education, and outreach) are common to all cruises. Below are brief descriptions of the science and programmatic objectives for EX-18-03.

2.2.1 Science Objectives

EX-18-03 operations occurred in the Gulf of Mexico. The expedition addressed several scientific themes and priority areas put forward by NOAA scientists and resource managers, the Gulf of Mexico Fisheries Management Council, the South Atlantic Fishery Management Council (SAFMC), BOEM, USGS, and the broad ocean science community indicated in the EX-18-03 Project Instructions found at <https://repository.library.noaa.gov/view/noaa/21419> (Last accessed August 2020). The primary objective of the expedition was to support priority NOAA science and management needs, including multiple MPAs, by providing baseline information collected during the *Gulf of Mexico 2018* expedition. This expedition sought to:

- Acquire data about deepwater habitats in the Gulf of Mexico to support priority science and management needs.
- Identify, map, and explore the diversity and distribution of benthic habitats, including fish habitats, deep-sea coral and sponge communities, chemosynthetic communities, and biological communities that colonize or aggregate around shipwrecks.
- Explore U.S. maritime heritage by identifying and investigating sonar anomalies as well as characterizing shipwrecks.
- Investigate biogeographic patterns of deep-sea ecosystems and connectivity across the Gulf of Mexico for use in broader comparisons of deepwater habitats throughout the Gulf of Mexico basin.
- Map, survey, and sample geological features within the Gulf of Mexico to better understand the geological context of the region and to improve knowledge of past and potential future geohazards.
- Collect high-resolution bathymetry in areas with no or low-quality mapping data.
- Acquire a foundation of ROV, sonar, and oceanographic data to understand the characteristics of the water column and fauna that live there.
- Engage a broad spectrum of the scientific community and the public in telepresence-based exploration.
- Provide a foundation of publicly-accessible data and information products to spur further exploration, research, and management activities.

2.2.2 Programmatic Objectives

a) *Mapping and ROV Operations*

Mapping objectives during each NOAA Ship *Okeanos Explorer* cruise are to collect high-resolution acoustic data. Data were collected from all four types of sonars on the ship: EM 302 multibeam, EK60 echo sounder, 3.5 kHz SBP, and ADCPs. Mapping data were acquired during transits, as well as on specific targets identified by the science team. Data from these systems were processed as quickly as possible in order to generate daily mapping products that supported ROV operations. Data quality was expected to be high, as a result of proper instrument maintenance, careful planning of the surveys, and appropriate calibration of the instruments. For example, standard operating procedure for the multibeam sonar is to obtain sound velocity profiles at regular intervals—no longer than six hours—using expendable bathythermographs (XBTs).

ROV objectives were to obtain high-quality video and sensor data on exploration targets to achieve the science objectives. This most often involved surveying benthic habitats and features in priority areas (e.g., deep corals and related benthic ecosystems, canyons, and seamounts), as well as occasionally surveying in midwater for water column organisms. Benthic surveys were not only used to characterize the habitats in each target area but also to ground-truth the acoustic data with visual data (i.e., video). In 2015, the ROV was fitted with hydraulically-activated sample boxes that permitted ROV pilots to collect limited geological and biological specimens.

b) *Telepresence*



Telepresence objectives were to provide real-time, high-quality video and audio during ROV dives to as wide a shoreside audience as possible. This audience included the general public, students, and researchers—the latter of whom were either passively watching or actively participating in the dives via teleconference or instant messaging. Telepresence was used to help achieve the science objectives by extending the science team well beyond those actually onboard the ship. Telepresence also helped to achieve the expedition’s education and outreach objectives through live ship-to-shore events.

c) Data Management

Data management objectives were to collect, process, distribute, and archive cruise data as quickly and efficiently as possible. Effective data management provided a foundation of publicly accessible information products to spur further exploration, research, and management activities; it also stimulated interest in the deep-sea environment and the excitement of exploration. Each year, new methods and new equipment, such as video encoders, are tried and tested in an effort to improve data management activities.

d) Education and Outreach

Education and outreach objectives included the engagement of the general public in ocean exploration through live video and a variety of other web-based products, both during and after each cruise. Web content included topical essays written before the cruise, daily updates, mission logs, highlight videos, still imagery and mapping products—all of which are posted on the OER website (<http://oceanexplorer.noaa.gov/okeanos/welcome.html>). Additional activities, including live telepresence events and ship tours, helped to expand the reach of this expedition.

3. Participants

EX-18-03 included at-sea mission personnel as well as shore-based science personnel who participated remotely via telepresence technology. See **Table 1** for the at-sea mission personnel and **Table 2** for the shore-based personnel who supported EX-18-03.

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4. Methodology

To accomplish its objectives, EX-18-03 used:

- A dual-bodied ROV system—ROVs *Deep Discoverer (D2)* and *Seirios*—to conduct daytime seafloor and water column surveys, as well as to collect a limited number of samples to help further characterize the deepwater fauna and geology of the region.
- Sonar systems—Kongsberg EM 302 multibeam sonar, Knudsen 3260 SBP, Simrad EK60 split-beam sonars, and ADCPs—to conduct mapping operations at night and when the ROVs were on deck.
- A high-bandwidth satellite connection for real-time ship-to-shore communications (telepresence).

All environmental data collected during this expedition have been archived with NOAA archives and are publicly accessible. The data management plan for EX-18-03 can be found in Appendix A.

4.1 ROV Seafloor Surveys

ROV dive operations supported the expedition objectives listed in Section 2.2 and included high-resolution visual surveys of seafloor and water column habitats as well as geological and biological sampling. During each dive, the ROVs descended to the seafloor and then moved from waypoint to waypoint, documenting the geology and biology of the area. Each ROV dive was approximately 8-10 hours long, conditions and logistics permitting. Dives were primarily conducted during the day (operations described in detail by Quattrini et al., 2015 and Kennedy et al., 2019). Additional information about the general process of site selection, collaborative dive planning, scientific equipment on the ROVs, and the approach to benthic exploration used on NOAA Ship *Okeanos Explorer* can be found in Kennedy et al. (2019).

At-sea and shore-based scientists identified organisms based on data available during real-time assessments to the lowest taxon possible. Additionally, they provided geological interpretations of the observed substrate throughout each ROV seafloor survey through audio commentary and a chat log. Geological and biological annotations were recorded using Ocean Networks Canada's SeaTube v2 and SeaScribe.

For water column exploration, a series of transects were performed during vehicle ascent following the completion of the benthic/seafloor exploration. Transects primarily targeted the deep scattering layer and the waters directly above and below it. Specific transect depths were decided each day during ROV descent through an evaluation of the Simrad EK60 data, which acoustically determined the position of the deep scattering layer, and the ROV conductivity, temperature, depth (CTD) data. Additionally, when seafloor depth allowed, a standard set of deeper transects were also completed at 2,100, 900, 700, and 500 meters. The length of time of the transects varied between 20 and 50 minutes at each depth, depending on the specific objectives for water column exploration, conditions, and seafloor depth. Specific transect depths and times are noted in each dive summary (see Section 7.1.1).

4.2 Sampling Operations

A limited number of geological and biological samples were collected on the seafloor using ROV *D2*'s manipulator arms and geological and biological collection boxes. The primary goal of the sampling operations was to collect voucher samples to be made publicly available for site characterization.

For each sample collected, the date, time, latitude, longitude, depth, salinity, temperature, and dissolved oxygen (DO) content were recorded at the time of collection. Geological samples were acquired for age dating and geochemical composition analysis. Biological collections targeted samples that represented potential new species, range extensions of animals not previously known to occur in the region, dominant species at the site, and/or rare morphotypes. Samples targeted to contribute to trans-Atlantic connectivity studies were also collected.

After vehicle recovery, samples were examined for commensal organisms, labeled, photographed, and entered into a database with all relevant metadata. Any commensal organisms found were separated from primary samples and processed separately as "associate" samples.

Geological samples were air dried and placed in rock bags or small containers, depending on the size of the sample. At the conclusion of the NOAA Ship *Okeanos Explorer* 2018 expeditions, these samples were shipped to the Marine and Geology Repository at Oregon State University (OSU) where they will be photographed and entered into the university's online database. Thin and polished sections will be made for each hard-rock sample. Descriptions and photos are included in the database.

Biological samples were subsampled for inclusion in the Smithsonian Institution's National Museum of Natural History (USNM) Biorepository for future barcoding and DNA extraction. For this purpose, a small subsample, consisting of not more than 1 cm² of tissue, was removed

from the original sample and placed in 95% analytical grade ethanol (EtOH).

For most of the biological samples, the remainder of the sample was also preserved in 95% EtOH. Some of the samples from seep sites were also frozen for isotope analysis. For select taxa, vouchers or subsamples were preserved in 10%, 5%, or 4% buffered formalin, per recommendation from taxonomic experts and guidance provided by the USNM. Full details of the preservation of each biological sample are in the associated metadata record. All voucher samples and subsamples from EX-18-03 were shipped to the USNM for long-term archival and public access. Additional information about accessing samples collected during this expedition can be found in Section 7.2.1.

4.3 Acoustic Operations

Acoustic operations included Kongsberg EM 302 multibeam, Simrad EK60 split-beam, Knudsen SBP, and ADCP data collection. The schedule of mapping operations included overnight transits and whenever the ROVs were on deck. The ADCP's and EK60 38kHz only run during ROV dives. Lines were planned to maximize edge matching of existing data or filling of data gaps in areas with incomplete bathymetry coverage. In regions with no existing data, exploration transit lines were planned to optimize potential discoveries. Targeted mapping operations were conducted in the vicinity of: (1) Perdido Canyon, (2) Pourtales Terrace, and (3) the West Florida Escarpment.

4.3.1 Multibeam Sonar (Kongsberg EM 302)

Multibeam seafloor mapping data were collected using the Kongsberg EM 302 sonar, which operates at a frequency of 30 kHz. Multibeam mapping operations were conducted during all overnight transits between ROV dive sites. When possible, transits were designed to maximize coverage over seafloor areas with no previous high-resolution mapping data. Overnight surveys were also completed in areas that were previously mapped with a lower resolution multibeam sonar system. Additionally, multibeam mapping operations were conducted directly over planned ROV dive locations in order to collect seafloor mapping data to help refine dive plans. Multibeam mapping operations collected data about seafloor depth (i.e., bathymetry), seafloor acoustic reflectivity (i.e., seafloor backscatter), and water column reflectivity (i.e., water column backscatter).

4.3.2 Sub-bottom Profiler (Knudsen Chirp 3260)

The primary purpose of the Knudsen Chirp 3260 (3.5 kHz) sonar is to image sediment layers underneath the seafloor to a maximum depth of about 80 m below the seafloor, depending on the specific sound velocity of the substrate. The sub-bottom profiler was operated simultaneously with the multibeam sonar during mapping operations to provide supplemental information about the sedimentary features underlying the seafloor.

4.3.3 Split-beam Sonars (Simrad EK60)



NOAA Ship *Okeanos Explorer* is equipped with three Simrad EK60 split-beam sonar transducers which operate at frequencies of 18, 38, 70, 120, and 200 kHz. EK60 sonars were used continuously throughout EX-18-03, during both overnight mapping operations and daytime ROV operations. The sonars provided calibrated, target-strength measurements of water column features such as dense biological layers and schools of fish. These sonars helped to support the EM 302 with identifying seeps on the seafloor. The EK60 was also used during midwater transects of ROV dives to detect the depth of the deep scattering layers, which are aggregations of biological organisms in the water column. The 38 kHz EK60 was only used during ROV dives.

4.3.4 Acoustic Doppler Current Profiler (Teledyne Workhorse Mariner and Teledyne Ocean Surveyor ADCPs)

NOAA Ship *Okeanos Explorer* is equipped with two ADCPs: a Teledyne Workhorse Mariner (300 kHz) and a Teledyne Ocean Surveyor (38 kHz). The ADCPs provide information on the speed and direction of currents underneath the ship. They were used throughout ROV dives to support safe deployment and recovery of the vehicles.

4.3.5 Expendable Bathythermograph (Lockheed Martin Sippican Deep Blue XBT) Systems

The Lockheed Martin Sippican Deep Blue XBT probe was deployed to obtain sound velocity profile and to help calibrate the multibeam system and ensure accurate bathymetric mapping. XBTs were collected every six hours as environmental conditions were met and applied in real time using Seafloor Information Software (SIS). Sound speed at the sonar head was determined using sound speed from a flow-through thermosalinograph (TSG).

4.4 Conductivity, Temperature, and Depth (CTD)

CTD profiles were collected to provide better information on the critical properties of the water column. Additional sensors installed on the ship's CTD measured light scattering (LSS), DO, and oxygen reduction potential (ORP).

4.5 Sun Photometer Measurements

OER gathers limited at-sea measurements aboard NOAA Ship *Okeanos Explorer* to support a National Aeronautics and Space Administration (NASA)-led, long-term research effort that assesses marine aerosols. As time allowed on cloud-free days during EX-18-03, at-sea personnel collected georeferenced sun photometer measurements for the Maritime Aerosol Network (MAN) component of the Aerosol Robotic Network (AERONET). AERONET is a network of sun photometers that measure atmospheric aerosol properties around the world. MAN complements AERONET by conducting sun photometer measurements on ships of opportunity to monitor aerosol properties over the global ocean. More information about this NASA Survey of Opportunity can be found in Appendix E.

5. Clearances and Permits

Pursuant to the National Environmental Policy Act (NEPA), 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. The companion manual for NOAA Administrative Order 216-6A (<https://www.nepa.noaa.gov/docs/NOAA-NAO-216-6A-Companion-Manual-03012018.pdf>) describes the agency's specific procedures for NEPA compliance.

An environmental review memorandum was completed for all NOAA Ship *Okeanos Explorer* expeditions in 2018 in accordance with Section 4 of the Companion Manual in the form of a categorical exclusion (CE) worksheet (Appendix B). Based on this review, a CE was determined to be the appropriate level of NEPA analysis necessary, as no extraordinary circumstances existed that required the preparation of an environmental assessment or environmental impact statement. OER is preparing a programmatic environmental assessment to cover future expeditions. This evaluation document memorandum describes all activities that are part of the SEDCI.

As required under Section 7 of the Endangered Species Act (ESA), OER conducted an informal consultation with the NMFS Office of Protected Resources to request their concurrence with OER's biological evaluation determining that NOAA Ship *Okeanos Explorer* operations conducted as part of SEDCI may affect, but are not likely to adversely affect, ESA-listed marine species. The informal consultation was completed on July 13, 2017, when OER received a signed letter from the Regional Administrator of South East Regional Office, stating that NMFS concurs with OER's determination that conducting proposed SEDCI cruises are not likely to adversely affect ESA-listed marine species (Appendix C). OER completed consultation with NOAA's Habitat Conservation Division on potential SEDCI impacts of OER's operations to Essential Fish Habitat (EFH). They concurred that OER's operations would not adversely affect EFH, provided adherence to OER's proposed procedures and their guidance stated in the letter (Appendix D). Copies of all environmental compliance are publicly available in the Project Instruction for EX-18-03 <https://repository.library.noaa.gov/view/noaa/21419> (Last accessed September 2020).

6. Schedule and Map

EX-18-03 consisted of a total of 22 days at sea operations, from April 11, 2018, to May 3, 2018. The ship departed from Pascagoula, Mississippi, and returned to port in Key West, Florida. See **Table 3** for a day-by-day breakdown of EX-18-03. There were 15 dives achieved (see **Table 6** for details). See **Figure 1** for a map of the ship's track, dive sites, and bathymetry collected during EX-18-03.



Table 3: EX-18-03 schedule.

