



*EX-19-05-L2 Expedition Report*

**Deep Connections 2019:  
Exploring Atlantic Canyons and  
Seamounts of the U.S. and Canada**

EX-19-05-L2: New England and Canada (ROV and Mapping)

August 28 - September 15, 2019

Halifax, Nova Scotia to North Kingstown, Rhode Island

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September 24, 2019

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## Abstract

Between August 28 and September 15, 2019, the NOAA Office of Ocean Exploration and Research (OER) and partners conducted a telepresence-enabled expedition on NOAA Ship *Okeanos Explorer* to collect critical baseline information about unknown and poorly understood deep-water areas off the U.S. and Canadian Atlantic Continental Margin. The goal of the expedition was to use remotely operated vehicle (ROV) dives in combination with mapping operations to increase our understanding of poorly studied deep-sea ecosystems in 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 completed 12 successful dives ranging in depth from 306 to 2,668 meters that explored a wide diversity of habitats and geological features, including deep-sea coral and sponge communities, deep-sea fish habitats, midwater habitats, submarine canyons, seamounts, and more. Midwater explorations at depths ranging from 700 to 2,175 meters were conducted during one ROV dive in order to investigate the diversity and abundance of the largely unknown pelagic fauna of the region. Overall, hundreds of different species were observed during ROV dive operations, including several potentially undescribed species and several range extensions. Throughout the expedition, 124 biological samples were collected (35 primary and 89 associated taxa), 26 of which likely represent either range expansions or potential new species. The remainder of the biological samples were collected to support studies on connectivity and biogeographic patterns across the Atlantic Ocean.

Six high-density communities of deep-sea corals and sponges were documented during the expedition, including a high-density forest of bamboo corals at depths of 1,100 meters inside Gully Canyon, and a highly diverse and dense assemblage of deep-sea sponges and corals at depths of 2,500-2,650 meters on Retriever Seamount, which is among the deepest known such communities in the region. Additional patches of high-density communities of deep-sea corals and sponges were documented during dives on an unnamed canyon, Kinlan Canyon, Bear Seamount, and Veatch Canyon. Other noteworthy ROV observations included records of three large (> 1 meter) individuals of the endangered Atlantic Halibut, *Hippoglossus hippoglossus*. Additionally, ROV dives documented various unique geological features, including inactive fluid expulsion features inside Verrill Canyon, evidence of recent sediment transport within Oceanographer Canyon, and a continuous sequence of carbonate rock (>100 meters thick) with near vertical relief at Veatch Canyon. Five geological samples were collected to support laboratory analyses that will increase our understanding of the geological context of this region.

In addition to ROV dives, the expedition included mapping operations using four different sonar systems, including multibeam sonar, split-beam fisheries sonars, sub-bottom profiler and Acoustic Doppler Current Profiler (ADCP). Over 10,729 square kilometers of seafloor were mapped over the course of the expedition, including areas around the Northeast Channel, the Fundian Valley, North of Alvin Canyon, and along the U.S.-Canadian boundary which had never before been mapped using high-resolution sonars. Re-mapping of a submarine landslide scarp at the head of an unnamed canyon located between Gilbert and

Lydonia Canyons revealed evidence of seabed instability over short timeframes (<7 years). Sub-bottom profiler data was collected south of Retriever Seamount in support of the U.S. Extended Continental Shelf project. Furthermore, water column mapping operations documented activity at various known seeps near Veatch and Oceanographer Canyons, thereby increasing our knowledge of the temporal persistence of these ephemeral features.

All 9.2 TB of data collected during the expedition, including video and environmental data collected on every ROV dive, mapping data, oceanographic and meteorological data, will be made publicly available through national archives. Highlight images, videos, educational materials, background information, and descriptions of the day-to-day activities and accomplishments of the expedition are all available via the expedition website (<https://oceanexplorer.noaa.gov/oceanos/explorations/ex1905>). A total of 51 scientists, managers, and students from 31 institutions in seven countries and 13 U.S. states participated in the expedition as members of the science team through telepresence technology. In addition to engaging scientists via telepresence technology, several different tools were used to engage the public in this expedition, including webinar presentations, ship tours, live interactions, public displays of live video, website stories, social media, and media articles. Collectively, over 8,400 individuals were reached in person through these avenues, with over 152,000 views online.

**This report can be cited as follows:**

Wagner D, Putts M, Obelcz J, White M, Gulbraa R and Eakins B (2019). EX-19-05-L2 Expedition Report - Deep Connections 2019: Exploring Atlantic Canyons and Seamounts of the U.S. and Canada. Office of Ocean Exploration and Research, Office of Oceanic & Atmospheric Research, NOAA, Silver Spring, MD 20910. OER Expedition Report EX-19-05-L2, 156 pp. doi: 10.25923/k1qe-yk14

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## Table of Contents

<b>1. Introduction</b> .....	7
1.1. Expedition Overview.....	7
1.2. Rationale for Exploration.....	8
1.3. Expedition Objectives.....	8
1.4. List of Participants.....	9
<b>2. Methods</b> .....	12
2.1. Operations Overview.....	12
2.2. Vessel Platform.....	13
2.3. ROVs.....	13
2.3.1. ROV Dive Operations.....	14
2.3.2. Specimen Collections.....	14
2.4. Mapping Operations.....	15
2.4.1. Multibeam Sonar ( <i>Kongsberg EM302</i> ).....	16
2.4.2. Sub-Bottom Profiler ( <i>Knudsen Chirp 3260</i> ).....	16
2.4.3. Split-Beam Sonar ( <i>Kongsberg EK60</i> ).....	16
2.4.4. Acoustic Doppler Current Profiler ( <i>Teledyne Marine Workhorse Mariner ADCP</i> ).....	17
2.5. Permits and Clearances.....	17
2.6. Expedition Schedule.....	18
2.7. Expedition Map.....	19
<b>3. Results</b> .....	20
3.1. Summary of Accomplished Objectives.....	20
3.2. ROV Dive Operations.....	24
3.3. Specimen Collections.....	25
3.4. Mapping Operations.....	30
3.4.1. Multibeam Sonar ( <i>Kongsberg EM302</i> ).....	30
3.4.2. Sub-Bottom Profiler ( <i>Knudsen Chirp 3260</i> ).....	31
3.4.3. Split-Beam Sonar ( <i>Kongsberg EK60</i> ).....	31

3.4.4. Acoustic Doppler Current Profiler ( <i>Teledyne Marine Workhorse Mariner ADCP</i> ).....	31
<b>4. Engagement, Education and Outreach</b> .....	31
<b>5. Acknowledgements</b> .....	33
<b>6. Appendices</b> .....	35
6.1. Appendix A: EX1905L2 Data Management Plan.....	35
6.2. Appendix B: NEPA Categorical Exclusion Worksheet.....	39
6.3. Appendix C: Endangered Species Act (ESA) Section 7 Concurrence Letter.....	45
6.4. Appendix D: Essential Fish Habitat (EFH) Concurrence Letter.....	47
6.5. Appendix E: Greater Atlantic Regional Fisheries Office (GARFO) Letter of Acknowledgement .....	48
6.6. Appendix F: Global Affairs Canada Permit for Activities in Canadian Waters.....	50
6.7. Appendix G: Fisheries and Oceans Canada Registration for Activities in Canadian Waters.....;	52
6.8. Appendix H: Fisheries and Oceans Canada Permit for Activities within the Gully Marine Protected Area.....	57
6.9. Appendix I: Environment of Canada Export Permit for Species listed under the Convention on International Trade in Endangered Species.....	59
6.10. Appendix J: Dive Summary Forms for all ROV Dives.....	60

## 1. Introduction

The NOAA Office of Ocean Exploration and Research (OER) is the only U.S. federal organization that is solely dedicated to exploring our global oceans. OER works with partners, collaborators, the scientific community, and the public to identify priority areas for exploration, support innovations in exploration tools and capabilities, and inspire the next generation of ocean explorers, scientists, and engineers. The data and information collected during OER expeditions gives resource managers, the academic community, the public, the private sector, and decision makers the information they need to identify, understand, and manage ocean resources for current and future generations.

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

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*. From mapping and characterizing previously unseen seafloor, to collecting and disseminating information about ocean depths, this work establishes a foundation of information and fills data gaps. Data collected on the ship 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.