April - May						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
4/8/2018	4/9/2018	4/10/2018 Mobilization of vessel in Pascagoula, Mississippi	4/11/2018 NOAA Ship <i>Okeanos Explorer</i> embarking on the <i>Gulf of Mexico 2018</i> expedition from Pascagoula, Mississippi	4/12/2018 Dive 01: Engineering and Cultural Heritage* BOEM 15445 Shakedown objectives readiness and archaeological focus	4/13/2018 Dive 02: Engineering and Cultural Heritage* BOEM 15572 (Thunder Hawks)	4/14/2018 Overnight mapping to Whiting Dome Rough weather
4/15/2018 Transit to next dive site due to rough weather	4/16/2018 Dive 03: Unnamed Ridge in GC973 Seafloor Biology	4/17/2018 Dive 04: Unnamed Mound in EB 1009 Seafloor Biology	4/18/2018 Dive 05: North wall of Perdido Canyon/AC 813 Geology	4/19/2018 Dive 06: Hidalgo Basin/GB 903 Seafloor Biology	4/20/2018 Dive 07: Mud Volcano in WR 488 Geology	4/21/2018 Transit to Pascagoula, Mississippi, for Engine Repairs
4/22/2018 Pascagoula for Engine Repairs	4/23/2018 Pascagoula for Engine Repairs	4/24/2018 Repairs complete— Departing Pascagoula and Transiting to the West Florida Escarpment	4/25/2018 Dive 08: Northern West Florida Escarpment, DeSoto Canyon Region Seafloor Biology	4/26/2018 Dive 09: Northern End of West Florida Escarpment, DeSoto Canyon Region (DC 862) Seafloor Biology/ Midwater West Florida Deep North	4/27/2018 Dive 10: North West Florida Escarpment Bend, DeSoto Canyon Region (DC 862) Seafloor Biology Big Bend	4/28/2018 Dive 11: South of Long Mounds and Midwater Transects Seafloor Biology/Mid water



4/29/2018	4/30/2018	5/1/2018	5/2/2018	5/3/2018		
Dive 12: South of Okeanos Ridge Seafloor Biology	Dive 13: Southern West Florida Escarpment Ridge and Midwater Transects Seafloor Biology Toe Ridge	Dive 14: Southern West Florida Escarpment Canyon Ridge Seafloor Biology Pulley Ridge	Dive 15: Southern West Florida Escarpment Ridge, Pourtales Terrace Sinkhole Seafloor Biology	NOAA Ship <i>Okeanos Explorer</i> arrived at port in Key West, Florida		

*Locations of Dive 01 and 02 are restricted

The expedition focused on acquiring data about priority exploration areas identified by the ocean management and scientific communities, building on the *Gulf of Mexico 2017* expedition. The EX-18-03 expedition consisted of exploration of deep-sea coral and sponge communities, bottomfish habitats, undersea canyons, shipwrecks, and a variety of chemosynthetic habitats including cold seeps, mud volcanoes, and brine pools. For Dives 01 and 02, OER followed the Operational Policy and Procedures for Underwater Cultural Heritage (UCH) Missions conducted onboard NOAA Ship *Okeanos Explorer*. This expedition helped to establish baseline information in the region to catalyze further exploration, research, and management activities.



Gulf of Mexico 2018

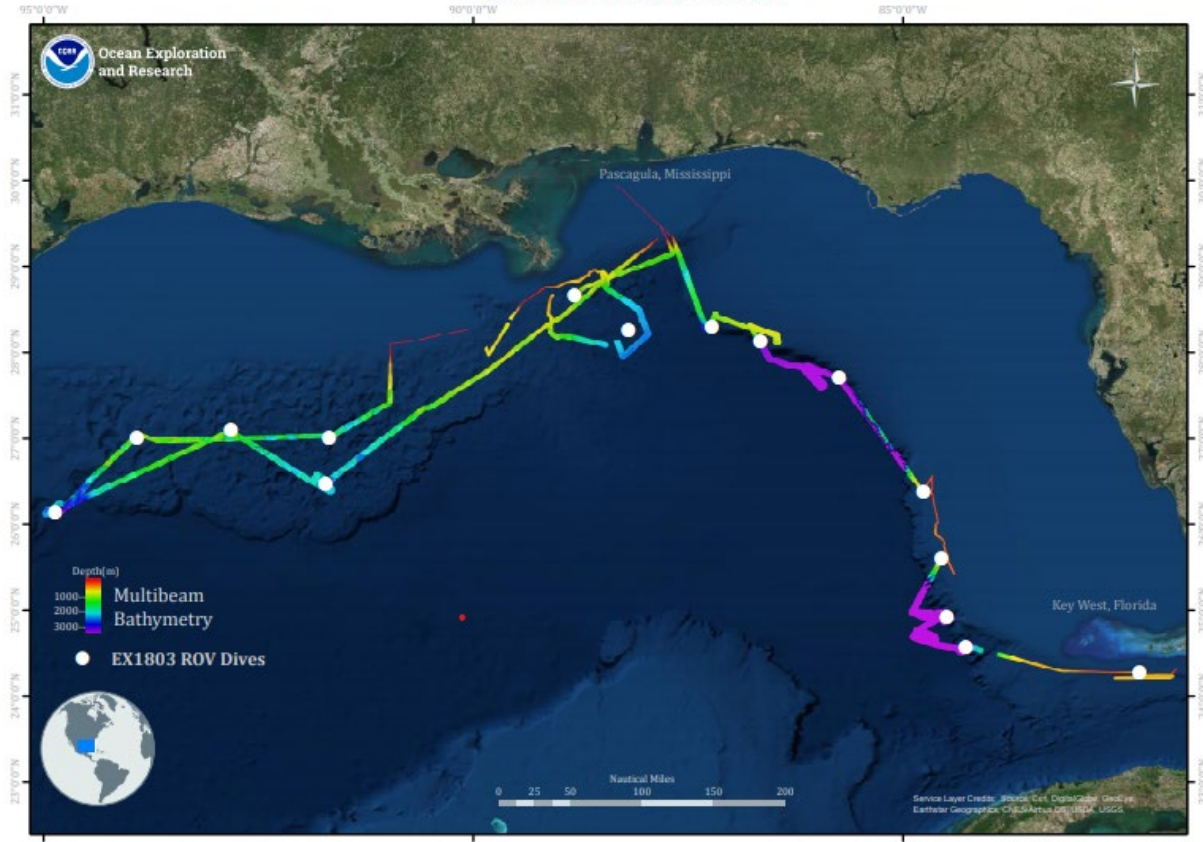


Figure 1. Map showing the ship track, 15 ROV dive sites, and bathymetry data collected during EX-18-03.

7. Results

Metrics for EX-18-03’s major exploration and scientific accomplishments are summarized in **Tables 4** and **5**. More detailed results are presented in the subsections that follow.

Table 4: Summary of exploration metrics for EX-18-03.

Exploration Metrics	Totals
Days at sea	22
Days at sea in U.S. EEZ	22
Linear km mapped by EM 302	4238
Square km covered by EM 302	22,099
Square km covered by EM 302 in U.S. EEZ	21,743
Vessel CTD casts	1

XBT casts	72
ROV dives	15
ROV dives in U.S. EEZ	15
Maximum ROV seafloor depth (m)	3010
Minimum ROV seafloor depth (m)	500
Total time on bottom (hh:mm:ss)	90:09:16
Total ROV time (hh:mm:ss)	126:56:07

Table 5: Summary of scientific metrics for EX-18-03.

Scientific Metrics	Totals
Actively participating scientists, students, and resource managers	173
Total samples	98
Biological samples (primary)	21
Biological associate samples	44
Geological samples	12
Geological associate samples	0

7.1 ROV Survey Results

Depth ranges explored during the 15 ROV surveys were between 500 to 3010 meters. During the 15 dives, the ROVs spent a total of 90 hours on the bottom (see **Table 5** for more cumulative results). See **Table 6** for dive-specific information about each of the dives.

Table 6: Summary information for the 15 ROV dives conducted during EX-18-03.

Date (mmddyyyy)	Dive #	Site Name	On Bottom Latitude (dd)	On Bottom Longitude (dd)	Max Depth (m)	Dive Duration (hh:mm:ss)	Bottom Time (hh:mm:ss)	Weather	Diverse Community Present	Corals/Sponges Present
4/12/2018	01	BOEM 15445	N/A	N/A	N/A	8:2:11	6:51:27	Calm	Yes	No
4/13/2018	02	BOEM 15572 (Thunder Hawks)	N/A	N/A	N/A	8:12:14	5:54:35	Calm	No	No
4/14/2018	No Dives. Rough weather									

4/15/2018	In Transit. Rough weather									
4/16/2018	03	Unnamed Ridge in GC973	27°, 0.65' N	91°, 40.439' W	1574.0 m	7:43:37	5:47:20	Calm	No	No
4/17/2018	04	Unnamed Mound in EB 1009	27°, 0.703' N	93°, 54.663' W	898.0 m	8:12:3	7:5:51	Good	No	YES
4/18/2018	05	North Wall of Perdido Canyon/AC 813	26°, 8.683' N	94°, 52.003' W	2797.0 m	7:53:5	4:40:0	Good	No	Yes
4/19/2018	06	Hidalgo Basin/GB 903	27°, 5.764' N	92°, 49.244' W	1104.0 m	7:26:44	5:59:10	Good	Yes	Yes
4/20/2018	07	Mud Volcano in WR 488	26°, 28.243' N	91°, 43.683' W	2249.0 m	8:17:53	5:34:31	Good	No	Yes
4/21/2018	Transit to Pascagoula, Mississippi. Mapping operations throughout the day and night									
4/22/2018	Repairs in Pascagoula, Mississippi									
4/23/2018	Repairs in Pascagoula, Mississippi									
4/24/2018	Transit to next dive site from Pascagoula, Mississippi									
4/25/2018	08	Northern West Florida Escarpment, DeSoto Canyon region	28°, 17.023' N	87°, 13.382' W	2635.0 m	8:15:21	5:25:7	Good	Yes	Yes
4/26/2018	09	Northern End of West Florida Escarpment, DeSoto Canyon region (DC 862)	28°, 7.397' N	86°, 39.527' W	2261.0 m	7:52:53	5:26:31	Good	Yes	Yes
4/27/2018	10	North West Florida Escarpment Bend, DeSoto Canyon region (DC 862)	27°, 42.5' N	85°, 44.897' W	3010.0 m	10:19:57	6:52:55	Good	No	Yes
4/28/2018	11	South of Long Mounds	26°, 22.571' N	84°, 46.396' W	535.0 m	10:3:45	6:41:58	Good	Yes	Yes
4/29/2018	12	South of Okeanos Ridge	25°, 36.274' N	84°, 33.039' W	515.0 m	8:19:20	7:2:9	Good	Yes	Yes



4/30/2018	13	Southern West Florida Escarpment Ridge	24°, 55.012' N	84°, 29.368' W	2240.0 m	10:15:5	5:16:32	Good	Yes	Yes
5/1/2018	14	Southern West Florida Escarpment Canyon Ridge	24°, 34.693' N	84°, 16.263' W	2366.0 m	8:10:2	5:13:58	Good	Yes	Yes
5/2/2018	15	Southern West Florida Escarpment Ridge, Pourtales Terrace Sinkhole	24°, 16.809' N	82°, 15.455' W	500.0 m	7:51:57	6:17:12	Good	Yes	Yes

7.1.1 Accessing ROV Data¹

OER Digital Atlas

ROV data from EX-18-03 are archived at NCEI and available through OER’s Digital Atlas at <https://www.ncei.noaa.gov/maps/oer-digital-atlas/mapsOE.htm> (Last accessed June 2020). To access these data, click on the Search tab, enter “EX1803” in the Enter Search Text field, and click Search. Click on the point that represents EX-18-03 to access data options. In the pop-up window, select the ROV Data Access tab for links to the ROV dive data, which is organized by dive.

ROV Dive Summaries

Individual ROV dive summaries and associated ROV dive data are archived at NCEI and available on their *Okeanos Explorer* website at: <https://www.ncei.noaa.gov/waf/okeanos-rov-cruises/ex1803/> (Last accessed June 2020).

SeaTube v2 and SeaScribe

OER works closely with Ocean Networks Canada to implement SeaTube v2 at <https://data.oceannetworks.ca/SeaTubeV2> (Last accessed June 2020), a web-based annotation interface for ROV operations on expeditions aboard NOAA Ship *Okeanos Explorer*. SeaTube v2 is the digital equivalent to a scientist's logbook. It is used by at-sea and shore-based scientists to log real-time observations on a variety of topics. To watch a video of a dive and search and export annotations, click on the Videos tab and select “NOAA”, “2018”, “NOAA OER Gulf of Mexico”, and “EX-18-03” under the Expeditions collapsible menu.

7.2 Sampling Operations Results

A total of 98 samples were collected during EX-18-03: 12 geological samples, 21 biological samples, 21 biological subsamples, and 44 associate samples (see **Table 5** for more cumulative

¹ If you are unable to access the results noted here, contact ex.expeditioncoordinator@noaa.gov.

results). The geological samples included multiple carbonate rock, a carbonate mud sample, authigenic carbonate rock, a bedded sedimentary rock, a ferromanganese-crusted limestone, a metamorphic rock, and an unknown black rock. See **Table 7** for full details about the geological samples collected.

Table 7: Inventory of geological samples collected during EX-18-03.

Sample #	Sample ID	Preservation	Collection Rationale	Site Name	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Weight (kg)
EX1803_D04_01G	Bedded sedimentary rock	washed and dried	Other	Unnamed Mound in EB 1009	20180417	193128	27.010000	-93.919998	638.650024 414063	13
EX1803_D04_02G	Unknown black rock	washed and dried	Other	Unnamed Mound in EB 1009	20180417	201517	27.010000	-93.919998	639.130004 882813	5.6999998 0926514
EX1803_D06_01G	Authigenic carbonate rock	washed and dried	Dominant Fauna	Hidalgo Basin/GB 903	20180419	151518	27.096469	-92.820953	1101.47314 453125	2.2799999 7138977
EX1803_D08_01G	Carbonate rock	washed and dried	Dominant Fauna	Northern West Florida Escarpment, DeSoto Canyon region	20180425	151142	28.280000	-87.220001	2631.98999 023438	8.5699996 9482422
EX1803_D08_04G	Carbonate mud	washed and dried	Other	Northern West Florida Escarpment, DeSoto Canyon region	20180425	200600	28.286546	-87.225112	2322.78002 929688	0.0399999 991059303
EX1803_D10_03G	Metamorphic rock	washed and dried	Other	Northern West Florida Escarpment Bend DeSoto Canyon region (DC 862)	20180427	220137	27.719999	-85.75	2574.46997 070313	9.3000001 9073486
EX1803_D11_01G	Carbonate rock	washed and dried	Dominant Fauna	South of Long Mounds	20180428	144232	26.379999	-84.769996	532.169982 910156	0.2099999 93443489
EX1803_D11_05G	Carbonate rock	washed and dried	Dominant Fauna	South of Long Mounds	20180428	202549	26.379999	-84.769996	478.700012 207031	22.200000 7629395
EX1803_D12_01G	Carbonate rock	washed and dried	Dominant Fauna	South of Okeanos Ridge	20180429	143605	25.600000	-84.550003	512.570007 324219	8.4499998 0926514
EX1803_D12_04G	Carbonate rock	washed and dried	Dominant Fauna	South of Okeanos Ridge	20180429	185523	25.610000	-84.550003	438.170013 427734	12.640000 3433228
EX1803_D14_02G	Carbonate rock	washed and dried	Other	Southern West Florida Escarpment Canyon Ridge	20180501	160818	24.579999	-84.269996	2344.63989 257813	4.3000001 9073486
EX1803_D15_01G	Ferromanganese e-crusted limestone	washed and dried	Other	Southern West Florida Escarpment Ridge, Pourtales Terrace Sinkhole	20180502	174223	24.280000	-82.2600025	433.399993 896484	9.5

There were 21 biological samples that were purposely collected (primary samples), as well as 44 samples that were incidentally collected (associate samples). In total, these samples amounted to 65 individuals. The biological samples included a variety of corals, known animals, and potential new species as seen in **Figure 2**. See **Table 8** for full details about the biological samples collected.

Table 8: Inventory of biological samples collected during EX-18-03.