### 1.1. Expedition Overview

From August 28 through September 15, 2019, NOAA and partners conducted a telepresence-enabled ocean exploration expedition on NOAA Ship *Okeanos Explorer* to collect critical baseline information about unknown and poorly understood deep-water areas off the U.S. and Canadian Atlantic Continental Margin. The deep waters in this region contain a wide diversity of poorly known habitats and geological features that are of interest to resource managers and scientists, including submarine canyons, seamounts, deep-sea coral and sponge habitats, submarine landslides, and other potential geohazards, the vast majority of which remain largely unexplored.

As with previous NOAA Ship *Okeanos Explorer* expeditions, NOAA worked closely with the science and resource management community to explore priority deep-water areas. Remotely operated vehicle (ROV) operations used OER's dual-body ROV capable of diving

to 6,000-meter depths to explore a diversity of poorly known deep seafloor and midwater habitats, as well as unique geological features. Mapping operations used NOAA Ship *Okeanos Explorer's* state-of-the-art sonar systems, and concentrated on seafloor and water column areas with little or no high-resolution sonar data. Additionally, the expedition used the ship's high-bandwidth satellite connection to engage a broad spectrum of scientists, resource managers, and the public in telepresence-based exploration.

## **1.2 Rationale for Exploration**

The *Deep Connections 2019* expedition was one of several expeditions in 2018-2020 that contributed directly to the OER's Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE) campaign, a major multi-year, multi-national field program focused on raising our collective knowledge of the North Atlantic Ocean. The North Atlantic plays a pivotal role in issues of human interest, including providing a myriad of ecosystem services,

such as food security, protection from natural hazards, trade, tourism, and recreation, which collectively provide employment and livelihood opportunities for millions of people. Despite its critical importance, we have only begun to understand the region's deep-sea resources, oceanography, bathymetry, geology, ecosystems, and trans-Atlantic biological connectivity.

Besides being largely unexplored, the deep waters of the U.S. and Canadian Atlantic Continental Margin also contain a wide diversity of deep-water habitats and geological features, including escarpments, slope habitats, seamounts, and an extensive network of submarine canyons. Seamounts and submarine canyons in particular are generally regarded as hotspots of deep-sea biodiversity, as these habitats harbor a great abundance and diversity of sensitive marine organisms, including commercially, recreationally, and ecologically important species. As a result, seamounts and submarine canyons have become a priority for resource management in both the United States and Canada. By exploring these important habitats across the U.S.-Canadian boundary, the *Deep Connections 2019* expedition sought to gain a better understanding of the North Atlantic Ocean as a whole.

## **1.3 Expedition Objectives**

The *Deep Connections 2019* expedition was designed to address the science and management priorities put forward by NOAA, resource managers, and scientists from the region. In this regard, the geographic and exploration priority areas for the expedition were identified by the management and scientific community, in response to a call for input (<https://oceanexplorer.noaa.gov/okeanos/explorations/2018-overview/input.html>) that was disseminated early in 2018. The *Deep Connections 2019* expedition addressed many of the priorities that were originally planned to be addressed during the *Deep Connections*

2018 expedition on NOAA Ship *Okeanos Explorer* (EX-18-08), an expedition which was cancelled due to emergency dry dock repairs. NOAA priorities for the expedition included a combination of science, education, outreach, and open-data objectives that aimed to provide a better understanding of this important, yet mostly unexplored, marine region. Specific expedition objectives included:

- Acquire data on deep-water habitats to support science and management needs in North Atlantic waters of the U.S., Canada, and in support of ASPIRE
- Explore deep-water areas relevant to resource managers, such as essential fish habitat (EFH), habitat areas of particular concern (HAPC), marine protected areas (MPAs), and other priority management areas
- Map, survey, and characterize the diversity and distribution of deep-sea benthic communities, particularly those found within deep-sea coral and sponge habitats, fish habitats, and other vulnerable marine habitats
- Investigate biogeographic patterns and connectivity of deep-sea organisms across the Atlantic Margin for use in broader comparisons of deep-water habitats across the Atlantic Basin
- Map, survey, and sample geologic features to better understand the geological context of the region, and improve knowledge of past and future geohazards
- Collect high-resolution bathymetry and backscatter data in areas with no (or low quality) sonar data, as well as to support ROV operations and identify potential maritime heritage sites
- Acquire a foundation of ROV, sonar, and oceanographic data to better understand the characteristics of the water column and the pelagic fauna that live there
- Engage a broad spectrum of the scientific community and public in telepresence-based exploration, and provide a foundation of publicly accessible data products to spur further exploration, research, and management activities

#### **1.4 List of Participants**

As with previous NOAA Ship *Okeanos Explorer* expeditions, the *Deep Connections 2019* expedition included mission personnel that participated in the expedition from aboard NOAA Ship *Okeanos Explorer*, as well as shore-side science personnel that participated in the expedition remotely via telepresence technology. Onboard mission personnel included a total of 21 members representing eight institutions, including NOAA's OER, NOAA's National Centers for Environmental Information (NCEI), the Global Foundation for Ocean Exploration (GFOE), Cherokee Nation Strategic Programs (CNSP), the Cooperative Institute for Research in Environmental Sciences (CIRES), the University Corporation for Atmospheric Research (UCAR), the University of Hawaii (UH), and the U.S. Naval Research Laboratory (NRL). A list of the 21 onboard mission personnel members of the *Deep Connections 2019* expedition is provided in Table 1.

**Table 1.** List of onboard mission personnel participants of the *Deep Connections 2019* expedition.

Name	Role	Affiliation	Email
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Shore-based science team members participated in this expedition via telepresence technology from various exploration command centers (ECCs), including an ECC that was established specifically for this mission at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia, as well as from the offices and homes of science team members. A total of 51 resource managers, scientists and students from 31 institutions participated in the expedition on a regular basis, including participants from 13 U.S. states and seven different countries. A list of shore-side science team members of the *Deep Connections 2019* expedition is provided in Table 2.

**Table 2.** List of shore-side science team members that participated in the *Deep Connections 2019* expedition remotely via telepresence technology.

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## 2. Methods

### 2.1 Operations Overview

The *Deep Connections 2019* expedition was a telepresence-enabled ocean exploration expedition that started in Halifax, Nova Scotia on August 28, 2019, and ended in North Kingstown, Rhode Island on September 15, 2019. The expedition included 24-hour operations, with daytime ROV dives to depths ranging between 306-2,668 meters, and overnight mapping operations to depths of over 4,400 meters, as well as continuous shore-side participation via telepresence technology. ROV dives focused on exploring deep-sea coral and fish habitats, midwater habitats, submarine canyons, seamounts, and other poorly known deep-sea habitats. Mapping operations concentrated on seafloor and water column areas with little or no high-resolution sonar data, and in support of ROV operations.

The methods and equipment employed during the expedition are briefly outlined below. Additional information concerning where data products will be deposited is provided the data management plan in Appendix A.

## **2.2 Vessel Platform**

All operations of the *Deep Connections 2019* expedition were conducted onboard NOAA Ship *Okeanos Explorer*, a 224 foot-long, 43 foot-wide U.S. Federal Government vessel with a 20 foot draft and a transit cruising speed of 10 knots. NOAA Ship *Okeanos Explorer* is outfitted with a suite of hull-mounted sonars, a dedicated two-body ROV system (*Deep Discoverer* and *Seirios*), a CTD-rosette, as well as high-speed satellite networks that enable remote participation from shore via telepresence technology.

## **2.3 ROVs**

NOAA Ship *Okeanos Explorer* is equipped with a custom-built, 6,000-meter rated, dual-body ROV system that consists of the main platform *Deep Discoverer (D2)* and the camera platform *Seirios*. *D2* is a 10.4-foot long, 6.4-foot wide, and 8.5-foot high vehicle that weighs approximately 9,150 pounds in air. *D2* is equipped with five high-definition cameras, five standard-definition cameras, and 24 LED lights that bring 144,000 lumens to the seafloor, resulting in some of the highest quality deep-sea footage available. Additionally, *D2* is equipped with four custom built lighting swing-arms that allow for the position and angle of the light to be adjusted for optimal imaging. The second body of the ROV system is the camera platform *Seirios*, a 11.5-foot long, 3.7-foot wide, and 4.1-foot high vehicle that weighs 2,925 pounds in air, and provides additional lighting and an overhead view of *D2* while it investigates the seafloor. *Seirios* has one high-definition camera, five standard-definition cameras, and 18 LED lights that add 108,000 lumens to *D2*'s lighting.

The two vehicles are connected to each other by a 30-meter long electro-optical tether. During ROV operations the vehicles work in tandem, with *D2* surveying the seafloor, and *Seirios* providing additional lighting and situational awareness, as well as dampening the movement of the ship above. On every ROV dive, the high-definition video cameras on *D2* are color-corrected and white-balanced in order to ensure correct color in video recordings.

Both ROVs are equipped with separate *Sea Bird 9/11+* CTD sensors that provide continuous measurements of depth, pressure, temperature, salinity, sound velocity, dissolved oxygen, turbidity, and oxidation-reduction potential. Furthermore, the ROVs are equipped with an ultra-short baseline acoustic navigation (USBL) system (*Tracklink TL10000MA*) that is used to track and record the position of the ROVs during the course of a dive. Continuous latitude, longitude, and depth are recorded on every ROV dive.

### **2.3.1 ROV Dive Operations**

All ROV dive operations were conducted during daytime. With the exception of Dive 10, which was dedicated to exploring midwater habitats, all other dives focused on exploring seafloor habitats. During each dive survey, the ROV descended onto the seafloor and then slowly moved upslope documenting the geology and biology of the area. Onboard and shore-based scientists identified substrate types and organisms to the lowest possible taxon, and recorded these using the science chatroom developed by the Global Foundation of Ocean Exploration (<https://exdata.tgfoe.org/chat>), as well as SeaTubeV2 software developed by Ocean Networks Canada (<https://data.oceannetworks.ca/SeaTubeV2>). The science chatroom was primarily used as a discussion tool to discuss possible identifications, whereas SeaTubeV2 was used to record science annotations. Transcripts of both the science chatroom and SeaTubeV2 software were produced after each dive. In addition to seafloor explorations, Dive 10 focused on exploring midwater habitats via a series of horizontal midwater transects. During Dive 10, midwater transects, 24 minutes in duration each, were conducted at depths of 2,180, 2170, 1100, and 900 meters, as well as for 10 minutes at 700 meters. The original plan for Dive 10 also included midwater transects at 500 and 300 meters, however, the dive had to be aborted early due to strong currents. Organisms encountered during midwater transects were identified to the lowest possible taxon, and recorded using the science chatroom and SeaTubeV2 software described above. Following all ROV dives, the linear distance surveyed was estimated by plotting the 5-minute averaged dive track of the ROV, and measuring its distance using the distance measurement tool in ArcGIS.

### **2.3.2 Specimen Collections**

*D2* is equipped with two manipulator arms (*Schillings Orion* and *Kraft Predator*) and a custom-built suction sampler that were used to collect physical specimens during ROV dive operations. The *Kraft* arm is more dexterous and was used for delicate work. This arm is also equipped with force feedback that allows the operator to feel how much force is being exerted by the arm. The *Orion* arm is used as a backup. Limited collections of biological and geological specimens were conducted during the *Deep Connections 2019* expedition. Limited biological specimen collections (no more than five primary specimens per dive) targeted animals suspected of being new species to science, range extensions for the region, the dominant morphotype in a habitat, specimens that may contribute to connectivity studies, or other specimens with significant discovery potential. Similarly, limited geologic specimen collections (no more than two specimens per dive) targeted samples that had the potential to contribute to significant scientific discoveries, such as providing new insights into the geologic context of the region.

For each collected specimen, the date, time, depth, latitude, longitude, temperature, dissolved oxygen, and salinity were recorded at the time of collection. Once specimens

were brought onto the deck of the ship, they were examined for commensal organisms, labeled, photographed, and inventoried into a database containing all relevant metadata. Any commensal organisms found on the specimens were separated and processed separately. Once photographed and labeled, biological specimens were preserved in non-denatured 95% ethanol, and in limited cases also in 10% buffered formalin seawater. In cases where biological specimens were large enough to allow for subsampling, small clippings were preserved separately for DNA analyses. DNA samples were preserved in 95% ethanol. All geological samples were weighed, and air dried.

Following the expedition, all collected specimens were shipped to various repositories for permanent curation, as well as to make these specimens publicly available to qualified researchers from around the world. Biological specimens were shipped to the Invertebrate Collections of the National Museum of Natural History, Smithsonian Institution, with the DNA samples being deposited in their Biorepository. Geological samples were all shipped to the Marine and Geology Repository at Oregon State University. Details for the repositories that will curate specimens collected during the *Deep Connections 2019* expedition, as well as links with information on how to access the specimens are provided below:

- Invertebrate Zoology Collections, National Museum of Natural History, Smithsonian Institution, Museum Support Center, MRC 534, 4210 Silver Hill Road, Suitland, MD 20746  
Contact: Abigail Reft, [ReftAJ@si.edu](mailto:ReftAJ@si.edu)  
Website: <https://invertebrates.si.edu/LoanPolicy.html>
- Biorepository, National Museum of Natural History, Smithsonian Institution, Museum Support Center, 4210 Silver Hill Road, Suitland, MD 20746  
Contact: Chris Huddleston, [huddlestonc@si.edu](mailto:huddlestonc@si.edu)  
Website: <https://naturalhistory.si.edu/research/biorepository>
- Marine and Geology Repository, Oregon State University  
Burt 346, Corvallis, OR 97331-5503  
Contact: Kevin Konrad, [Konradke@geo.oregonstate.edu](mailto:Konradke@geo.oregonstate.edu)  
Website: <http://osu-mgr.org/noaa-ex/>

## **2.4 Mapping Operations**

NOAA Ship *Okeanos Explorer* is equipped with four different types of hull-mounted sonars that were used throughout the *Deep Connections 2019* expedition in order to map seafloor and water column features. These sonars include a Kongsberg EM302 multibeam, a suite of five Kongsberg EK60 and EK80 split-beam fisheries sonars (18, 38, 70, 120, and 200 kHz), a

Knudsen 3260 chirp sub-bottom profiler, and a Teledyne Workhorse Mariner 300 kHz Acoustic Doppler Current Profiler (ADCP). With the exception of the ADCP and the 38 kHz EK60 (which cause interference with the multibeam), all sonars were typically used simultaneously during mapping operations. Transit and survey mapping operations were conducted whenever ROV dive operations were not taking place, either overnight or when weather conditions did not allow for ROV dive operations. Mapping operations taking place concurrently with ROV dive operations were limited to collecting data with the ADCP and the EK60 and EK80 fisheries sonars. The ADCP was run throughout ROV dive operations to assess water currents within the upper 60 meters of the water column in order to gather information to support safe ROV launch and recovery. The EK60 and EK80 split-beam fisheries sonars were used to characterize water column biological scattering layers at ROV dive sites, and to help guide exploration transects during the midwater ROV dive (Dive 10). Mapping operations using the four different types of sonars conducted during the *Deep Connections 2019* expedition are briefly outlined below.

#### ***2.4.1 Multibeam Sonar (Kongsberg EM302)***

Multibeam seafloor mapping data were collected using the Kongsberg EM302 sonar, which operates at a frequency of 30 kHz. Multibeam mapping operations were conducted during all overnight transits between ROV dive sites, which were designed to maximize coverage over seafloor areas with no previous high-resolution mapping data whenever feasible. Overnight surveys were also completed in some areas that were previously mapped with a lower resolution multibeam sonar system. Additionally, multibeam mapping operations were conducted directly over most planned ROV dive locations in order to collect seafloor mapping data to help refine dive plans. Multibeam mapping operations collected data on seafloor depth (i.e., bathymetry), seafloor acoustic reflectivity (i.e., seafloor backscatter), and water column reflectivity (i.e., water column backscatter).

#### ***2.4.2 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 meters below the seafloor. The sub-bottom profiler was operated simultaneously with the multibeam sonar during mapping operations in order to provide supplemental information about the sedimentary features underlying the seafloor. Additionally, targeted sub-bottom profile surveys were conducted to support the Extended Continental Shelf project.