Sample #*	Sample ID	Preservative	Collection Rationale	Site Name	Date (yyyymmdd)	UTC Time (hhmmss)	Latitude (dd)	Longitude (dd)	Depth (m)	Salinity (ppt)	Temperature (C)	Dissolved Oxygen (mg/l)
EX1803_D04_01G_A01	<i>Caryophyllia</i> sp.	EtOH		Unnamed Mound in EB 1009	20180417	193128	27.010000	-93.919998	638.6500244	34.93000031	7.25	3.950000048
EX1803_D04_02G_A01	<i>Caryophyllia</i> sp.	EtOH		Unnamed Mound in EB 1009	20180417	201517	27.010000	-93.919998	639.1300049	34.58000183	7.710000038	3.900000095
EX1803_D06_01G_A01	Brachiopoda	EtOH		Hidalgo Basin/GB 903	20180419	151518	27.096469	-92.820953	1101.473145	34.94475174	4.791210175	5.846819878
EX1803_D06_01G_A02	Ophiuroidea	EtOH		Hidalgo Basin/GB 903	20180419	151518	27.096469	-92.820953	1101.473145	34.94475174	4.791210175	5.846819878
EX1803_D06_01G_A02	Polychaeta	EtOH		Hidalgo Basin/GB 903	20180419	151518	27.096469	-92.820953	1101.473145	34.94475174	4.791210175	5.846819878
EX1803_D06_02B	Myxasteridae	EtOH	Potential Undescribed Species	Hidalgo Basin/GB 903	20180419	174446	27.090000	-92.819999	1051.089966	34.95000076	4.809999943	5.789999962
EX1803_D06_03B	<i>Narella pauciflora</i>	EtOH	Potential Undescribed Species	Hidalgo Basin/GB 903	20180419	182705	27.090000	-92.819999	1054.689941	34.93999863	4.849999905	5.789999962
EX1803_D06_04B	<i>Polyacanthonotus merretti</i>	EtOH	Other	Hidalgo Basin/GB 903	20180419	999999	27.005140	-93.916046				
EX1803_D07_01B	<i>Lepidisis caryophyllia</i>	EtOH	Dominant Fauna	Mud Volcano in WR 488	20180420	184836	26.4699993	-91.720001	2188.73999	34.97999954	4.28000021	6.579999924
EX1803_D07_02B	<i>Sclerolinum</i> sp.	EtOH	New or Unusual Morphotype	Mud Volcano in WR 488	20180420	192841	26.469999	-91.720001	2168.310059	34.97000122	4.28000021	6.590000153
EX1803_D07_02B_A01	Ophiuroidea	EtOH		Mud Volcano in WR 488	20180420	192841	26.469999	-91.720001	2168.310059	34.97000122	4.28000021	6.590000153
EX1803_D07_02B_A02	Gastropoda A	EtOH		Mud Volcano in WR 488	20180420	192841	26.469999	-91.720001	2168.310059	34.97000122	4.28000021	6.590000153
EX1803_D07_02B_A03	Polychaeta	EtOH		Mud Volcano in WR 488	20180420	192841	26.469999	-91.720001	2168.310059	34.97000122	4.28000021	6.590000153
EX1803_D07_02B_A04	Gastropoda B	EtOH		Mud Volcano in WR 488	20180420	192841	26.469999	-91.720001	2168.310059	34.97000122	4.28000021	6.590000153
EX1803_D08_01G_A01	Polychaeta A	EtOH		Northern West Florida Escarpment, DeSoto Canyon region	20180425	151142	28.280000	-87.220001	2631.98999	34.97000122	4.329999924	6.570000172
EX1803_D08_01G_A02	Polychaeta B	EtOH		Northern West Florida Escarpment, DeSoto Canyon region	20180425	151142	28.280000	-87.220001	2631.98999	34.97000122	4.329999924	6.570000172
EX1803_D08_01G_A03	Hexactinellida	EtOH		Northern West Florida Escarpment, DeSoto Canyon region	20180425	151142	28.280000	-87.220001	2631.98999	34.97000122	4.329999924	6.570000172
EX1803_D08_02B	<i>Circeaster</i> sp.	EtOH	Potential New Species	Northern West Florida Escarpment, DeSoto Canyon	20180425	164442	28.280000	-87.220001	2549.850098	34.97000122	4.320000172	6.559999943



				region									
EX1803_D08_03B	<i>Bathypathes</i> sp.	EtOH	Range Extension	Northern West Florida Escarpment, DeSoto Canyon region	20180425	192206	28.290000	-87.220001	2325.23999	34.97000122	4.309999943	6.5	
EX1803_D09_01B	Primnoidae	EtOH	Dominant Fauna	Northern End of West Florida Escarpment, DeSoto Canyon region (DC 862)	20180426	162534	28.120000	-86.660003	2176.919922	34.97000122	4.309999943	6.570000172	
EX1803_D10_01B	<i>Umbellula</i> sp.	EtOH	Other	North West Florida Escarpment Bend, DeSoto Canyon region (DC 862)	20180427	164514	27.709999	-85.75	2945.860107	34.97000122	4.360000134	6.610000134	
EX1803_D10_02B	<i>Sibogaster</i> sp.	EtOH	Other	North West Florida Escarpment Bend, DeSoto Canyon region (DC 862)	20180427	211239	27.729999	-85.760002	2597.040039	34.97000122	4.329999924	6.480000019	
EX1803_D10_03G_A01	Hormethiidae	EtOH		North West Florida Escarpment Bend, DeSoto Canyon region (DC 862)	20180427	220137	27.719999	-85.75	2574.469971	34.97000122	4.320000172	6.489999771	
EX1803_D10_03G_A02	Euplectellidae	EtOH		North West Florida Escarpment Bend, DeSoto Canyon region (DC 862)	20180427	220137	27.719999	-85.75	2574.469971	34.97000122	4.320000172	6.489999771	
EX1803_D10_03G_A03	Polychaeta	EtOH		North West Florida Escarpment Bend, DeSoto Canyon region (DC 862)	20180427	220137	27.719999	-85.75	2574.469971	34.97000122	4.320000172	6.489999771	
EX1803_D11_02B	<i>Acanthogorgia</i> sp.	EtOH	Other	South of Long Mounds	20180428	151742	26.379999	-84.769996	525.2700195	34.91999817	7.300000191	4.010000229	
EX1803_D11_02B_A01	Chyrostylidae	EtOH		South of Long Mounds	20180428	151742	26.379999	-84.769996	525.2700195	34.91999817	7.300000191	4.010000229	
EX1803_D11_02B_A02	Polychaeta	EtOH		South of Long Mounds	20180428	151742	26.379999	-84.769996	525.2700195	34.91999817	7.300000191	4.010000229	
EX1803_D11_03B	<i>Acanthogorgia</i> sp.	EtOH	Other	South of Long Mounds	20180428	161221	26.379999	-84.769996	520.8300171	34.91999817	7.369999886	3.980000019	
EX1803_D11_04B	<i>Paramuricea</i> sp.	EtOH	Other	South of Long Mounds	20180428	194008	26.379999	-84.769996	472	34.97999954	8.109999657	3.799999952	
EX1803_D11_04B_A01	Hexactinellidae	EtOH		South of Long Mounds	20180428	194008	26.379999	-84.769996	472	34.97999954	8.109999657	3.799999952	
EX1803_D11_04B_A02	Polychaeta	EtOH		South of Long Mounds	20180428	194008	26.379999	-84.769996	472	34.97999954	8.109999657	3.799999952	



EX1803_D11_05G_A01	Nuriceides	EtOH		South of Long Mounds	20180428	202549	26.379999	-84.769996	478.7000122	34.93999863	7.630000114	3.890000105
EX1803_D11_05G_A02	Ophioroidae	EtOH		South of Long Mounds	20180428	202549	26.379999	-84.769996	478.7000122	34.93999863	7.630000114	3.890000105
EX1803_D11_05G_A03	Hexactinellidae	EtOH		South of Long Mounds	20180428	202549	26.379999	-84.769996	478.7000122	34.93999863	7.630000114	3.890000105
EX1803_D11_05G_A04	Polychaeta	EtOH		South of Long Mounds	20180428	202549	26.379999	-84.769996	478.7000122	34.93999863	7.630000114	3.890000105
EX1803_D11_05G_A05	Stylasteridae	EtOH		South of Long Mounds	20180428	202549	26.379999	-84.769996	478.7000122	34.93999863	7.630000114	3.890000105
EX1803_D11_05G_A06	<i>Caryophyllia</i> sp.	EtOH		South of Long Mounds	20180428	202549	26.379999	-84.769996	478.7000122	34.93999863	7.630000114	3.890000105
EX1803_D11_05G_A07	Hydroidolina	EtOH		South of Long Mounds	20180428	202549	26.379999	-84.769996	478.7000122	34.93999863	7.630000114	3.890000105
EX1803_D11_05G_A08	Octocorallia	EtOH		South of Long Mounds	20180428	202549	26.379999	-84.769996	478.7000122	34.93999863	7.630000114	3.890000105
EX1803_D12_01G_A01	Polychaeta	EtOH		South of Okeanos Ridge	20180429	143605	25.600000	-84.550003	512.5700073	34.93999863	7.630000114	3.900000095
EX1803_D12_01G_A02	Bryozoa	EtOH		South of Okeanos Ridge	20180429	143605	25.600000	-84.550003	512.5700073	34.93999863	7.630000114	3.900000095
EX1803_D12_01G_A03	Octocorallia	EtOH		South of Okeanos Ridge	20180429	143605	25.600000	-84.550003	512.5700073	34.93999863	7.630000114	3.900000095
EX1803_D12_01G_A04	Hexactinellida	EtOH		South of Okeanos Ridge	20180429	143605	25.600000	-84.550003	512.5700073	34.93999863	7.630000114	3.900000095
EX1803_D12_01G_A05	Echinoidea	EtOH		South of Okeanos Ridge	20180429	143605	25.600000	-84.550003	512.5700073	34.93999863	7.630000114	3.900000095
EX1803_D12_02B	Primnoidae	EtOH	Dominant Fauna	South of Okeanos Ridge	20180429	153100	25.610000	-84.550003	467.2399902	34.95000076	7.739999771	3.880000114
EX1803_D12_02B_A01	Ophioroidae	EtOH		South of Okeanos Ridge	20180429	153100	25.610000	-84.550003	467.2399902	34.95000076	7.739999771	3.880000114
EX1803_D12_03B	Antipatharia	EtOH	Other	South of Okeanos Ridge	20180429	181028	25.610000	-84.550003	437.0499878	35.02999878	8.619999886	3.730000019
EX1803_D12_04G_A01	Hexactinellida	EtOH		South of Okeanos Ridge	20180429	185523	25.610000	-84.550003	438.1700134	35.02999878	8.640000343	3.730000019
EX1803_D12_04G_A02	Scleractinia	EtOH		South of Okeanos Ridge	20180429	185523	25.610000	-84.550003	438.1700134	35.02999878	8.640000343	3.730000019
EX1803_D12_04G_A03	Stylasteridae	EtOH		South of Okeanos Ridge	20180429	185523	25.610000	-84.550003	438.1700134	35.02999878	8.640000343	3.730000019
EX1803_D12_04G_A04	Branchiopoda	EtOH		South of Okeanos Ridge	20180429	185523	25.610000	-84.550003	438.1700134	35.02999878	8.640000343	3.730000019
EX1803_D12_04G_A05	Ophioroidae	EtOH		South of Okeanos Ridge	20180429	185523	25.610000	-84.550003	438.1700134	35.02999878	8.640000343	3.730000019
EX1803_D13_01B	<i>Keratoisis</i> sp.	EtOH	New or Unusual Morphotype	Southern West Florida Escarpment Ridge	20180430	153336	24.920000	-84.489997	2229.149902	34.97000122	4.300000191	6.650000095
EX1803_D13_02B	<i>Telopathes</i> sp.	EtOH	Potential Undescribed Species	Southern West Florida Escarpment Ridge	20180430	163451	24.920000	-84.489997	2184.040039	34.97000122	4.300000191	6.639999866



EX1803_D13_03B	Phoronematidae	EtOH	Other	Southern West Florida Escarpment Ridge	20180430	193555	24.909999	-84.489997	2127.139 893	34.970001 22	4.289999962	6.610000134
EX1803_D14_01B	<i>Bathygorgia</i> sp.	EtOH	Other	Southern West Florida Escarpment Canyon Ridge	20180501	152631	24.579999	-84.269996	2360.600 098	34.970001 22	4.300000191	6.679999828
EX1803_D14_02G_A01	Crinoidea (stalk only)	EtOH	Other	Southern West Florida Escarpment Canyon Ridge	20180501	160818	24.579999	-84.269996	2344.639 893	34.970001 22	4.309999943	6.650000095
EX1803_D14_02G_A02	Hexactinellida	EtOH		Southern West Florida Escarpment Canyon Ridge	20180501	160818	24.579999	-84.269996	2344.639 893	34.970001 22	4.309999943	6.650000095
EX1803_D14_02G_A03	Polychaeta	EtOH		Southern West Florida Escarpment Canyon Ridge	20180501	160818	24.579999	-84.269996	2344.639 893	34.970001 22	4.309999943	6.650000095
EX1803_D14_03B	<i>Monachocrinus</i> sp.	EtOH		Southern West Florida Escarpment Canyon Ridge	20180501	160818	24.579999	-84.269996	2344.639 893	34.970001 22	4.309999943	6.650000095
EX1803_D14_03B_A01	Bryozoa	EtOH	Range Extension	Southern West Florida Escarpment Canyon Ridge	20180501	175005	24.579999	-84.269996	2283.590 088	34.970001 22	4.309999943	6.599999905
EX1803_D14_04B	<i>Isidella kerl2c</i>	EtOH		Southern West Florida Escarpment Canyon Ridge	20180501	175005	24.579999	-84.269996	2283.590 088	34.970001 22	4.309999943	6.599999905
EX1803_D15_01G_A01	Hexactinellida	EtOH	Range Extension	Southern West Florida Escarpment Ridge, Pourtales Terrace Sinkhole	20180501	194849	24.569999	-84.269996	2274.520 02	34.970001 22	4.300000191	6.599999905
EX1803_D15_01G_A02	Polychaeta	EtOH		Southern West Florida Escarpment Ridge, Pourtales Terrace Sinkhole	20180502	174223	24.280000	-82.260002	433.3999 939	34.959999 08	7.980000019	3.799999952

*Sample numbers with “_A##” indicate associate samples.



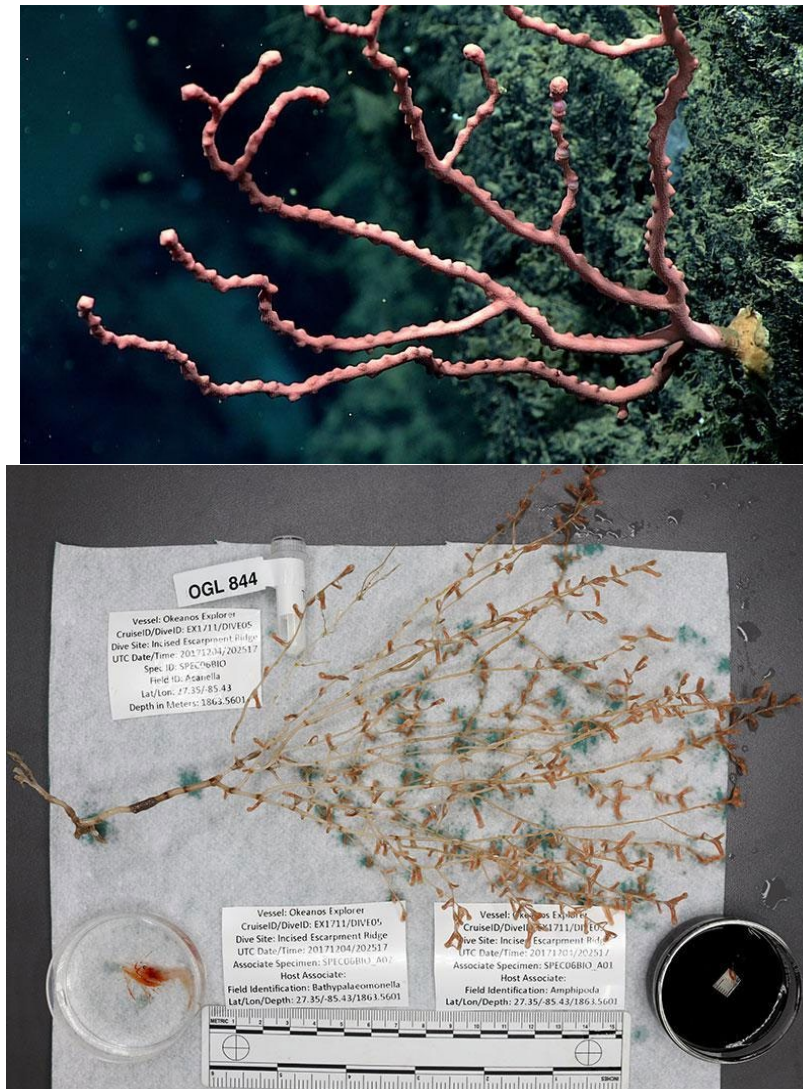


Figure 2. (Top image) A bubblegum coral grows from the vertical face of a rock at 2,614 meters (~8,575 feet) depth in the De Soto Canyon region. (Bottom image) *Acanella* bamboo coral collected from soft sediments. Images courtesy of the NOAA Office of Ocean Exploration and Research, Gulf of Mexico 2018.

7.2.1 Sample Repositories

The following repositories archive samples collected during NOAA Ship *Okeanos Explorer* expeditions.

- Invertebrate Zoology Collections, National Museum of Natural History, Smithsonian Institution, Museum Support Center, MRC 534, 4210 Silver Hill Road, Suitland, MD 20746
Website: <https://invertebrates.si.edu/LoanPolicy.html> (Last accessed: September 2020)
- Biorepository, National Museum of Natural History, Smithsonian Institution, Museum Support Center, 4210 Silver Hill Road, Suitland, MD 20746



Website: <https://naturalhistory.si.edu/research/biorepository> (Last accessed: September 2020)

- Marine and Geology Repository, Oregon State University, Burt 346, Corvallis, OR 97331-5503

Website: <http://osu-mgr.org/noaa-ex/> (Last accessed: September 2020)

- Ocean Genome Legacy Center, Northeastern University, 430 Nahant Road, Nahant, MA 01908

Website: <https://www.northeastern.edu/ogl/> (Last accessed: September 2020)

7.3 Acoustic Operations Results

During EX-18-03, multibeam mapping operations results included 4,283 linear kilometers mapped and 22,099 square kilometers covered (during this cruise, 15 ROV dives were attempted in the U.S. EEZ). **Figure 3** and **Figure 4** show detailed coverage areas of operation for EX-18-03.

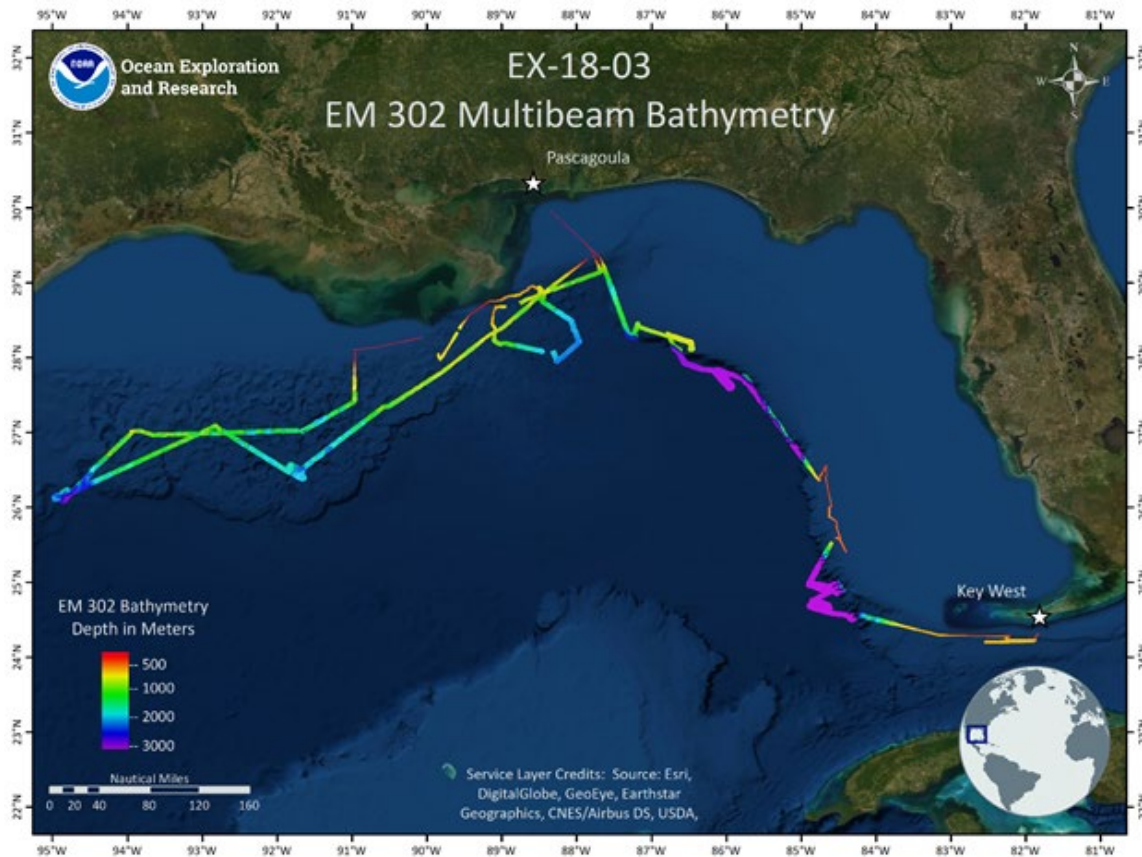


Figure 3. Overview of bathymetric mapping coverage during the EX-18-03, Gulf of Mexico 2018, expedition. The color-coded bathymetry shows cumulative multibeam sonar bathymetry collected previously by NOAA Ship Okeanos Explorer. Image courtesy of the NOAA Office of Ocean Exploration and Research.

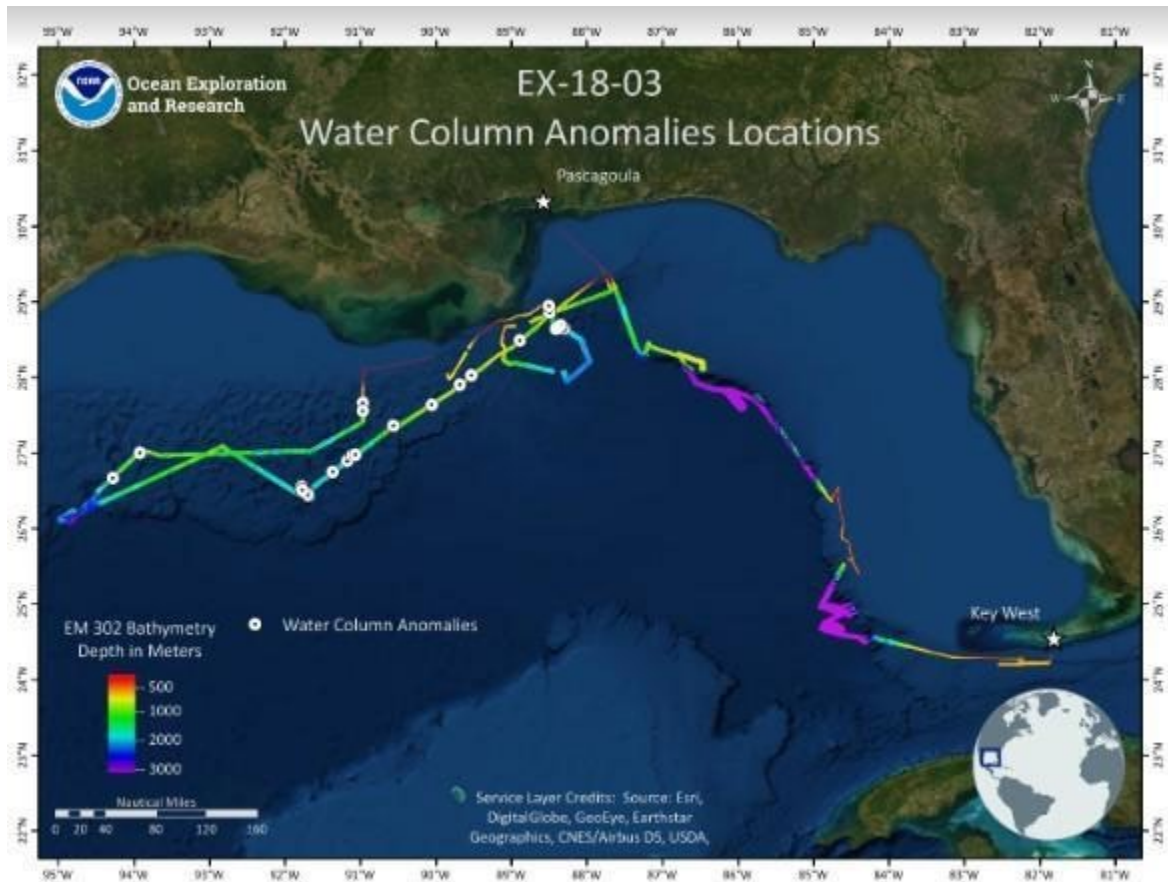


Figure 4. Locations of EM 302 water column anomalies from EX-18-03.

The *EX* explored two archaeological sites resulting in 3D models of both sites for BOEM and NOAA maritime heritage programs. Photogrammetry was used to document underwater features in 3D (**Figure 5**); this combined image acquisition protocols and the ability to render both geometrically accurate and photorealistic models crafted from photos and videos collected by the ROV. These are available on the OER website at <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1803/logs/apr21/welcome.html> (Last accessed June 2020).



Figure 5. Orthophoto showing the bow of the tugboat *New Hope*, generated using imagery collected during Dive 01 of the expedition. This kind of orthomosaic is a series of individual photos which are matched using thousands of points to form a new 2D composite image consisting of all the smaller images, but with any distortion from perspective shift removed. Image courtesy of the NOAA Office of Ocean Exploration and Research, Gulf of Mexico 2018

Additional information about the mapping conducted during EX-18-03, including data quality assessments, is in the EX-18-03 mapping data report at <https://repository.library.noaa.gov/view/noaa/23723> (Last accessed June 2020).

7.3.1 Acoustic Operations Data Access

Multibeam Sonar (Kongsberg EM 302)

The multibeam dataset for the expedition is archived at NCEI and accessible through their Bathymetric Data Viewer at <https://maps.ngdc.noaa.gov/viewers/bathymetry/> (Last accessed June 2020). To access these data, click on the Search Bathymetric Surveys button, select “NOAA Ship *Okeanos Explorer*” from the Platform Name dropdown menu, and “EX1803” from the Survey ID dropdown menu. Click OK, and the ship track for the cruise will appear on the map. Click the ship track for options to download data.

Sub-bottom Profiler (Knudsen Chirp 3260)

The sub-bottom profiler was not run during any of EX-18-03’s ROV dive operations, but generally was operated during multibeam mapping operations. The data are archived at NCEI and accessible through their Trackline Geophysical Data Viewer at <https://maps.ngdc.noaa.gov/viewers/geophysics/> (Last accessed June 2020).

Sub-bottom data, supporting data, and informational logs will be available in the NCEI Data Archives accessible at <https://www.ngdc.noaa.gov/> (last accessed June 2020). For any challenges accessing SBP data, send an inquiry to ncei.info@noaa.gov requesting access to EX-18-03 Knudsen 3260 sub-bottom raw and processed data.



Split-beam Sonars (Simrad EK60)

EK60 water column data for EX-18-03 are archived at NCEI and available through their Water Column Sonar Data Viewer at https://www.ngdc.noaa.gov/maps/water_column_sonar/index.html (Last accessed June 2020). To access these data, click on the Additional Filters button, deselect “All” next to Survey ID, and select “EX1803” from the Survey ID list. Click OK, and the ship track for the cruise will appear on the map. Click on the ship track for options to download data.

Acoustic Doppler Current Profilers (Teledyne Marine Workhorse Mariner and Teledyne Ocean Surveyor ADCPs)

ADCP data collected before and during ROV dive operations are archived at NCEI and will be available through their Global Ocean Currents Database at https://www.nodc.noaa.gov/goacd/sadcp_oer_inv.html (Last accessed June 2020). For any issues accessing the ADCP data please contact ncei.info@noaa.gov.

7.4 Conductivity, Temperature, and Depth (CTD) Measurements

The ship’s CTD profile data from EX-18-03 are archived at NCEI and available through OER’s Digital Atlas at <https://www.ncei.noaa.gov/maps/oer-digital-atlas/mapsOE.htm> (Last accessed June 2020). To access these data, click on the Search tab, enter “EX1803” in the Enter Search Text field, and click Search. Click on the point that represents EX-18-03 to access data options. In the pop-up window, select the Data Access tab for a link to download the CTD profile data.

7.5 Sun Photometer Measurements

Sun photometer measurements are available through NASA’s MAN at https://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html (Last accessed June 2020). Access these data by searching the table for “2018”, “*Okeanos Explorer*”, and “Gulf of Mexico”. Click on the links to download the data. (Note: There may be more than one entry for NOAA Ship *Okeanos Explorer* in a region in a given year.)

7.6 Engagement

EX-18-03 engaged with audiences around the world, opening a window of understanding into the deep sea. Highlights are listed below:

- Live video feeds received over 300,700 views, and web content received 99,700 website visits during EX-18-03.
- Conducted 16 live interactions and 40 ship tours to engage over 400 people from a diversity of audiences on both the ship and the shore, including supporting events at the Exploratorium in San Francisco, Stanislaus College, NOAA Kids Day, NCEI VIP Open House, Sushi by the Sea, Boston College at the URI ISC, the Los Angeles Conservation Corp’s SEA Lab, a Silver Spring ECC Open House, and other events.
- Over 50 news/web articles covered EX-18-03. Stories appeared in national and local media outlets and on websites throughout the country, including National Geographic,



Ocean Conservancy, Ocean News & Technology, NCCOS, Daily Mail, Business Insider, MSN Video, Live Science, ScienceAlert, the Inquisitr, My SanAntonio, CBS Miami, The PEW Charitable Trust, Science Examiner, E&E News, Washington Post, Oceans Deeply, and much more. This coverage amplified the impact of the expedition, increasing the audience reached.

- A Facebook Live question and answer session that answered 20 questions and received over 4,000 views.
- Live educational Professional Development workshops and webinars with the National Aquarium, Loveland Aquarium, museums, and educators.

8. Summary

The *Gulf of Mexico 2018* expedition was a 22-day, telepresence enabled cruise to collect critical information and acquire data about priority exploration areas identified by the ocean management and scientific communities. The goal of the expedition was to use ROV dives in combination with seafloor mapping operations to increase the understanding of deep-sea ecosystems and collect scientific information to support future management decisions. During the expedition, 15 ROV dives were conducted ranging from 500 to 3,010 meters (1,640 to 9,875 feet) to explore the diversity and distribution of deep-sea habitats and associated marine communities in the Gulf of Mexico basin. Operations focused on characterizing deep-sea coral and sponge communities as well as bottomfish habitats, such as brine pools, gas seeps, and mud volcanoes. Midwater exploration was conducted during two dives, at depths ranging from 2,100 to 300 meters (6,890 to 984 feet), to investigate the diversity and abundance of largely unknown pelagic fauna.

Hundreds of different species of animals, including several potential new species, new behaviors, and numerous significant range extensions, were observed. These included the following observations:

- During Video annotations, the unusual behavior of a potentially new species of squid was documented around 850 meters (2,789 feet) during Dive 04 of the expedition.
- Documented deep-sea coral and sponge communities during 12 of the 15 ROV dives (Dives 03-15) during Video annotations, included five high-density communities of deep-sea corals, one of which is currently among the deepest known (2,600 meters) high-density communities in the Gulf of Mexico.
- Documented through Video annotations several species of sea stars that were feeding, including one feeding on a black coral.
- Conducted the first-ever in situ observation of the rare sea star, *Remaster palmatus* (family Korethrasteridae).
- Collected 65 biological samples—with thirteen of these biological samples representing substantial range extensions, while several of these may be new species to science.
- Surveyed two sites identified by the Gulf of Mexico Fishery Management Council for potential future establishment of HAPCs, and to help provide critical baseline data and information to inform science and management decisions.