#### ***2.4.3 Split-beam Sonars (Kongsberg EK60 and EK80)***

NOAA Ship *Okeanos Explorer* is equipped with five EK60 and EK80 split-beam sonar transducers operated at frequencies of 18, 38, 70, 120 and 200 kHz. These sonars were used continuously (aside from the 38 kHz which interferes with the multibeam during mapping operations) throughout the expedition during both overnight mapping operations

and daytime ROV operations. The sonars provided calibrated target strength measurements on water column features such as dense biological layers or schools of fish. These sonars can also help detect the presence of gaseous seeps emanating from the seafloor. Data collected using the EK60 and EK80 sonars were used during midwater transects of one ROV dive (Dive 10) to detect the depth of the deep scattering layers due to aggregations of biological organisms in the water column.

#### ***2.4.4 Acoustic Doppler Current Profiler (Teledyne Workhorse Mariner ADCP)***

NOAA Ship *Okeanos Explorer* is equipped with two ADCPs: a Teledyne Workhorse Mariner (300 kHz) and a Teledyne Ocean Surveyor (38 kHz). However, only the 300 kHz ADCP was operational during this expedition. This ADCP had a reliable range of approximately 60 meters throughout the expedition and provided information on the speed and direction of currents underneath the ship. It was used throughout ROV dives to support safe deployment and recovery of the vehicles.

## **2.5 Permits and Clearances**

The operating area of the *Deep Connections 2019* expedition focused on deep waters off the Atlantic Continental Margin in the EEZ of both the U.S. and Canada. Pursuant to the National Environmental Policy Act (NEPA), NOAA OER is required to give careful consideration of potential environmental consequences of its actions. NOAA's Administrative Order (NAO) 216-6A Companion Manual describes the agency's specific procedures for NEPA compliance. Among these is the need to review all proposed NOAA-supported field projects for their environmental effects. An environmental review analysis was completed for this expedition in accordance with Section 4 of the Companion Manual. Based on this review, a categorical exclusion was determined to be the appropriate level of NEPA analysis for this expedition, as no extraordinary circumstances existed that required the preparation of an environmental assessment or environmental impact statement.

Informal consultation was also initiated under section 7 of the Endangered Species Act (ESA), requesting NOAA Fisheries' Protected Resources Division concurrence with our evaluation determining that our operations are not likely to adversely impact ESA-listed marine species. The informal consultation was completed on August 8, 2018, when OER received a signed letter from the Chief ESA Interagency Cooperation Division in the NOAA Office of Protected Species, stating that NMFS concurs with OER's determination that operations conducted during NOAA Ship *Okeanos Explorer* 2018-2019 field seasons are not likely to adversely affect ESA-listed species.

OER further completed a consultation with NOAA's Habitat Conservation Division on potential impacts of our operations on essential fish habitat (EFH) in the Greater Atlantic Region. They concurred that our operations would not adversely affect EFH, provided

adherence to our standard operating procedures. Additionally, on April 24, 2019 the NOAA Greater Atlantic Region Fisheries Office (GARFO) issued a letter of acknowledgement (LOA) stating that expedition activities are all in accordance with NMFS regulations.

Operations in the EEZ of the Canada were conducted under a marine scientific research permit approved by the Global Affairs of Canada (DCEP 031004), as well as a registration licence (352729) and Gully Marine Protected Area permit (GMPA-2019-05) issued by Fisheries and Oceans Canada. While no biological specimens of species that are listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) ended up being collected in Canadian waters, a CITES export permit issued by the Environment of Canada (19CA00050FONHQ) was also secured prior to the mission. Copies of all permits and environmental clearance documents that were secured for the expedition are presented in Appendices B though I.

## 2.6 Expedition Schedule

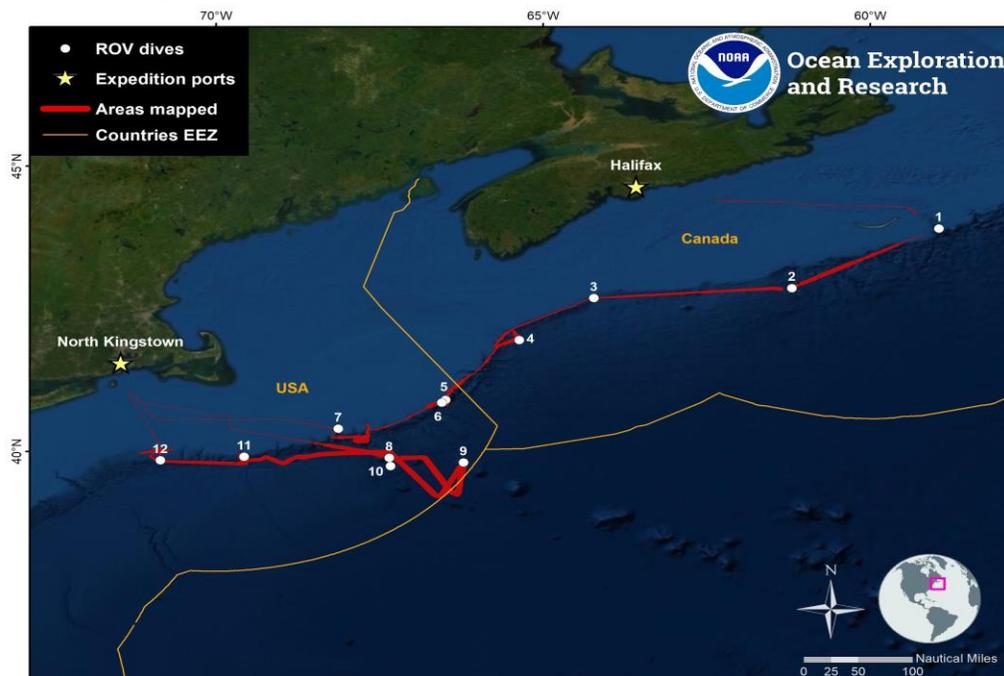
The *Deep Connections 2019* expedition started in Halifax, Nova Scotia on August 28, 2019, and ended in North Kingstown, Rhode Island on September 15, 2019 (Table 3; Figure 1). The expedition was originally scheduled to depart Halifax on August 26, 2019. However, bad weather on August 26, and an engine problem on August 27, delayed the departure of the expedition by two days. Additionally, the ship had to pull into port in North Kingstown, Rhode Island midway through the expedition on September 5-7 in order to weather any impacts from Hurricane Dorian. Daily mapping operations were conducted throughout the expedition from August 28 to September 15, 2019, with the exception of September 6-7, when no mapping operations were conducted because the ship was in port. Daily ROV dives were conducted between August 29 and September 14, 2019, with the exception of September 5-9, when no dive operations were conducted as the ship was in port due to Hurricane Dorian, as well as September 13, when rough sea states prevented ROV operations.

**Table 3.** Schedule of the *Deep Connections 2019* expedition. The locality is where most operations were undertaken each day, which in most cases is the location of ROV dives.

Date	Locality	Operations
Aug-26	Halifax, Nova Scotia	Delayed departure due to bad weather
Aug-27	Halifax, Nova Scotia	Delayed departure to engine problems
Aug-28	Halifax, Nova Scotia	Departed Halifax, mapping operations while in transit
Aug-29	Gully Canyon	Dive 1, overnight mapping operations
Aug-30	Verrill Steps	Dive 2, overnight mapping operations
Aug-31	"Vazella Sponge Grounds"	Dive 3, overnight mapping operations

Date (cont.)	Locality	Operations
Sep-1	Northeast Channel	Dive 4, overnight mapping operations
Sep-2	Unnamed Canyon	Dive 5, overnight mapping operations
Sep-3	Kinlan Canyon	Dive 6, overnight mapping operations
Sep-4	Oceanographer Canyon	Dive 7, overnight mapping operations, transit to North Kingstown due to Hurricane Dorian
Sep-5	North Kingstown, Rhode Island	Mapping operations in transit, in port in North Kingstown
Sep-6	North Kingstown, Rhode Island	In port due to Hurricane Dorian
Sep-7	North Kingstown, Rhode Island	In port due to Hurricane Dorian
Sep-8	In transit to Bear Seamount	In transit mapping operations
Sep-9	Bear Seamount	Dive 8, overnight mapping operations
Sep-10	Retriever Seamount	Dive 9, overnight mapping operations
Sep-11	Bear Seamount Midwater	Dive 10, overnight mapping operations
Sep-12	Veatch Canyon	Dive 11, overnight mapping operations
Sep-13	North of Block-Alvin Intercanyon	All day mapping operations (no ROV dive due to bad weather)
Sep-14	Block-Alvin Intercanyon	Dive 12, overnight mapping operations
Sep-15	North Kingstown, Rhode Island	Transit mapping operations, arrived in North Kingstown

## 2.8 Expedition Map



**Figure 1.** Map showing the location of ROV and mapping operations conducted during the *Deep Connections 2019* expedition. Labels correspond to ROV dive numbers.

### 3. Results

#### 3.1 Summary of Accomplished Expedition Objectives

The major accomplishments that supported expedition objectives are briefly summarized in the section below. Additional information on accomplished science objectives of the expedition is presented in sections 3.2-3.5, and additional information on accomplished engagement objectives is presented in section 4. Access to most data products from this expedition, including bathymetry data, ROV dive locations, ROV dive tracks, ship tracks, and ship-based meteorological observations, are available by looking up the expedition code (EX1905L2) at this portal:

<https://service.ncddc.noaa.gov/website/EXAtlas/viewer.htm>. These and all other data products from the expedition will also be available from the following portal:

[https://www.ncddc.noaa.gov/website/google\\_maps/OE/mapsOE.htm](https://www.ncddc.noaa.gov/website/google_maps/OE/mapsOE.htm). ROV dive annotations from expedition are available by looking up the expedition code (EX1905L2) at <https://data.oceannetworks.ca/SeaTubeV2>.

#### **Objective 1:** Acquire data on deep-water habitats to support science and management needs in North Atlantic waters of the U.S., Canada, and in support of ASPIRE

- Conducted a total of 12 ROV dives in deep waters off the U.S. and Canadian Atlantic Continental Margin for a total dive time of 85 hours and 58 minutes and total on-bottom time of 54 hours and 49 minutes. Collectively, these dives explored seafloor habitats at depths between 306-2,668 meters over a linear distance of 5.996 kilometers. Hundreds of different species of animals were documented during these dives, including several potential new species, numerous range extensions, as well as observations of new behaviors. Some particularly noteworthy ROV dive observations include:
  - Documented high-density communities of deep-sea corals and sponges on five dives (Dives 1, 5, 6, 8, 9, 11), and across a wide depth range (921-2,668 meters). These included a high-density forest of bamboo corals at depths of 1,100 meters inside the Gully Canyon, a highly diverse and dense assemblage of deep-sea sponges at depths of 2,500-2,650 meters on Retriever Seamount, as well as patches of high-density communities on Bear Seamount, Veatch Canyon, Kinlan Canyon, as well as an unnamed canyon located north of Kinlan Canyon.
  - Documented three large (> 1 meter) individuals of the endangered Atlantic Halibut *Hippoglossus hippoglossus* in an unnamed canyon north of Kinlan Canyon (Dive 5).
- Collected 124 biological samples (35 primary and 89 associated taxa). Twenty-six of the primary biological samples represented range extensions, and several of these may be new species to science. The other biological samples were collected to

support studies on connectivity and biogeographic patterns across the Atlantic Ocean, an important goal of the ASPIRE campaign.

**Objective 2:** Explore deep-water areas relevant to resource managers, such as essential fish habitat (EFH), habitat areas of particular concern (HAPC), marine protected areas (MPAs), and other priority management areas

- Conducted six ROV dives in three different marine managed areas, including the Gully MPA (Dive 1), the Northeast Canyons and Seamounts Marine National Monument (Dives 7-10), and the Frank R. Lautenberg Deep-Sea Coral Protection Area (Dive 12).
- Conducted one dive just outside the Northeast Channel Coral Conservation Area (Dive 4) in an area that is under consideration for potential expansion of the protected area in order to collect data to help support management decisions.
- Conducted seafloor and water column mapping operations inside the Northeast Canyons and Seamounts Marine National Monument and the Frank R. Lautenberg Deep-Sea Coral Protection Area. Additionally, water column mapping operations were conducted in the Gully MPA in order to help characterize the rich midwater fauna of the region. While the seafloor in these protected areas had mostly been mapped during previous explorations, very few previous water column mapping surveys had been conducted prior to this mission.
- Collected sub-bottom profiler data south of Retriever Seamount in support of the U.S. Extended Continental Shelf project.

**Objective 3:** Map, survey, and characterize the diversity and distribution of deep-sea benthic communities, particularly those found within deep-sea coral and sponge habitats, fish habitats, and other vulnerable marine habitats.

- Deep-sea corals and sponges were recorded on all eleven of the benthic focused ROV dives of the expedition, and across depth range (306-2,668 meters).
- High-density communities of deep-sea corals and sponges were documented during six different dives of the expedition (Dives 1, 5, 6, 8, 9, 11). These high-density communities were found at depths ranging between 921-2,668 meters, including one of which is currently among the deepest high-density communities (2,668 meters; Dive 9) known from the Northeast U.S. region.
- Documented three large (>1 meter) individuals of the endangered Atlantic Halibut *Hippoglossus hippoglossus* in an unnamed canyon north of Kinlan Canyon (Dive 5; 535-754 meters).
- Water column mapping operations documented various known seeps near Veatch and Oceanographer Canyons, thereby increasing our knowledge on the temporal persistence of these ephemeral features.

**Objective 4:** Investigate biogeographic patterns and connectivity of deep-sea organisms across the Atlantic Margin for use in broader comparisons of deep-water habitats across the Atlantic Basin.

- The 12 ROV dives completed during the expedition will likely represent the northwestern-most extension of the geographic range that will be explored by NOAA Ship *Okeanos Explorer* during the ASPIRE campaign in 2018-2020. Hundreds of different species of animals were observed during the expedition, including numerous significant range extensions and several potential new species. As such, the information collected during these dives will provide very valuable information to interpret biogeographic patterns across the entire Atlantic range.
- Four biological specimens were collected specifically to support studies on connectivity and broad biogeographic patterns across the Atlantic Ocean.

**Objective 5:** Map, survey, and sample geologic features to better understand the geological context of the region, and improve knowledge of past and future geohazards.

- Collectively, the 12 ROV dives explored a variety of different geological features including submarine seamounts, submarine canyons, intercanyon areas, and slopes.
- Documented and sampled inactive fluid expulsion features during one ROV dive on the steep walls of Verrill Canyons (Dive 2). These unique features were similar to the ones that have been observed during previous ROV dives further south on the Atlantic Margin.
- Found visual evidence of active sediment transport during one dive within Oceanographer Canyon (Dive 7), including a flushed canyon axis, as well as erosional features carved into recently deposited marine clays.
- Documented a stunning, >100 meter thick continuous sequence of carbonate rock with almost vertical relief at Veatch Canyon (Dive 11) that is comparable in height of the Cliffs of Dover. This sequence was also observed in a nearby unnamed box canyon between Block and Alvin Canyons (Dive 12).
- Found evidence for seabed instability over short timeframes (<7 years) by re-mapping a submarine landslide scarp at the head of an unnamed canyon located between Gilbert and Lydonia Canyons.
- Collected five geological samples that can be used for future geochemical composition analyses and age-dating in order to increase our understanding of the geological history of the region.

**Objective 6:** Collect high-resolution bathymetry and backscatter data in areas with no (or low-resolution) sonar data, as well as to support ROV operations and identify potential maritime heritage sites.

- Mapped more than 10,729 square kilometers of seafloor, including 7,221 square kilometers in the U.S. EEZ, 3,157 square kilometers in the EEZ of Canada, and 351 square kilometers in marine areas beyond national jurisdiction.
- Mapping operations included several areas that had never before been mapped with high-resolution multibeam sonars, including areas around the Northeast Channel, the Fundian Valley, North of Alvin Canyon, and along the U.S.-Canadian boundary.
- High-resolution multibeam data were collected over all ROV dive sites with the exception of the Gully MPA site due to permit restrictions, and used to refine dive plans and safely conduct dive operations.
- While no maritime heritage sites were identified during seafloor mapping operations, the expedition included mapping in large areas around Northeast Channel that were identified as priorities by several maritime archaeologists.