- Explored two proposed expansion areas for the Flower Garden Banks National Marine Sanctuary.
- Two archaeological sites were explored resulting in 3D models for BOEM and NOAA’s maritime heritage programs. Photogrammetry was used to document underwater features in 3D; this combined image acquisition protocols and the ability to render both geometrically accurate and photorealistic models crafted from photos and videos collected by the ROV. Images are available on the OER website at <https://oceanexplorer.noaa.gov/oceanos/explorations/ex1803/logs/apr21/welcome.html> (Last accessed June 2020). The location of these dives are restricted.
 - During Dive 01, archaeologists and scientists explored the shipwreck of the tug boat *New Hope* for the first time (**Figure 5**). Information collected during the dive confirmed the identity of the wreck and might help to support an application of the *New Hope* shipwreck to the National Register of Historic Places.
 - During Dive 02, archaeologists and scientists performed a reconnaissance survey of an unidentified wooden vessel with a limited number of metal items inside that may be related to propulsion or steering (e.g., prop shaft or rudder post).
- Mapped nearly 22,099 square kilometers of seafloor, including several areas that have never been mapped with high-resolution multibeam sonars in the U.S. Gulf of Mexico EEZ.
- Investigated a variety of different geological features including gas seeps, mud volcanoes, asphalt seeps, and brine pools. The team collected 12 rock samples during the dives that can be used for geochemical composition analysis and age dating. During Dives 06 and 07 two new chemosynthetic communities were documented, which included brine pools and an extinct brine waterfall at Hidalgo Basin and gas seeps at Walker Ridge 488. Further exploration was done in previously unmapped and unexplored sinkholes on the Pourtales Terrace.
- Collected of more than 11.2 TB of data, including multibeam, single beam, sub-bottom, ADCP, XBT, CTD and DO profiles; surface oceanographic and meteorological sensors; and video, imagery, and associated dive and video products.
- Engaged with audiences around the world by sharing live video feed of the expedition via the Internet. The expedition received more than 300,700 views on the OER YouTube channel; had over 4,000 views on a Facebook Live question and answer session; received news and media coverage by numerous media sources; and benefitted from the scientific participation of 85 scientists, managers, and students from 35 institutions in the U.S., Japan, Russia, Norway, the United Kingdom, and Canada. The team conducted two ship tours—for Congressional Staffers and 20 students from St. Stanislaus College Mississippi—and conducted 16 live telepresence interactions with various groups, ultimately engaging with over 400 individuals.

Data collected during this expedition are intended to inform the initial characterization of the areas visited and include multibeam, single beam, sub-bottom, ADCP, XBT, CTD, and DO profiles; surface oceanographic and meteorological sensors; videos and imagery; and physical specimens. All data from this expedition have been made publicly available through the national archives.



9. References

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10. Appendices

Appendix A: Data Management Plan

Data Management Plan

Okeanos Explorer (EX1803): Gulf of Mexico (ROV & Mapping)



Ocean Exploration and Research

OER Data Management Objectives

Testing all newly re-designed network impacts on data pipelines. Updating sample data management standard operating procedures.

20-Mar-18

Page 1

1. General Description of Data to be Managed

1.1 Name and Purpose of the Data Collection Project

Okeanos Explorer (EX1803): Gulf of Mexico (ROV & Mapping)

1.2 Summary description of the data to be collected.

Operations will include the use of the ship's deep water mapping systems (Kongsberg EM302 multi beam sonar, EK60 split-beam fisheries sonars, Knudsen 3260 chirp sub-bottom profiler sonar, and Teledyne Acoustic Doppler Current Profiler), XBT and CTD casts in support of multi beam sonar mapping operations, OER's two-body ROV Deep Discoverer and Seirios, and the ship's high-bandwidth satellite connection for continuous real-time ship-to-shore communications. Operations are planned in and around the US Gulf of Mexico and potentially the international waters of the Gulf.

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, single beam sonar, single-beam sonar, sub-bottom profile, water column backscatter

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

Okeanos ROV Cruises

1.5 Planned or actual temporal coverage of the data.

Dates: 4/11/2018 to 5/3/2018

1.6 Planned or actual geographic coverage of the data.

Latitude Boundaries: 23.7 to 30.2

Longitude Boundaries: -97.2 to -80.9

1.7 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, CTD (processed), CTD (product), CTD (raw), Dive Summaries, EK60 Singlebeam Data, Expedition Cruise Report, Floating Point GeoTIF, HDCS, Highlight Video, Images, Multibeam (image), Multibeam (processed), Multibeam (product), Multibeam (raw), NetCDF, Publication, Raw Video (digital), Raw Video Inventory logs, Sample Logs, SCS Output (compressed), SCS Output (native), Sub-Bottom Profile data, Temperature data, Water Column Backscatter, XBT

Okeanos Explorer (EX1803): Gulf of Mexico (ROV & Mapping)



Ocean Exploration and Research

(raw)

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: Lt. Nikolai Pawlenko
 Title: Expedition Coordinator
 Affiliation/Dept: NOAA Office of Ocean Exploration and Research
 E-Mail: Nikolai.Pawlenko@noaa.gov
 Phone: (401) 874-6478

3. Point of Contact for Managing the Data

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

4. Resources

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

5. Data Lineage and Quality**5.1 What is the processing workflow from collection to public release?**

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

5.2 What quality control procedures will be employed?

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

6. Data Documentation

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?

Okeanos Explorer (EX1803): Gulf of Mexico (ROV & Mapping)



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-M5 for

URL: <https://www.ncddc.noaa.gov/oer-waf/ISO/Resolved/2018/>

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

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: 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: not applicable

Authority: not applicable

7.4 Prepare a Data Access Statement

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

8. Data Preservation and Protection

8.1 Actual or planned long-term data archive location:

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

8.2 If no archive planned, why?

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

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

Okeanos Explorer (EX1803): Gulf of Mexico (ROV & Mapping)



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

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

8.5 Prepare a Data Use Statement

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

Okeanos Explorer (EX1803): Gulf of Mexico (ROV & Mapping)



Appendix B: EX-18-03 Categorical Exclusion (CE)

Form Version: September 2017

Categorical Exclusion (CE) Evaluation Worksheet

Project Identifier: EX1803

Date Review Completed: 3/5/2018

Completed by: LTJG Nikolai Pawlenko

OAR Functional Area: OER

Worksheet File Name: 2018-03-OER-CE-EX1803

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 collect baseline mapping data using the NOAA Ship Okeanos Explorer's sonar systems and to conduct baseline characterizations of unexplored areas using NOAA's two-body remotely operated vehicle (ROV) and CTD rosette system on the NOAA Ship Okeanos Explorer. ROV operations will include collection of detailed high resolution imagery, collection of limited biological and geological samples, and digital sensor data collection.

The expedition will conduct operations in the US Exclusive Economic Zone (EEZ) in the Gulf of Mexico and potentially in international waters of the Gulf of Mexico, commencing on April 11, 2018 in Pascagoula MS, (30° 20.36'N, 88° 34.50'W) and concluding on May 3, 2018 in Key West FL (24° 33.86'N, 81° 48.01'W). See Project Instructions EX-18-03 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?**

1.



- a. E3: Activities to collect aquatic, terrestrial, and atmospheric data in a non-destructive manner.
- b. This exploratory expedition will use remote sensing, video, imagery and a limited number of samples to collect baseline information on unexplored areas of the Gulf of Mexico

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 deep sea areas of the Gulf of Mexico during EX-18-03, an expedition which is part of the Southeast Deep Coral Initiative (SEDCI), [see Table 1 of EX-18-03 Project Instructions: Bounding coordinates of the EX-18-03 operating area] 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 survey/expedition will conduct operations near the Florida Keys and Flower Gardens National Marine Sanctuaries, but not within sanctuary boundaries. OER is working closely with Sanctuaries staff to ensure impacts will be less than negligible.

The expedition is being planned and conducted in partnership with NOAA National Marine Fisheries Service (NMFS), National Centers for Coastal Ocean Science (NCCOS), Deep Sea Coral Research and Technology Program (DSCRTP), Florida Keys NMS and Flower Gardens Banks NMS, Gulf of Mexico Fisheries Management Council and the Bureau of Ocean Energy Management (BOEM). OER will use input from these management authorities that are familiar with these areas to ensure no more than negligible effects on these areas with potentially unique environmental characteristics.

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 and the National Centers for Coastal Ocean Science (NCCOS) have 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 June 2017, a request from NCCOS was submitted to the NMFS



PIRD Protected Resources Division to initiate consultation under Section 7 of the ESA for all Southeast Deep Coral Initiative (SEDCI) cruises. Accompanying this request was a biological assessment that described the planned operations proposed for 2017-2019 expeditions in the Gulf of Mexico and the South Atlantic that identified all ESA-listed species, including corals, in the vicinity of the operations. On August 17, 2017, NCCOS received a letter that concurred with its determination that these 2017-2019 operations are not likely to adversely affect ESA-listed species. The ESA Section 7 concurrence letter is provided as an Appendix in the Project Instructions document for EX-18-03.

Given the offshore focus area of our 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 marine mammals or seabirds, our effect would be negligible because of the best management practices to which we adhere to avoid or minimize environmental effects. NCCOS also initiated a request for a Magnuson-Stevens Essential Fish Habitat (EFH) consultation for this same series of cruises and subsequently received a determination that the proposed cruises will not reduce the quality and/or quantity of EFH, provided adherence to the OER proposed procedures and the NMFS guidance were both conveyed via letter from Virginia Fay Assistant Regional Administrator, NMFS Habitat Conservation Division on June 22, 2017.

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 superseding OMAO procedures) 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?

During EX-18-03, we will be conducting ROV dives on sonar anomaly targets believed to be shipwrecks. If these anomalies are confirmed to be significant shipwrecks, they can potentially be eligible for listing on the National Register of Historic Places. OER conducts non-invasive surveys of archaeology targets and protects the location of sensitive cultural heritage sites.



(UCH). Appendix H of the EX-18-03 project instructions includes DER's standard operating procedures for UCH sites. This expedition is being planned in conjunction with the NOAA Office of National Marine Sanctuaries' Maritime Heritage Program and the Bureau of Ocean Energy Management (BOEM). Staff from the Maritime Heritage Program and BOEM will participate in UCH operations to ensure that operations are non-invasive and compliant to all applicable regulations.

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 deep sea areas of the Gulf of Mexico (see Table 1, EX 18-03 Project Instructions). There are no human communities within the geographic scope of the cruise; and when nearshore, operations will be conducted several miles offshore. 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 EX-18-03 the ship will not make landfall in areas other than commercial ports. The ship and DER 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 systems will be thoroughly rinsed with fresh water, completely dried and checked for the presence of biological organisms 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 any violations of Federal, State, or local law or requirements imposed for protection of the environment. The survey coordinator obtained [or



are in the process of obtaining] authorizations and/or consultations pursuant to applicable laws. See responses to questions #4, 5, 6, and 7 for details.

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 this project's scope and breadth, 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 activity.

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: *Craig Russell*

Signed by: Craig W Russell

Date Signed: March 5, 2018



Appendix C: EX-18-03 ESA Letter of Concurrence

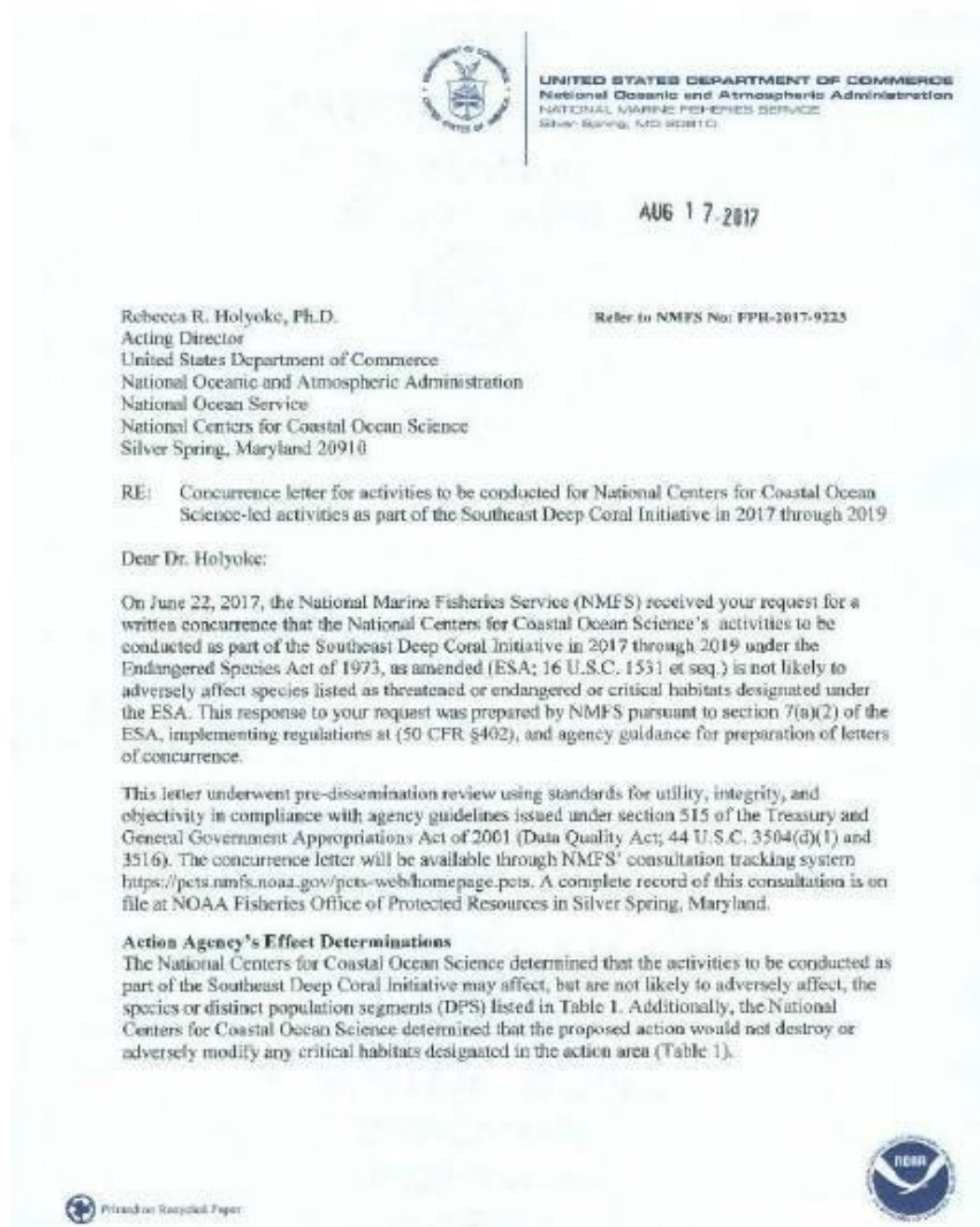


Table 1. Action agency determinations for species and critical habitat.

Species	ESA Status	Critical Habitat	Action Agency Determination
Marine Mammals			
Blue whale (<i>Balaenoptera musculus</i>)	Endangered	N/A	Not likely to adversely affect
Fin whale (<i>Balaenoptera physalus</i>)	Endangered	N/A	Not likely to adversely affect
Sei Whale (<i>Balaenoptera borealis</i>)	Endangered	N/A	Not likely to adversely affect
Bryde's whale, Gulf of Mexico subspecies (<i>Balaenoptera edeni</i>)	Endangered	N/A	Not likely to adversely affect
Sperm whale (<i>Physeter macrocephalus</i>)	Endangered	N/A	Not likely to adversely affect
North Atlantic Right whale (<i>Eubalaena glacialis</i>)	Endangered	No effect	Not likely to adversely affect
Marine Reptiles			
Green turtle (<i>Chelonia mydas</i>) – North Atlantic DPS	Threatened	No effect	Not likely to adversely affect
Hawksbill turtle (<i>Eretmochelys imbricata</i>)	Endangered	No effect	Not likely to adversely affect
Kemp's ridley turtle (<i>Lepidochelys kempi</i>)	Endangered	N/A	Not likely to adversely affect
Leatherback turtle (<i>Dermochelys coriacea</i>)	Endangered	No effect	Not likely to adversely affect
Loggerhead turtle (<i>Caretta caretta</i>) – Northwest Atlantic Ocean DPS	Threatened	No effect	Not likely to adversely affect
Marine and Anadromous Fishes			
Gulf sturgeon (<i>Acipenser oxyrinchus desotoi</i>)	Threatened	No effect	Not likely to adversely affect
Smalltooth sawfish (<i>Pristis pectinata</i>) – U.S. portion of range DPS	Endangered	No effect	Not likely to adversely affect
Nassau grouper (<i>Epinephelus striatus</i>)	Threatened	N/A	Not likely to adversely affect
Atlantic sturgeon (<i>Acipenser oxyrinchus oxyrinchus</i>) – South Atlantic DPS	Endangered	No effect	Not likely to adversely affect
Atlantic sturgeon (<i>Acipenser oxyrinchus oxyrinchus</i>) – Carolina DPS	Endangered	No effect	Not likely to adversely affect
Oceanic whitetip shark (<i>Carcharhinus longimanus</i>)	Proposed Threatened	N/A	Not likely to adversely affect
Giant manta ray (<i>Manta birostris</i>)	Proposed Threatened	N/A	Not likely to adversely affect

Species	ESA Status	Critical Habitat	Action Agency Determination
Marine Invertebrates			
Elkhorn coral (<i>Acropora palmata</i>)	Threatened	No effect	Not likely to adversely affect
Staghorn coral (<i>Acropora curvicornis</i>)	Threatened	No effect	Not likely to adversely affect
Pillar coral (<i>Dendrogyra cylindrus</i>)	Threatened	N/A	Not likely to adversely affect
Mountainous star coral (<i>Orbicella faveolata</i>)	Threatened	N/A	Not likely to adversely affect
Boulder star coral (<i>Orbicella frankisi</i>)	Threatened	N/A	Not likely to adversely affect
Lobed star coral (<i>Orbicella annularis</i>)	Threatened	N/A	Not likely to adversely affect
Rough cactus coral (<i>Mycetophyllia ferox</i>)	Threatened	N/A	Not likely to adversely affect

Proposed Action and Action Area

The NOAA Deep-Sea Coral Research and Technology Program identified research needs in the U.S. Federal waters of the South Atlantic Bight, the Caribbean Sea, and the northern Gulf of Mexico. The National Centers for Coastal Ocean Science proposes to fund a three-year project to collect information on the deep-water corals found in these areas to provide scientific information to manage, conserve, and protect deep-sea coral and sponge ecosystems. The proposed action will survey the species and abundance of deep-water corals and sponges to inform proposals for new managed areas in the region. The proposed action will:

- 1) Survey deep-sea coral ecosystems using remotely operated vehicles.
- 2) Map deep-water habitats using multibeam echosounders.
- 3) Sample the physical and chemical properties of the water column via the deployment of conductivity, temperature, and depth casts and collection of water samples.

The study will target several non ESA-listed species of deep-water corals. "Deep-water corals" here are regarded as those at depths greater than 50 meters. These include *Lophelia pertusa*, *Leiopathes glaberrima*, and other coral members of the Cnidarian orders Scleractinia, Antipatharia, Aleyonacea, and Gorgonacea. Deep-water sponge species will also be sampled: Classes Demospongiae, Hexactenellidae, Calcareo, and Homoscleromorpha. *Lophelia pertusa*, and *Leiopathes glaberrima* are typically found at depths between 300 and 1,000 meters. The other coral members of the Cnidarian orders are found at depths greater than 50 meters, as are the deep-water sponge species.

The study will involve vessel operations aboard two vessels; the vessel used will depend upon the area for the particular cruise and the availability of the vessel at a given time. The two cruises in August 2017 will be conducted aboard the NOAA Ship *Nancy Foster*. The later cruises in 2018 and 2019 will be conducted on board either the NOAA Ships *Nancy Foster* or the NOAA *Okeanos Explorer*, depending on availability and proximity to the sampling site.



Researchers will use either of two remotely operated vehicles (ROVs) to collect samples from target coral species and collect video imagery. The ROV used for each cruise will depend on the ship used. It is still being determined what type of ROV will be used for cruises aboard the NOAA Ship *Nancy Foster*. For cruises aboard the NOAA Ship *Okeanos*, the researchers will use the two-bodied ROV Deep Discoverer and Serios. Each of the proposed ROVs are equipped with acoustic telemetry devices (a transponder unit, a receiving beacon, and an altimeter) which are used to locate the ROV during use. The transponder units emit signals at between eight and 30 kilohertz, and the receiving beacons also transmit signals in the mid-frequency range (21.5 to 43.2 kilohertz). The ROV may also use high-frequency imaging sonar (675 kilohertz) and an altimeter (500 kilohertz).

Active acoustic sources would be part of the proposed action. There will be a few different hull-mounted multi-beam echosounders used by the research vessels. The proposed action would use different multibeam echosounders because each has a unique operational depth and will thus be able to ensonify the seafloor at a variety of depths. On board the NOAA Ship *Nancy Foster*, three devices may be used. The Reson 712 SV2 has a dual frequency of 200 kilohertz or 400 kilohertz, with an optimal depth range of five to 250 meters. The Simrad EM 1002 operates at 95 kilohertz, and has an optimal depth of 200 to 1,000 meters. The Kongsberg/Simrad EK60 operates at 38, 120, and 200 kilohertz. The NOAA Ship *Okeanos* has two multi-beam echosounders. The Kongsberg EM-302 operates at 30 kilohertz, with an optimal range of 250 to 7,000 meters. The NOAA Ship *Okeanos* also uses a Kongsberg/Simrad EK60. During operation, the power setting for all devices is at the lowest possible level (approximately 190 to 210 dB re: 1 μ PA with a duty cycle set to 10 to 30 hertz).

The ROV will move along pre-determined transects; dives last about two to six hours. The ROV will be tethered at all times. The ROV and the vessel will be moving at between 0.5 and one knot while the ROV is deployed. About six samples will be collected during each dive, and there will be between one and three dives per day. During sample collection, the ROV will hover about one meter from the bottom to avoid making contact with substrate. Coral samples will be collected by a cutting tool on the ROV. Samples will be about ten to 50 centimeters long, cut from the distal branches of each targeted coral colony.

During cruises, researchers would also use a conductivity, temperature, and depth (CTD) cast to collect water samples and characterize the chemical and physical properties of the water around deep-water coral and sponge ecosystems. The CTD Sea Bird Electronics-32 (SBE-32) is a device, 3.25 feet in diameter and four feet tall, that holds 12 five liter bottles on a carousel. The bottles are programmed to open and collect water at different depths. It weighs 69 kilograms, and is lowered into the water by a power winch. An SBE 9-11 sensor is attached to the CTD SBE-32, and it is used to take water measurements for parameters like temperature, depth, conductivity, pressure, and dissolved oxygen.

The study will be conducted for three years, with cruises typically taking place in the summer (May through September). The first two cruises will take place in August 2017, with one 13-day cruise and one five-day cruise. The first 2017 cruise will leave and return to St. Petersburg, Florida, and focus on surveying the deep-sea coral habitats off West Florida, in the Gulf of Mexico. The second 2017 cruise will leave St. Petersburg and end in Charleston, South Carolina, focusing on deep-sea corals off East Florida. The cruises for 2018 and 2019 are still being planned, and could occur in the South Atlantic, northern Gulf of Mexico, and the Caribbean. The



National Centers for Coastal Ocean Science expects that there will be four surveys per year in 2018 and 2019.

Action Area

The study would take place in three regions of the Southeast U.S. Federal waters: the northern Gulf of Mexico, the South Atlantic Bight, and the Caribbean Sea. The deep-water coral research activities could take place in existing (in orange on the maps) or proposed (in green and purple on the maps) marine managed areas. Areas proposed for inclusion in the marine managed areas would be prioritized for sampling over already-existing marine managed areas.

Gulf of Mexico

The areas prioritized for survey in the northern Gulf of Mexico include those in the Flower Garden Banks National Marine Sanctuary, off Alabama, Mississippi, Louisiana, and Texas (Figure 1). Other potential areas for research include the waters around the Florida Keys National Marine Sanctuary and additional areas off Florida.

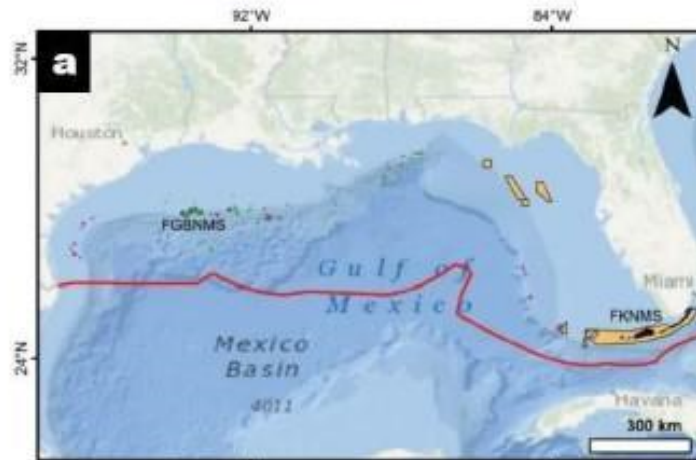


Figure 1. Map of proposed survey areas in the Gulf of Mexico. Areas prioritized for surveys include the Flower Garden Banks National Marine Sanctuary (FGBNMS) and the Florida Keys National Marine Sanctuary (FKNMS).

South Atlantic Bight

The areas surveyed in the South Atlantic Bight would include those off the coast of North Carolina, south around the Florida Peninsula (Figure 2). Sites proposed for inclusion in marine managed areas include those near Gray's Reef National Marine Sanctuary, off Georgia, and the Monitor National Marine Sanctuary, off North Carolina.



Figure 2. Map of proposed survey areas in the South Atlantic Bight. Areas prioritized for surveys include the Florida Keys National Marine Sanctuary (FKNMS), the Gray's Reef National Marine Sanctuary (GRNMS), and the Monitor National Marine Sanctuary (MNMS).

Caribbean Sea

The areas surveyed in the Caribbean Sea will include those waters around the U.S. Virgin Islands, Puerto Rico and its surrounding islands such as Vieques, Culebra, Mona, Desecheo, and Monito (Figure 3). Surveys may also take place around the Navassa Island National Wildlife Refuge, a small, uninhabited island west of Haiti, administered by the U.S. Fish and Wildlife Service.

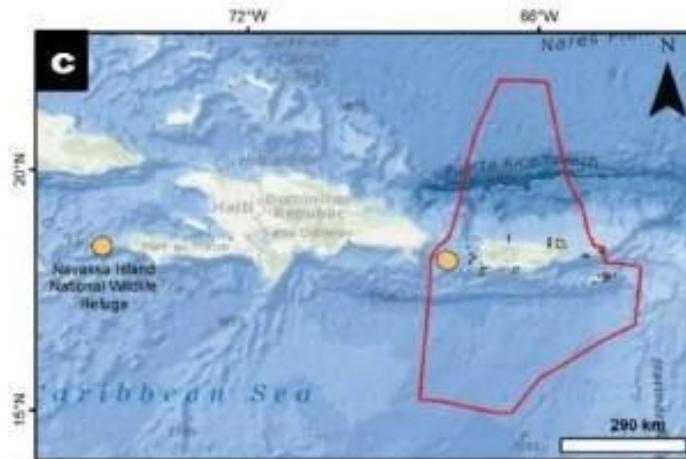


Figure 3. Map of proposed survey areas in the Caribbean.

Neither NMFS nor the Office of Coast Survey identified any interrelated or interdependent activities associated with the proposed action.

Minimization Measures

The National Centers for Coastal Ocean Science's activities would include the same protective measures described and analyzed in the 2013 Biological Opinion (see description in Consultation History). These measures are as follows:

- Minimize vessel disturbance and ship strike potential
 - Reduced speeds (less than 13 knots) when transiting through ranges of ESA-listed cetaceans (unless otherwise required, e.g., NOAA Sanctuaries)
 - Reduced speeds (less than 13 knots) while transiting through designated critical habitat (unless slower speeds are required, e.g., less than 10 knots in right whale designated critical habitat and management areas)
 - Trained observers aboard all vessels; 100 percent observer coverage
 - Species identification keys (for marine mammals, sea turtles, as applicable) will be available on all vessels
- Minimize noise
 - Reduced speed (see above)
 - Multibeam surveys using ≥ 50 kilohertz frequencies, lowest possible power and ping-rate
 - Single beam surveys using ≥ 30 kilohertz frequencies, lowest possible power and ping-rate, and 12° beam angle.
 - Reduce use of active acoustics as much as possible. Active acoustic sources should be used only when required for navigation or data collection and should be used at the lowest source level and highest frequency available that is suitable for the purpose.
- Minimize vessel discharges (including aquatic nuisance species)
 - Meet all Environmental Protection Agency Vessel General Permits and Coast Guard requirements¹.
 - Avoid discharge of ballast water in designated critical habitat.
 - Use anti-fouling coatings.
 - Clean hull regularly to remove aquatic nuisance species.
 - Avoid cleaning of hull in critical habitat.
 - Avoid cleaners with nonylphenols.
 - Rinse anchor with high-powered hose after retrieval.
- Minimize anchor impact to corals, seagrass or other designated habitat (e.g., Essential Fish Habitat)
 - Use designated anchorage area when available
 - Use mapping data to anchor in mud or sand, to avoid anchoring on corals

¹ See requirements for Vessels General Permits at: <https://www.epa.gov/hpdes/vessels-vgp>



- Avoid anchoring in seagrass critical habitat
 - Minimize anchor drag
- Avoid collecting bottom samples in seagrass designated critical habitat
 - There will be no bottom sample collections of any kind conducted during this cruise
- Cetaceans
 - Avoid approaching within 200 yards (182.9 meters), 500 yards for right whales.
 - Avoid critical habitat, when possible.
- Sea Turtles and Manatees
 - Avoid approaching within 50 yards.
- Entanglement Protective Measures
 - Use stiff line materials for towing and keep taut during operations to reduce potential for entanglement
 - Reduce knots in the line as much as possible
 - Clearly mark lines in the event an animal does become entangled so that NMFS experts can identify the gear.
- Habitat Protection
 - Avoid contact of gear, towed or lowered, with the sensitive bottom habitat (e.g., submerged aquatic vegetation and hard bottom)

ESA-Listed Species and Designated Critical Habitat Not Affected by the Proposed Action

Upon review of their known range and overlap with the proposed action, we have determined that the following species will not be affected by the proposed action: Gulf sturgeon, smalltooth sawfish, and ESA-listed corals. These species will not be considered further.

Gulf sturgeon could occur within the northern Gulf of Mexico action area. Gulf sturgeon are found in coastal rivers in Florida, Alabama, Mississippi, and Louisiana throughout most of the year, moving into the Gulf of Mexico between September and November to forage over winter. During winter, gulf sturgeon are typically found in nearshore waters two to four meters deep (Fox et al. 2002). Since the research activities will take place primarily in waters greater than 50 meters deep, we do not expect gulf sturgeon to be exposed to the stressors associated with ROV operation and coral sampling. The vessels used for the sampling cruises may transit through waters occupied by gulf sturgeon. However, the proposed action would take place during the summer, when gulf sturgeon are in rivers, not the Gulf of Mexico. Therefore, we do not expect gulf sturgeon to be exposed to stressors associated with vessel activity. We have determined that there will be no effect to gulf sturgeon as a result of the proposed action.

In the United States, smalltooth sawfish are typically found in shallow coastal waters around southern Florida up to ten meters deep (NMFS 2010). Since the proposed action will take place in waters greater than 50 meters deep, we do not expect smalltooth sawfish to be exposed to the proposed action. We have determined that there will be no effect to smalltooth sawfish as a result of the proposed action.

In their concurrence request, the National Centers for Coastal Ocean Science identified several species of ESA-listed invertebrates that may be affected by the proposed action. These species included: mountainous star coral (*Orbicella faveolata*), rough cactus coral (*Mycetophyllia ferox*),



boulder star coral (*Orbicella franksi*), lobed star coral (*Orbicella annularis*), pillar coral (*Dendrogyra cylindrus*), staghorn coral (*Acropora cervicornis*) and elkhorn coral (*Acropora palmata*).

Upon examining the current known range of each of these species and the extent of the action area, we determined that these ESA-listed corals occur in some parts of the action area. ESA-listed corals occur in the Caribbean and Florida Keys; there is no confirmed presence of ESA-listed corals in the northern Gulf of Mexico region (Veron 2014). The proposed action is focusing on corals in the deep-water environment at depths greater than 50 meters. ESA-listed corals found in the Caribbean and Florida Keys are found at depths shallower than the proposed action area (Table 2), so we do not expect any ESA-listed coral species to be exposed. Because the proposed action would take place in an environment where we do not expect ESA-listed corals to occur, we conclude that there is no effect of the action to ESA-listed corals.

Table 2. Depth ranges of ESA-listed coral species found in the Caribbean.