**Objective 7:** Acquire a foundation of ROV, sonar, and oceanographic data to better understand the characteristics of the water column and the pelagic fauna living within it.

- Dedicated midwater transects were conducted during one ROV dive (Dive 10) for a total of 3 hours and 40 minutes and at depths between 700-2,170 meters. Additional data on midwater habitats were collected during all ascents and descents of the 12 ROV dives of the expedition, for a total of 31 hours and 9 minutes.
- One specimen of a midwater ctenophore was collected during the expedition, which likely represents a new species to science.

**Objective 8:** Engage a broad spectrum of the scientific community and public in telepresence-based exploration and provide a foundation of publicly accessible data products to spur further exploration, research, and management activities.

- A total of 51 scientists, managers, and students from seven different countries and 13 U.S. states participated in the expedition regularly via telepresence technology as members of the shore-side science team. Additionally, 306 scientists, managers and students signed up for the expedition science listserv, and participated intermittently via telepresence technology.
- All 9.2 TB of data collected during the expedition, including public domain imagery and environmental data collected on every ROV dive, mapping data, oceanographic and meteorological data, will be made publicly available through national archives. Highlight images, videos, daily updates and descriptions of the dives, relevant logs about key aspects of the expedition, background essays, and educational materials, were all posted throughout the expedition, and are available via the expedition website (<https://OceanExplorer.NOAA.gov/oceanos/explorations/ex1905>).

- Live-streamed video feeds from the expedition received more than 112,830 views. Expedition content on the OER website received over 23,500 views during the expedition.
- Public displays of the live streamed video from the expedition were hosted during all dives in Canadian waters at the Canadian Museum of Nature in Ottawa, the Natural History Museum in Halifax, and the Bedford Institute of Oceanography. Collectively, these displays reached over 8,100 visitors.
- One new exploration command center was established at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia, thereby facilitating participation by Canadian scientists and resource managers throughout the expedition.
- Conducted five live telepresence interactions reaching a total of 243 individuals at various venues, including Congressional staff and other visitors at the NOAA exploration command center in Silver Spring, MD, and members of the public at the New England Aquarium in Boston, MA, and the Mystic Aquarium in Mystic, CT
- Conducted four tours of NOAA Ship *Okeanos Explorer* while the ship was docked in Dartmouth, Nova Scotia, reaching a total of 83 Canadian partners representing management agencies, non-governmental institutions, academic institutions, and the private sector.
- Conducted interviews with Canadian filmmakers creating a forthcoming short documentary about the expedition.
- Published feature story on the NOAA.gov website, which received over 15,800 views.
- Received international, national, and local web and media coverage, including feature stories from NOAA, the Natural Resources Defense Council (NRDC), Canada's National Observer, the Canada Broadcasting Company, the Ottawa Citizen, CTV News, Boston Magazine, Knox Village Soup, Penobscot Pilot, Coast Mountain News, WTOL, and the Free Press.

### **3.2 ROV Dive Operations**

A total of 12 ROV dives were conducted during the *Deep Connections 2019* expedition to maximum depths ranging between 306-2,668 meters (Table 4). The primary focus was on benthic biology and geology on eleven dives and on midwater biology on one dive. Total dive times of individual ROV dives ranged between 3 hours and 13 minutes to 9 hours and 18 minutes, for a total dive time of 85 hours and 58 minutes. On-bottom dive times of individual ROV dives ranged between 51 minutes to 6 hours and 35 minutes, for a total on-bottom time of 54 hours and 49 minutes over the course of the expedition. Linear distances covered on individual ROV dives ranged between 125-1,404 meters, for a total on-bottom distance covered throughout the expedition of 5,996 meters. Summary information for the 12 ROV dives performed over the course of the expedition is presented in Table 4 below.

Additionally, dive summary forms, which include narratives of the dives, dive track maps and photos, are presented in Appendix J.

**Table 4. Summary information for the 12 ROV dives conducted during the expedition.**

Date	Dive no.	Location	Dive focus	Depth range (m)	On bottom latitude	On bottom longitude	Bottom distance covered (m)	Bottom time (h:min)	Total dive time (h:min)
Aug-29	1	Gully MPA	Benthic	1,088-1,348	43.8998	-58.94058	250	3:58	6:00
Aug-30	2	Verrill Steps	Benthic	2,459-2,505	42.86808	-61.20375	400	3:13	6:12
Aug-31	3	"Vazella Grounds"	Benthic	306-358	42.68255	-64.21957	1,404	5:54	7:26
Sep-1	4	Northeast Channel	Benthic	1,347-1,494	41.98382	-65.37542	975	5:51	8:08
Sep-2	5	Unnamed Canyon	Benthic	535-754	40.90572	-66.50047	705	6:35	8:01
Sep-3	6	Kinlan Canyon	Benthic	921-1,074	40.85017	-66.54200	455	4:27	6:06
Sep-4	7	Oceanographer Canyon	Benthic	538-600	40.39768	-68.13232	155	1:54	3:13
Sep-9	8	Bear Seamount	Benthic	1,876-2,139	39.88532	-67.33907	533	5:18	9:18
Sep-10	9	Retriever Seamount	Benthic	2,510-2,668	39.80403	-66.21417	194	4:38	8:06
Sep-11	10	Bear Seamount	Midwater	2,178-2,180	39.9924	-67.35045	125	0:51	6:56
Sep-12	11	Veatch Canyon	Benthic	1,195-1,341	39.84865	-69.55360	365	5:46	8:08
Sep-14	12	Block-Alvin Intercanyon	Benthic	1,089-1,277	39.82075	-70.85013	435	6:18	8:18
<b>TOTAL</b>		<b>12 dives</b>		<b>306-2,668</b>			<b>5,996</b>	<b>54:49</b>	<b>85:58</b>

### 3.3 Specimen Collections

A total of 129 samples were collected using the manipulator arms or suction sampler of the ROV, including five geological samples (Table 5) and 124 biological samples (Table 6). Among the collected biological samples, 35 were collected as primary specimens, whereas 89 were collected as associated samples on either rock or primary biological samples. As noted above, geological samples were shipped to the Marine Geology Repository at Oregon State University for permanent curation, whereas biological samples were shipped to the Invertebrate Zoology Collections at the National Museum of Natural History, Smithsonian Institution for curation. Additionally, in cases where there was enough tissue to allow for subsampling, DNA tissue samples were taken and shipped to the Biorepository at the National Museum of Natural History, Smithsonian Institution.

**Table 5.** Summary information for the five collected geological samples. All of these samples were deposited at the Marine and Geology Repository of Oregon State University.

Specimen code	Date (UTC)	Time (UTC)	Field ID	Latitude	Longitude	Depth (m)	Temp. (°C)	Salinity (PSU)	Dissolved oxygen (mg/L)
EX1905L2_D02_03G	Aug-30	18:54	Concretion/nodule	42.8698	-61.2071	2,435	3.06	34.91	7.76
EX1905L2_D02_04G	Aug-30	19:09	Fluid expulsion pipe outlet	42.8694	-61.2070	2,432	3.06	34.92	8.05
EX1905L2_D04_02B_A01	Sep-1	14:55	Slate	41.9850	-65.3737	1,455	3.87	34.94	8.41
EX1905L2_D06_01B_A07	Sep-3	17:43	Slate	40.8532	-66.5397	935	4.53	34.97	8.02
EX1905L2_D07_01G	Sep-4	19:58	Consolidated clay	40.3974	-68.1307	546	6.82	35.13	6.76

**Table 6.** Summary information for the 124 biological samples that were collected using the manipulator arms of the ROV. All of these samples were deposited to the Invertebrate Zoology Collections at the National Museum of Natural History, Smithsonian Institution. Additionally, DNA subsamples of most of these specimens were sent to the Biorepository at the National Museum of Natural History, Smithsonian Institution, for curation.