ESA-listed Coral Species	Depth	Source
Elkhorn Coral	Usually less than 6 meters; up to 20 meters	(NMFS 2015)
Staghorn Coral	0 to 30 meters	(NMFS 2015)
Mountainous Star Coral	Typically 10 to 20 meters; up to 40 meters	(Holstein et al. 2015)
Boulder Star Coral	1 to 30 meters	(Brainard 2011)
Lobed Star Coral	1 to 30 meters	(Brainard 2011)
Pillar Coral	1 to 25 meters	(Aronson 2008a)
Rough Cactus Coral	5 to 30 meters	(Aronson 2008b)

Several areas of critical habitat have been designated throughout the action area. Designations for smalltooth sawfish, Gulf sturgeon, and the proposed Atlantic sturgeon critical habitat are in shallow coastal areas or in rivers. These areas will not be affected by the proposed action, which will take place in the oceanic, deep-water environment. These areas will not be considered further.

Affected ESA-listed Species and Designated Critical Habitat

The proposed action has the potential to affect ESA-listed species that occur in the waters of the South Atlantic Bight, Caribbean Sea, and Gulf of Mexico. Species or designated critical habitat that may overlap the action area are included in Table 3. Because the action would occur in three distinct areas, each with its own variety of ESA-listed resources, not all species or critical habitat would be affected by the action at any one time. We have identified the potentially affected resources in the table by the three areas: Gulf of Mexico, South Atlantic Bight, and Caribbean Sea.



Table 3. Potentially affected ESA-listed species and designated critical habitat.

Species	ESA Status	Critical Habitat	Recovery Plan	Survey area where species are most likely to be affected
Marine Mammals				
Blue whale (<i>Balaenoptera musculus</i>)	E – 35 FR 18319	---	07/1996	Gulf of Mexico, South Atlantic, Caribbean
Fin whale (<i>Balaenoptera physalus</i>)	E – 35 FR 18319	---	75 FR 47538	Gulf of Mexico, South Atlantic, Caribbean
Sei whale (<i>Balaenoptera borealis</i>)	E – 35 FR 18319	---	76 FR 43985	Gulf of Mexico, South Atlantic, Caribbean
Bryde's whale Gulf of Mexico subspecies (<i>Balaenoptera edeni</i>)	E – 81 FR 88639	---	---	Gulf of Mexico
North Atlantic Right Whale (<i>Eubalaena glacialis</i>)	E – 73 FR 12024	59 FR 28805 and 81 FR 4637	70 FR 32293	South Atlantic
Sperm whale (<i>Physeter macrocephalus</i>)	E – 35 FR 18319	---	75 FR 81584	Gulf of Mexico, South Atlantic, Caribbean
Marine Reptiles				
Green turtle (<i>Chelonia mydas</i>) – North Atlantic DPS	T – 81 FR 20267	63 FR 46693	63 FR 28359	Gulf of Mexico, South Atlantic, Caribbean
Hawksbill turtle (<i>Eretmochelys imbricata</i>)	E – 35 FR 8491	63 FR 46693	57 FR 38818	Gulf of Mexico, South Atlantic, Caribbean
Kemp's Ridley turtle (<i>Lepidochelys kempi</i>)	E – 35 FR 18319	---	75 FR 12496	Gulf of Mexico, South Atlantic, Caribbean
Leatherback turtle (<i>Dermochelys coriacea</i>)	E – 35 FR 8491	44 FR 17710 and 77 FR 4170	63 FR 28359	Gulf of Mexico, South Atlantic, Caribbean
Loggerhead turtle (<i>Caretta caretta</i>) – Northwest Atlantic Ocean DPS	T – 76 FR 58868	79 FR 39856	63 FR 28359 74 FR 2895	Gulf of Mexico, South Atlantic, Caribbean
Fishes				
Nassau grouper (<i>Epinephelus striatus</i>)	T – 81 FR 42268	---	---	Caribbean
Scalloped hammerhead shark (<i>Sphyrna lewini</i>) Central and Southwest Atlantic DPS	T – 79 FR 38213	---	---	Caribbean
Atlantic sturgeon (<i>Acipenser oxyrinchus</i>)	T – 77 FR 5879	81 FR 35701 (Proposed)*	---	South Atlantic



Species	ESA Status	Critical Habitat	Recovery Plan	Survey area where species are most likely to be affected
<i>oxyrinchus</i>) Gulf of Maine DPS				
Atlantic sturgeon, (<i>Acipenser oxyrinchus oxyrinchus</i>) New York Bight DPS	E -- 77 FR 5879	81 FR 35701 (Proposed)*	--	South Atlantic
Atlantic sturgeon, (<i>Acipenser oxyrinchus oxyrinchus</i>) Chesapeake DPS	E -- 77 FR 5879	81 FR 35701 (Proposed)*	--	South Atlantic
Atlantic sturgeon, (<i>Acipenser oxyrinchus oxyrinchus</i>) Carolina DPS	75 FR 61904	81 FR 35077 (Proposed)*	--	South Atlantic
Atlantic sturgeon, (<i>Acipenser oxyrinchus oxyrinchus</i>) South Atlantic DPS	75 FR 61904	81 FR 35077 (Proposed)*	--	South Atlantic
Oceanic whitetip shark (<i>Carcharhinus longimanus</i>)	I -- 81 FR 96304 (Proposed)	--	--	Gulf of Mexico, South Atlantic, Caribbean
Giant manta ray (<i>Manta birostris</i>)	I -- 82 FR 3694 (Proposed)	--	--	Gulf of Mexico, South Atlantic, Caribbean

*Critical habitat has been designated, but it will not be affected by the proposed action.

Consultation History

On June 1, 2017, the National Centers for Coastal Ocean Science submitted a memorandum requesting a letter of concurrence under the ESA for activities to be conducted on the NCCOS-led field activities to be conducted as part of the Southeast Deep Coral Initiative in 2017 through 2019. On June 22, 2017, the National Centers for Coastal Ocean Science submitted a revised memorandum with additional information. The National Centers for Coastal Ocean Science have requested our concurrence that these activities are not likely to adversely affect ESA-listed species or designated critical habitat. NMFS Office of Protected Resources responded on the same date that it received all necessary information.

Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the ESA-listed species or designated critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR §402.02). The applicable standard to find that a proposed action is not likely to adversely affect ESA-listed species or designated critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the



impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur.

Effects of the Action: Vessel Activity

The 2013 biological opinion identified several stressors associated with the Office of Coast Survey's hydrographic surveys in coastal waters. These included vessel activity (strike, acoustic disturbance, vessel presence, discharges, and introduction of aquatic nuisance species). These stressors pose risks to ESA-listed whales, sea turtles, and fishes.

Stressor: Vessel Strike

Because the vessel would move at a very slow speed during the survey, a strike of marine mammals or sea turtles would be improbable and extremely unlikely. Further, adherence to observation and avoidance procedures is also expected to avoid vessel strikes for marine mammals and sea turtles. We also expect ESA-listed fishes to move away from the vessel, and thus a strike would be extremely unlikely. Therefore, effects from vessel strikes during the survey would be discountable for ESA-listed fishes, whales, and sea turtles.

Stressor: Acoustic Disturbance and Vessel Presence

When a vessel transits to and from the survey areas, potential effects on the ESA-listed species include vessel strikes, acoustic disturbance, and disturbance from the vessel's presence. Combined vessel noise and presence could cause slight marine mammal or sea turtle response or behavioral interruptions, but they would be minor and temporary as the vessel moves away from any marine mammals or sea turtles. The distance between the vessel and observed marine mammals and sea turtles, per avoidance protocols, would also minimize the potential for acoustic disturbance from engine noise. Therefore, effects from acoustic disturbance or presence associated with vessels would be insignificant for ESA-listed whales and sea turtles.

ESA-listed fishes such as all five Atlantic sturgeon DPSs, Nassau grouper, Central and Southwest Atlantic DPS scalloped hammerhead sharks, oceanic whitetip sharks, and giant manta rays might occur in the action area and be exposed to the stressors associated with vessel activity.

Central and Southwest Atlantic DPS scalloped hammerhead sharks, oceanic whitetip sharks and giant manta rays occupy tropical and subtropical oceanic waters. Oceanic whitetip sharks can be found at the ocean surface, but most frequently stay between 25.5 and 50 meters deep (Carlson and Gulak 2012; Young 2016). Giant manta rays are found at depths less than ten meters during the day (Miller 2016). Scalloped hammerhead sharks can be found to depths of 1,000 meters. We expect that scalloped hammerhead sharks, giant manta rays, and whitetip oceanic sharks will, for the most part, be at depths where there will be minimal risk of vessel strike or exposure to noise.

When in the marine environment, Atlantic sturgeon adults and sub-adults typically occupy shallow marine waters, less than 15 meters deep (Dunton et al. 2015; Erickson et al. 2011). The proposed action would take place in summer months, placing Atlantic sturgeon largely out of the area where most of the vessel activity and research will occur.



Nassau grouper typically associate with coral reefs, with juveniles occupying shallow reef habitat, and adults occupying deep reefs (NMFS 2013). The vessels in use for the proposed action would be too large to enter shallow waters, and we expect that any exposed Nassau grouper would move away from the vessels.

The vessel's passage past an ESA-listed fish would be brief and not likely to be significant in impacting any individual's ability to feed, reproduce, or avoid predators. Because the potential acoustic interference from engine noise would be undetectable or so minor that it could not be meaningfully evaluated, we find that the risk from this potential stressor is insignificant. Therefore, we conclude that acoustic interference from engine noise is not likely to adversely affect any ESA-listed fishes.

Stressor: Discharges

The potential for discharges via fuel or oil leakages is extremely unlikely. An oil or fuel leak would likely pose a significant risk to the vessel and its crew and actions to correct a leak should occur immediately to the extent possible. In the event that a leak should occur, the amount of fuel and oil onboard the research vessel is unlikely to cause widespread, high dose contamination (excluding the remote possibility of severe damage to the vessel) that would impact listed species directly or pose hazards to their food sources. Because the potential for fuel or oil leakage is extremely unlikely to occur, we find that the risk from discharges to any ESA-listed species is discountable.

Stressor: Aquatic Nuisance Species

To minimize the risk of aquatic nuisance species introduction, personnel would: avoid discharge of ballast water in designated critical habitat; use anti-fouling coatings; clean the hull regularly to remove aquatic nuisance species (but avoid doing so in critical habitat), and rinse the anchor with a high-powered hose after retrieval. These protective measures go beyond the requirements of the Vessel and Small Vessel General Permits², as described in the mitigation measures above. Furthermore, the vessels would not transit outside of the United States; therefore, they would not introduce foreign aquatic nuisance species. Given the protective measures, it is highly unlikely that the vessels would transfer aquatic nuisance species to any ESA-listed species during the proposed action. We find that the risk from aquatic nuisance species to any ESA-listed species is discountable.

Conclusion

Therefore, we conclude that the effects from vessel activity, pollution by oil or fuel leakage, and risk of aquatic nuisance species introduction are insignificant or discountable, and not likely to adversely affect ESA-listed marine mammals, sea turtles, or fishes.

Effects of the Action: Deployment and Operation of Survey Equipment

The proposed action includes the operation of equipment such as the remotely operated vehicles and CTD casts that could be potential stressors for ESA-listed species. The ROVs will be used to collect coral samples, and the CTD casts will be used to collect water samples and data.

² See requirements for the Vessels General Permit at: <https://www.epa.gov/npdes/vessels-vgp>



ROVs have acoustic tracking devices on them that emit sound which could be detected by and impact ESA-listed species. The effects of sound from the ROV operation will be discussed in the section below.

Stressor: Operation of Remotely Operated Vehicle and CTD Cast

A ROV is an underwater observation vehicle connected to a computer operated by personnel on board the ship. The operator directs the ROV to use its camera to photograph the sea floor. The ROV is tethered at all times. The CTD cast is lowered into the ocean by a power winch and is tethered the entire time.

Possible stressors from the ROV and CTD cast during the proposed activities include entanglement from the tether during operation, equipment strike (which could include hitting coral reefs, substrate, or an ESA-listed species while in the water column).

The ROV is controlled by an operator who would have visual of the surroundings during operation and would avoid interaction with ESA-listed species by navigating the ROV away from the organism, thereby reducing the likelihood that the ROV would strike any ESA-listed resource while in use. In addition to the camera, the ROV has navigational equipment (e.g., depth, heading, altitude), allowing the operator to avoid striking bottom. To reduce the risk of entanglement from the tether attached to the ROV, the Office of Coast Survey proposed mitigation measures. These include using a stiff line material, keeping the line taut during operations and reducing knots in the line as much as possible. Therefore, the risks of strike or entanglement to ESA-listed species from ROV use are discountable.

Unlike the ROV, the CTD cast would not have a camera on it while in use. Before deploying the CTD cast, researchers would use the echosounder to ensure that the water depth is greater than the maximum depth of the CTD cast. This would prevent the CTD cast from striking bottom. While there is some possibility that a CTD cast could strike an ESA-listed species while being lowered into the ocean, we consider that possibility to be extremely unlikely. Another stressor from the CTD cast would be risk of entanglement from the tether. Similar to the ROV, researchers would use a stiff line material, keeping the line taut during operations and reducing knots in the line as much as possible. Therefore, the risks of strike or entanglement to ESA-listed species from CTD cast are discountable.

Stressor: Sound Sources

Devices such as multibeam echosounders and ROVs would be in use and emit sound which could be within the hearing range of ESA-listed whales, sea turtles, and fishes. There are up to five different types of multibeam echosounders that could be used during the proposed action, each with a different operating frequency (Table 4).



Table 4. Operating frequencies of acoustic devices in the proposed action.

Vessel	Device	Operating Frequency
NOAA Ship <i>Okeanos Explorer</i>	Kongsberg EM-302	30 kHz
	Kongsberg/Simrad EK-60	38, 120, and 200 kHz
NOAA Ship <i>Nancy Foster</i>	Reson 7125 SV2	200 or 400 kHz
	Simrad EM 1002	95 kHz
	Kongsberg EM 710	65 to 100 kHz
	Kongsberg/Simrad EK-60	38, 120, and 200 kHz

The ROVs proposed for use in the proposed action are equipped with various devices used to locate and operate the ROV. The ROVs are equipped with acoustic tracking equipment which operates at frequencies between eight and 30 kilohertz. The ROV or research vessel's acoustic telemetry systems could have transponder units, altimeters, and/or sonar that would operate at frequencies and emit sound that could be within the functional hearing range of ESA-listed sea turtles, fishes, and marine mammals (Table 5).

Table 5. Functional hearing ranges of species in the action area.

Species/Group	Functional Hearing Range	Source
Low frequency cetaceans (Balween whales)	7 Hz to 25 kHz	(NMFS 2016)
Mid-frequency cetaceans (Toothed whales)	150 Hz to 160 kHz	(NMFS 2016)
Sea turtles (general)	Less than 1 kHz	(Moein et al. 1994)
Loggerhead sea turtles	250 Hz to 750 Hz	(Bartol et al. 1999)
Kemp's ridley sea turtles	100 Hz to 500 Hz	(Ketten and Bartol 2005)
Green sea turtles	100 Hz to 800 Hz	(Ketten and Bartol 2005)
Elasmobranchs (Lemon sharks and horn sharks)	20 Hz to 1,000 Hz	(Casper and Mann 2006)

The functional hearing ranges of ESA-listed sea turtles are not well understood and vary by species. In general, the available information on sea turtle hearing indicates that their hearing thresholds are less than 1 kilohertz (Moein et al. 1994). Loggerhead sea turtles are thought to have a functional hearing range of 250 to 750 hertz (Bartol et al. 1999), Kemp's ridely sea turtles a range of 100 to 500 hertz, and green sea turtles 100 to 800 hertz (Ketten and Bartol 2005). The operating frequencies of the ROV telemetry devices (i.e., transponder units, altimeters, and sonar) and the multibeam echosounders are outside the functional hearing range of ESA-listed

sea turtles, meaning that sound associated with their operation is discountable, therefore, not likely to adversely affect ESA-listed sea turtles.

Mid-frequency toothed whales, including the ESA-listed sperm whale, have a functional hearing range of 150 hertz to 160 kilohertz. The Simrad EM 1002, Kongsberg/Simrad EK-60, and the Kongsberg EM-302 would operate at frequencies within the hearing range of sperm whales.

Sperm whales have been observed in the continental slope waters north of Cape Hatteras, North Carolina, in waters 1000 meters or deeper. Sperm whale densities in this area are higher during summer months (Mullin and Fulling 2004; Waring et al. 2006). The survey would be south of where we expect sperm whales to occur in high densities. As such, we believe it is very unlikely that sperm whales would be exposed to the proposed action. The minimization measures further reduce the likelihood of exposure. Multibeam echosounder transmissions would be suspended when ESA-listed whales are within range. The research vessel would also avoid approaching cetaceans within 200 yards (600 feet). Due to the minimization measures and that it is unlikely that sperm whales would be present in the action area, we conclude that the effects of the proposed action to sperm whales would be discountable, and sperm whales not likely to be adversely affected.

The functional hearing range of ESA-listed baleen whales (Gulf of Mexico Bryde's whale, blue, fin and sei whales) is 7 hertz to 25 kilohertz. The multibeam echosounders operate outside the functional hearing range of these whales, meaning that operation of these devices are not likely to adversely affect ESA-listed baleen whales.

The altimeters (500 kilohertz) and sonar systems (675 kilohertz) associated with the ROVs proposed for use will be outside the functional hearing range of ESA-listed baleen whales. As a result, the risk of effects to ESA-listed baleen whales from exposure to sound associated with the operations of altimeters and sonar systems are discountable, and are not likely to adversely affect these species. However, the transponder units for the acoustic tracking systems are within the hearing range of ESA-listed baleen whales. The transponder units for the acoustic tracking systems operate at between eight and 30 kilohertz or 21.5 and 43.2 kilohertz, putting these devices in the functional hearing range of ESA-listed baleen whales (Gulf of Mexico bryde's, blue, fin and sei whales). We expect that ESA-listed species will avoid the vessel and ROV, minimizing the exposure to sound from the ROV operation and the multibeam echosounders. Generally, we expect that ESA-listed whales to move away from or parallel to the vessel (Hauser and Holst 2009). The minimization measures further reduce the likelihood of exposure. We conclude that the effects of the proposed action to ESA-listed baleen whales would be discountable, and not likely to be adversely affected.

The functional hearing ranges of ESA-listed fishes are not well understood. Oceanic whitetip sharks, scalloped hammerhead sharks, and giant manta rays are elasmobranchs, and although there is no known information on the hearing ability of these species specifically, other species of elasmobranchs have been studied. Hearing ranges of lemon sharks and horn sharks are between 20 hertz and one kilohertz (Casper and Mann 2006), and we assume that the hearing range of oceanic whitetip sharks and giant manta rays are within this range as well. The altimeters, sonar systems, and transponder units for the acoustic tracking system for the ROV are



not in the hearing range of elasmobranchs, and thus not within the range of scalloped hammerhead sharks, oceanic whitetip sharks and giant manta rays. The multibeam echosounders all operate at frequencies above one kilohertz, and thus not in the hearing range of ESA-listed sharks.

Information available about the hearing abilities of Atlantic sturgeon come from studies of other species of sturgeon. All five DPSs are considered in this analysis since Atlantic sturgeon from multiple river systems “mix” in the marine environment (Wirgin et al. 2015a; Wirgin et al. 2015b). Meyer et al. (2010) recorded auditory evoked potentials to pure tone stimuli of varying frequency and intensity in lake sturgeon (*Acipenser fulvescens*) have best sensitivity from 50 to 400 hertz. Lovell et al. (2005) also studied sound reception in and the hearing abilities of paddlefish (*Polyodon spathula*) and lake sturgeon in pressure dominated and particle motion dominated sound fields. They concluded that both species were responsive to sounds ranging in frequency from 100 to 500 hertz with lowest hearing thresholds from frequencies in bandwidths between 200 and 300 hertz and higher thresholds at 100 and 500 hertz. Based on this information, we conclude that the multibeam echosounders and the systems associated with the ROVs operate outside the functional hearing range of Atlantic sturgeon. The effects are insignificant, and Atlantic sturgeon are not likely to be adversely affected.

There are limited data on sound production in Nassau grouper; other species of grouper have been studied and summarized here. Nassau grouper sound production, or “grunts”, involves contraction of a bilateral post-opercular muscle that is connected to the swim bladder (Hazlett 1962). Nelson et al. (2011) reported on red grouper sound production in Florida using passive acoustic and video monitoring. Red grouper produce low-frequency pulses, broadband pulses and pulse trains, as well as short calls labelled as “growls” with their dominant frequency at about 180 hertz (Nelson et al. 2011). Based on this information, we conclude that the multibeam echosounders and the systems associated with the ROVs operate outside the functional hearing range of Nassau grouper. The effects are insignificant, and Nassau grouper are not likely to be adversely affected.

Due to the minimization measures and the expected avoidance behavior of ESA-listed species, we believe that the proposed use of the multibeam echosounders, ROVs, and those associated sound sources would have insignificant effects, if any, on ESA-listed species. Therefore, the effects from sound associated with ROV use and its operation are not likely to adversely affect ESA-listed whales, sea turtles, or fishes.

Effects of the Action: Designated Critical Habitat

The proposed action may occur within critical habitats that have been designated for loggerhead sea turtle Northwest Atlantic Ocean DPS, green turtle North Atlantic DPS, hawksbill and leatherback sea turtles, elkhorn and staghorn corals, and North Atlantic right whale.

Critical habitat for the Northwest Atlantic Ocean distinct population segment of loggerhead sea turtles is designated in several units off the southeastern coast of the United States, within the proposed action area, specifically, the *Sargassum* habitat. Other units of designated critical habitat for loggerhead sea turtles, such as nearshore reproductive, foraging, breeding, migratory,



or winter units, are outside the action area. The essential biological features for *Sargassum* habitat include:

1. Convergence zones, surface-water downwelling areas, margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for optimal growth of *Sargassum* and inhabitation of loggerheads.
2. *Sargassum* in concentrations that support adequate prey abundance and cover.
3. Available prey and other material associated with *Sargassum* habitat including plants and cyanobacteria and animals native to the *Sargassum* community.
4. Sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatchling loggerheads, i.e., greater than ten meters depth.

The proposed action will involve vessel activity, ROV operation, bathymetric data acquisition, and coral and water sample collection. These activities will not affect the oceanic features, prey abundance, cover, water depth, or other essential biological features for loggerhead *Sargassum* critical habitat. Therefore, we conclude that there will be no effect from the proposed action to loggerhead designated critical habitat.

Critical habitat has been designated for hawksbill sea turtles in Puerto Rico, around the coastal waters adjacent to Mona and Monito Islands, and may be exposed to the proposed action. Critical habitat has been designated for green sea turtles in Culebra Island, Puerto Rico. No primary constituent elements were identified in either designation, but several activities were identified as requiring special management considerations. These include vessel traffic, coastal construction, point and non-point source pollution, fishing activities, dredge and fill activities, and habitat restoration. The proposed action will include vessel activity, and therefore does require special management consideration with regard to hawksbill and green sea turtle designated critical habitat. The rule includes a discussion of vessel traffic potentially affecting designated critical habitat, specifically, propeller dredging and anchor mooring disrupting benthic habitats by crushing coral, breaking seagrass root systems, and severing rhizomes. Recreational boating may also trample seagrass beds and live bottom, and disturb seagrasses and coral. The vessel operators will use mapping data to avoid anchoring on sensitive bottom types like coral reefs and seagrasses. The ROV would be operated to avoid hitting bottom. We believe it is extremely unlikely that the large research vessels, which have a 13.5-foot and 20-foot draft, would be in such shallow waters as to damage benthic habitats with its propeller. We conclude that the proposed action would not destroy or adversely modify designated critical habitat for green and hawksbill sea turtles.

Critical habitat has been designated for leatherback sea turtles in the coastal waters adjacent to St. Croix, U.S. Virgin Islands, and may be exposed to the proposed action. No primary constituent elements were identified in the designation, but several activities were identified as those that might modify critical habitat. These include recreational boating and swimming, and sandmining. The proposed action will include vessel activity, ROV operation, bathymetric data acquisition, and coral and water sample collection. These activities are not identified as ones that



can modify the critical habitat. We conclude that the proposed action would not be likely to destroy or adversely modify designated critical habitat for leatherback sea turtles.

Critical habitat has been designated for elkhorn and staghorn coral in the Florida Keys, Puerto Rico, and the U.S. Virgin Islands. Designated critical habitat for these species is within the action area, specifically the South Atlantic Bight and the Caribbean Sea. The essential biological features for the designation includes substrate of suitable quality and availability to support successful larval settlement and recruitment, and reattachment and recruitment of fragments. The proposed action will involve vessel activity, ROV operation, bathymetric data acquisition, and coral and water sample collection. These activities will not involve altering the availability or quality of substrate. The researchers will use designated anchorage areas and use mapping data to only anchor in appropriate areas (e.g., mud or sand). We conclude that the proposed action would not be likely to destroy or adversely modify designated critical habitat for elkhorn and staghorn coral.

Critical habitat for North Atlantic right whales is designated within the action area, in the marine waters extending from Cape Fear, North Carolina to approximately 27 nautical miles below Cape Canaveral, Florida. This unit was designated as a calving area for North Atlantic right whales. Essential features for North Atlantic right whale critical habitat include:

- Calm sea surface conditions of Force Four or less on the Beaufort Wind Scale,
- Sea surface temperatures from a minimum of seven degrees Celsius and never more than 17 degree Celsius, and
- Water depths of six to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 nautical miles squared of ocean waters during the months of November through April.

The proposed action would not entail activities that affect the essential features of the critical habitat, because the activities would not affect oceanographic conditions. We conclude that the proposed action would not be likely to destroy or adversely modify designated critical habitat for North Atlantic right whales.

Conclusion

Based on this analysis, NMFS concurs with National Centers for Coastal Ocean Science's determination that all effects of the proposed action are not likely to adversely affect the subject ESA-listed species and/or designated critical habitats.

Reinitiation of Consultation

Reinitiation of consultation is required and shall be requested by the Federal agency, or by NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized by law and (1) new information reveals effects of the action that may affect an ESA-listed species or designated critical habitat in a manner or to an extent not previously considered; (2) the identified action is subsequently modified in a manner that causes an effect to the ESA-listed species or designated critical habitat that was not considered in this concurrence letter; or if (3) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR §402.16).



Please direct questions regarding this letter to Colette Cairns, consulting biologist, NMFS' Office of Protected Resources, at (301) 427-8414 or colette.cairns@noaa.gov.

Sincerely,



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

cc: Paula Whitfield; National Centers for Coastal Ocean Science, National Ocean Service

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Appendix D: EX-18-03 Essential Fish Habitat (EFH) Consultation Letter



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
283 13th Avenue South
St. Petersburg, Florida 33701-0000
<http://sero.nmfs.noaa.gov>

June 15, 2017

F/SER4-DD

MEMORANDUM FOR: Steven Thur, Ph.D.
Deputy Director, National Centers for Coastal Ocean Science

FROM: Virginia M. Fay *VMF* /for
Assistant Regional Administrator, Habitat Conservation Division

SUBJECT: Essential Fish Habitat (EFH) Consultation for activities to be
conducted as part of the Southeast Deep Sea Coral Initiative in
2017-2019

This responds to the request for an EFH review of the subject action. During this project, National Centers for Coastal Ocean Science (NCCOS) researchers will lead field efforts that will map, survey and sample deep-sea coral ecosystems throughout the Southeast U.S., a region including the U.S. federal waters of the Gulf of Mexico, South Atlantic Bight and Caribbean Sea. These efforts will be conducted on research expeditions aboard the NOAA Ship *Nancy Foster* in 2017-2019 (3 years), as well as on the NOAA Ship *Okeanos Explorer* in 2018-2019 (2 years). Specifically, these efforts will (1) survey deep-sea coral ecosystems using remotely operated vehicles (ROV), (2) map deep-water habitats using multibeam echosounders, and (3) sample the physical and chemical properties of the water column via the deployment of CTD-casts and collection of water samples.

As specified in the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), EFH consultation is required for federal actions which may adversely affect EFH. As the federal action agency in this matter, the NCCOS has determined the proposed activities would not adversely affect EFH. The Habitat Conservation Division (HCD) has reviewed the proposed activities as well as the protective measures and best management practices incorporated into the action. In our assessment of overall activity including the experimental design, nature of the collection, and limited scope of subject activity the HCD has no EFH conservation recommendations to provide pursuant to Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act. Further EFH consultation on this action is not necessary unless future modifications are proposed and you believe that resulting activities may result in adverse impacts to EFH.

Be advised the harvest and possession of coral is prohibited by current federal fishing regulations in the Gulf of Mexico. NCCOS should contact Susan Gerhart (Susan.Gerhart@noaa.gov), Chief of the Southeast Region's Sustainable Fisheries Division Gulf of Mexico Branch, to apply for a letter of acknowledgment (LOA) of scientific research activities. LOAs are issued by the National Marine Fisheries Service (NMFS) under the authority of the MSFCMA for situations where research activities would normally be in violation of federal fishing regulations. The NMFS indicates its acknowledgment by issuing a LOA specifying the activities are scientific research, and therefore, exempt from the fishing regulations developed under the MSFCMA.

cc:
F/SER24 – susan.gerhart@noaa.gov, lauren.waters@noaa.gov
F/SER4 – rusty.swafford@noaa.gov
File



Appendix E: NASA Maritime Aerosols Network Survey of Opportunity

Survey or Project Name

NASA Maritime Aerosol Network Survey of Opportunity

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 ocean.

During the cruise the marine aerosol layer observations were collected for the NASA MAN research effort. Observations were made by mission personnel (as time and weather allowed) with a sun photometer instrument provided by the NASA MAN program. Resulting data were delivered to the NASA MAN principle investigator, Alexander Smirnov, by the expedition coordinator. All collected data were archived and are publicly available at:

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

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



Appendix F: Acronyms

3D—Three-dimensional
ADCP—Acoustic Doppler Current Profiler
AERONET—Aerosol Robotic Network
AMNH—American Museum of Natural History
BOEM—Bureau of Ocean Energy Management
BSEE—Bureau of Safety and Environmental Enforcement
CE—Categorical Exclusion
CTD—Conductivity, temperature, and depth
D2—ROV Deep Discoverer
DNA—Deoxyribonucleic acid
DO—Dissolved oxygen
DSCRTP—NOAA Deep Sea Coral Research and Technology Program
EEZ—Exclusive Economic Zone
EFH—Essential Fish Habitat
ESA—Endangered Species Act
EtOH—Ethyl alcohol, or ethanol
FAU—Florida Atlantic University
FIU—Florida International University
GEMS—Geoscience Earth & Marine Services
GFOE—Global Foundation for Ocean Exploration
GCSC—NOAA Gulf Coast Services Center
HAPC—Habitat areas of particular concern
ISC—Inner Space Center
JAMSTEC—Japan Agency for Marine-Earth Science and Technology
LSU—Louisiana State University
LSS—Light scattering
MAN—Maritime Aerosol Network
MPA—Marine Protected Area
NASA—National Aeronautics and Space Administration
NCCOS—NOAA National Centers for Coastal Ocean Science
NCEI—NOAA National Centers for Environmental Information
NEPA—National Environmental Policy Act
NESDIS—NOAA National Environmental Satellite, Data, and Information Service
NMFS—NOAA National Marine Fisheries Service
NOAA—National Oceanic and Atmospheric Administration
NWFSC—NOAA Northwest Fisheries Science Center
OER—NOAA Office of Ocean Exploration and Research
OMAO—NOAA Office of Marine and Aviation Operations
ONMS—NOAA Office of National Marine Sanctuaries
ORP—Oxygen reduction potential
ORR—NOAA Office of Response and Restoration
OSU—Oregon State University
ROV—Remotely operated vehicle
SAFMC—South Atlantic Fisheries Management Council



SEDCI—NOAA Southeast Deep Coral Initiative
SEFSC—NOAA Southeast Fisheries Science Center
SBP—Sub-bottom profiler
SI—Smithsonian Institution
SIO—Scripps Institution of Oceanography
SIS—Seafloor Information Software
SOI—Schmidt Ocean Institute
TSG—Thermosalinograph
TB—Terabytes
UCAR—University Corporation for Atmospheric Research
UCH—Underwater Cultural Heritage
UH—University of Hawai'i at Mānoa (UH)
ULL—University of Louisiana at Lafayette
URI—University of Rhode Island
USGS—U.S. Geological Survey
USNM—National Museum of Natural History
WHOI—Woods Hole Oceanographic Institution
XBT—Expendable bathythermographs