Specimen code	Date (UTC)	Time (UTC)	Field ID	Latitude	Longitude	Depth (m)	Temp. (°C)	Salinity (PSU)	Dissolved oxygen (mg/L)	DNA sub-sample
EX1905L2_D01_01B	29-Aug	18:45	<i>Dictyaulus</i> sp.	43.9001	-58.9406	1,317	3.93	34.93	8.48	Yes
EX1905L2_D01_01B_A01	29-Aug	18:45	Decapoda shrimp white	43.9001	-58.9406	1,317	3.93	34.93	8.48	Yes
EX1905L2_D01_02B	29-Aug	19:03	<i>Paragorgia</i> sp.	43.9002	-58.9407	1,316	3.97	34.93	8.88	Yes
EX1905L2_D01_02B_A01	29-Aug	19:03	Asteroschematidae	43.9002	-58.9407	1,316	3.97	34.93	8.88	Yes
EX1905L2_D01_02B_A02	29-Aug	19:03	Pycnogonidae	43.9002	-58.9407	1,316	3.97	34.93	8.88	Yes
EX1905L2_D01_02B_A03	29-Aug	19:03	Amphipoda	43.9002	-58.9407	1,316	3.97	34.93	8.88	Yes
EX1905L2_D01_02B_A04	29-Aug	19:03	Polychaeta	43.9002	-58.9407	1,316	3.97	34.93	8.88	Yes
EX1905L2_D01_03B	29-Aug	19:38	<i>Geodia barretti</i>	43.9004	-58.9406	1,294	3.97	34.93	8.53	Yes
EX1905L2_D01_04B	29-Aug	20:58	Corbitellinae new genus	43.9012	-58.9402	1,143	4.04	34.93	8.42	Yes
EX1905L2_D01_04B_A01	29-Aug	20:58	<i>Keratoisis</i> sp.	43.9012	-58.9402	1,143	4.04	34.93	8.42	Yes
EX1905L2_D01_05B	29-Aug	21:54	Keratoisidinae nodal	43.9017	-58.9397	1,085	4.13	34.93	8.81	Yes
EX1905L2_D01_05B_A01	29-Aug	21:54	Mysida	43.9017	-58.9397	1,085	4.13	34.93	8.81	
EX1905L2_D01_05B_A02	29-Aug	21:54	Decapoda shrimp	43.9017	-58.9397	1,085	4.13	34.93	8.81	
EX1905L2_D02_01B	30-Aug	18:18	Chonelasmatinae	42.8698	-61.2069	2,448	3.06	34.91	8.39	Yes
EX1905L2_D02_01B_A01	30-Aug	18:18	Aplacophora	42.8698	-61.2069	2,448	3.06	34.91	8.39	Yes
EX1905L2_D02_02B	30-Aug	18:41	Farreidae	42.8698	-61.2071	2,438	3.06	34.91	8.4	Yes

Specimen code (cont.)	Date (UTC)	Time (UTC)	Field ID	Latitude	Longitude	Depth (m)	Temp. (°C)	Salinity (PSU)	Dissolved oxygen (mg/L)	DNA sub-sample
EX1905L2_D02_02B_A01	30-Aug	18:41	Tubularidae	42.8698	-61.2071	2,438	3.06	34.91	8.4	
EX1905L2_D03_01B	31-Aug	14:42	Foraminifera?	42.6827	-64.2198	357	8.31	35.14	5.01	
EX1905L2_D03_02B	31-Aug	21:00	<i>Illex illecebrosus</i>	42.6956	-64.226	N/A	N/A	N/A	N/A	Yes
EX1905L2_D04_01B	1-Sep	14:24	<i>Hyalonema</i> sp.?	41.9844	-65.3751	1,482	3.86	34.93	8.4	Yes
EX1905L2_D04_02B	1-Sep	14:55	<i>Phakelia</i> sp.?	41.985	-65.3737	1,455	3.87	34.94	8.41	Yes
EX1905L2_D04_02B_A02	1-Sep	14:55	Isopoda	41.985	-65.3737	1,455	3.87	34.94	8.41	Yes
EX1905L2_D04_02B_A03	1-Sep	14:55	Ophiacanthidae	41.985	-65.3737	1,455	3.87	34.94	8.41	Yes
EX1905L2_D04_02B_A04	1-Sep	14:55	Gastropoda	41.985	-65.3737	1,455	3.87	34.94	8.41	Yes
EX1905L2_D04_02B_A05	1-Sep	14:55	Polychaeta	41.985	-65.3737	1,455	3.87	34.94	8.41	Yes
EX1905L2_D04_02B_A06	1-Sep	14:55	Polychaeta red	41.985	-65.3737	1,455	3.87	34.94	8.41	
EX1905L2_D04_02B_A07	1-Sep	14:55	Sipunculida	41.985	-65.3737	1,455	3.87	34.94	8.41	Yes
EX1905L2_D04_02B_A08	1-Sep	14:55	Tubularidae	41.985	-65.3737	1,455	3.87	34.94	8.41	
EX1905L2_D04_02B_A09	1-Sep	14:55	Amphipoda A	41.985	-65.3737	1,455	3.87	34.94	8.41	
EX1905L2_D04_02B_A10	1-Sep	14:55	Amphipoda B	41.985	-65.3737	1,455	3.87	34.94	8.41	
EX1905L2_D04_02B_A11	1-Sep	14:55	Amphipoda C	41.985	-65.3737	1,455	3.87	34.94	8.41	
EX1905L2_D04_02B_A12	1-Sep	14:55	Isopoda	41.985	-65.3737	1,455	3.87	34.94	8.41	
EX1905L2_D04_03B	1-Sep	16:06	<i>Paragorgia</i> sp.	41.9867	-65.3737	1,378	3.9	34.93	8.39	Yes
EX1905L2_D04_03B_A01	1-Sep	16:06	Euryalida	41.9867	-65.3737	1,378	3.9	34.93	8.39	Yes
EX1905L2_D04_03B_A02	1-Sep	16:06	Polychaeta	41.9867	-65.3737	1,378	3.9	34.93	8.39	
EX1905L2_D04_04B	1-Sep	17:24	Demospongiae?	41.9882	-65.3737	1,349	3.9	34.93	8.37	Yes
EX1905L2_D04_04B_A01	1-Sep	17:24	Mysida	41.9882	-65.3737	1,349	3.9	34.93	8.37	Yes
EX1905L2_D05_01B	2-Sep	14:05	Krill	40.9052	-66.5012	748	5.12	35	7.66	
EX1905L2_D05_02B	2-Sep	18:51	<i>Plesionika holthuisi</i>	40.9024	-66.5029	564	5.36	35.01	7.25	Yes
EX1905L2_D05_02B_A01	2-Sep	18:51	Hydroidolina	40.9024	-66.5029	564	5.36	35.01	7.25	Yes
EX1905L2_D05_02B_A02	2-Sep	18:51	Gastropoda	40.9024	-66.5029	564	5.36	35.01	7.25	Yes
EX1905L2_D05_02B_A03	2-Sep	18:51	Amphipoda	40.9024	-66.5029	564	5.36	35.01	7.25	Yes
EX1905L2_D05_02B_A04	2-Sep	18:51	Animalia	40.9024	-66.5029	564	5.36	35.01	7.25	
EX1905L2_D05_03B	2-Sep	18:54	Siphonophore	40.9024	-66.5029	564	5.39	35.01	7.23	Yes
EX1905L2_D05_04B	2-Sep	19:43	<i>Acanthogorgia</i> sp.	40.9012	-66.5034	541	5.39	35.01	7.24	Yes
EX1905L2_D05_04B_A01	2-Sep	19:43	Polynoidae	40.9012	-66.5034	541	5.39	35.01	7.24	

Specimen code (cont.)	Date (UTC)	Time (UTC)	Field ID	Latitude	Longitude	Depth (m)	Temp. (°C)	Salinity (PSU)	Dissolved oxygen (mg/L)	DNA sub-sample
EX1905L2_D05_04B_A02	2-Sep	19:43	Amphipoda	40.9012	-66.5034	541	5.39	35.01	7.24	
EX1905L2_D06_01B	3-Sep	17:43	<i>Regadrella</i> sp.?	40.8532	-66.5397	935	4.53	34.97	8.02	Yes
EX1905L2_D06_01B_A01	3-Sep	17:43	Decapod shrimp	40.8532	-66.5397	935	4.53	34.97	8.02	Yes
EX1905L2_D06_01B_A02	3-Sep	17:43	Polychaete	40.8532	-66.5397	935	4.53	34.97	8.02	Yes
EX1905L2_D06_01B_A03	3-Sep	17:43	Ophiuroidea	40.8532	-66.5397	935	4.53	34.97	8.02	
EX1905L2_D06_01B_A04	3-Sep	17:43	Gastropoda A	40.8532	-66.5397	935	4.53	34.97	8.02	
EX1905L2_D06_01B_A05	3-Sep	17:43	Gastropoda B	40.8532	-66.5397	935	4.53	34.97	8.02	
EX1905L2_D06_01B_A06	3-Sep	17:43	Poecilasmataidae	40.8532	-66.5397	935	4.53	34.97	8.02	
EX1905L2_D06_02B	3-Sep	17:58	<i>Hertwigia</i> sp. yellow	40.8532	-66.5397	932	4.57	34.97	7.98	Yes
EX1905L2_D06_02B_A01	3-Sep	17:58	Polynoidae	40.8532	-66.5397	932	4.57	34.97	7.98	Yes
EX1905L2_D06_02B_A02	3-Sep	17:58	Polychaeta	40.8532	-66.5397	932	4.57	34.97	7.98	
EX1905L2_D06_02B_A03	3-Sep	17:58	Gastropoda	40.8532	-66.5397	932	4.57	34.97	7.98	
EX1905L2_D06_02B_A04	3-Sep	17:58	Ophiacanthidae	40.8532	-66.5397	932	4.57	34.97	7.98	Yes
EX1905L2_D06_02B_A05	3-Sep	17:58	Isopoda	40.8532	-66.5397	932	4.57	34.97	7.98	Yes
EX1905L2_D06_02B_A06	3-Sep	17:58	Amphipoda	40.8532	-66.5397	932	4.57	34.97	7.98	Yes
EX1905L2_D06_02B_A07	3-Sep	17:58	Polychaeta	40.8532	-66.5397	932	4.57	34.97	7.98	Yes
EX1905L2_D06_03B	3-Sep	18:42	<i>Pocillastra</i> sp.? yellow	40.8533	-66.5396	924	4.55	34.97	7.99	Yes
EX1905L2_D06_03B_A01	3-Sep	18:42	Ophiurida	40.8533	-66.5396	924	4.55	34.97	7.99	Yes
EX1905L2_D06_03B_A02	3-Sep	18:42	Amphipoda	40.8533	-66.5396	924	4.55	34.97	7.99	
EX1905L2_D06_03B_A03	3-Sep	18:42	Polychaeta	40.8533	-66.5396	924	4.55	34.97	7.99	Yes
EX1905L2_D06_04B	3-Sep	19:07	Geodiidae	40.8535	-66.5396	919	4.57	34.97	7.95	Yes
EX1905L2_D06_04B_A01	3-Sep	19:07	<i>Placiphorella atlantica</i>	40.8535	-66.5396	919	4.57	34.97	7.95	Yes
EX1905L2_D06_04B_A02	3-Sep	19:07	<i>Hanleya nagelfar</i>	40.8535	-66.5396	919	4.57	34.97	7.95	Yes
EX1905L2_D06_04B_A03	3-Sep	19:07	Ophiurida	40.8535	-66.5396	919	4.57	34.97	7.95	
EX1905L2_D06_04B_A04	3-Sep	19:07	Polychaeta	40.8535	-66.5396	919	4.57	34.97	7.95	Yes
EX1905L2_D06_04B_A05	3-Sep	19:07	Polychaeta B	40.8535	-66.5396	919	4.57	34.97	7.95	
EX1905L2_D06_05B	3-Sep	19:21	<i>Paragorgia</i> sp.	40.8535	-66.5397	919	4.58	34.97	7.95	Yes
EX1905L2_D06_05B_A01	3-Sep	19:21	Eurylida	40.8535	-66.5397	919	4.58	34.97	7.95	Yes
EX1905L2_D06_05B_A02	3-Sep	19:21	Ctenophore	40.8535	-66.5397	919	4.58	34.97	7.95	Yes
EX1905L2_D09_01B	10-Sep	15:15	Corbitellinae pink	39.8045	-66.2146	2,604	2.9	34.91	8.4	Yes

Specimen code (cont.)	Date (UTC)	Time (UTC)	Field ID	Latitude	Longitude	Depth (m)	Temp. (°C)	Salinity (PSU)	Dissolved oxygen (mg/L)	DNA sub-sample
EX1905L2_D09_01B_A01	10-Sep	15:15	Polychaeta A	39.8045	-66.2146	2,604	2.9	34.91	8.4	
EX1905L2_D09_01B_A02	10-Sep	15:15	Polynoidae	39.8045	-66.2146	2,604	2.9	34.91	8.4	
EX1905L2_D09_01B_A03	10-Sep	15:15	Amphipoda A	39.8045	-66.2146	2,604	2.9	34.91	8.4	
EX1905L2_D09_01B_A04	10-Sep	15:15	Amphipoda B	39.8045	-66.2146	2,604	2.9	34.91	8.4	
EX1905L2_D09_01B_A05	10-Sep	15:15	Amphipoda C	39.8045	-66.2146	2,604	2.9	34.91	8.4	
EX1905L2_D09_01B_A06	10-Sep	15:15	Demospongiae	39.8045	-66.2146	2,604	2.9	34.91	8.4	
EX1905L2_D09_02B	10-Sep	15:50	Hexactinellida	39.8045	-66.2151	2590	3.01	34.92	8.43	Yes
EX1905L2_D09_03B	10-Sep	17:39	Nidaliidae	39.8046	-66.2159	2,540	3.26	34.92	8.29	Yes
EX1905L2_D09_03B_A01	10-Sep	17:39	Euretidae	39.8046	-66.2159	2,540	3.26	34.92	8.29	
EX1905L2_D09_03B_A02	10-Sep	17:39	Polychaeta	39.8046	-66.2159	2,540	3.26	34.92	8.29	
EX1905L2_D09_03B_A03	10-Sep	17:39	<i>Munidopsis</i> sp.	39.8046	-66.2159	2,540	3.26	34.92	8.29	
EX1905L2_D09_04B	10-Sep	18:17	Hexactinellida	39.8047	-66.2159	2,528	3.28	34.93	8.27	Yes
EX1905L2_D09_04B_A01	10-Sep	18:17	Zoantharia	39.8047	-66.2159	2,528	3.28	34.93	8.27	
EX1905L2_D09_04B_A02	10-Sep	18:17	Isopoda	39.8047	-66.2159	2,528	3.28	34.93	8.27	
EX1905L2_D09_04B_A03	10-Sep	18:17	Nidaliidae	39.8047	-66.2159	2,528	3.28	34.93	8.27	
EX1905L2_D09_04B_A04	10-Sep	18:17	Amphipoda	39.8047	-66.2159	2,528	3.28	34.93	8.27	
EX1905L2_D09_04B_A05	10-Sep	18:17	Scalpellidae	39.8047	-66.2159	2,528	3.28	34.93	8.27	
EX1905L2_D09_04B_A06	10-Sep	18:17	Balanoidea	39.8047	-66.2159	2,528	3.28	34.93	8.27	
EX1905L2_D09_04B_A07	10-Sep	18:17	Hydroidolina	39.8047	-66.2159	2,528	3.28	34.93	8.27	
EX1905L2_D09_04B_A08	10-Sep	18:17	<i>Corallium</i> dead	39.8047	-66.2159	2,528	3.28	34.93	8.27	
EX1905L2_D09_05B	10-Sep	18:58	Geodiidae	39.8045	-66.216	2,504	3.3	34.93	8.26	Yes
EX1905L2_D09_05B_A01	10-Sep	18:58	Ophiurida	39.8045	-66.216	2,504	3.3	34.93	8.26	
EX1905L2_D09_05B_A02	10-Sep	18:58	Zoantharia	39.8045	-66.216	2,504	3.3	34.93	8.26	
EX1905L2_D09_05B_A03	10-Sep	18:58	<i>Corallium</i> dead	39.8045	-66.216	2,504	3.3	34.93	8.26	
EX1905L2_D10_01B	11-Sep	14:56	<i>Agmayeria</i> sp.?	39.9926	-67.3506	2,173	3.29	34.93	8.16	Yes
EX1905L2_D11_01B	12-Sep	18:13	Keratoisidinae	39.8498	-69.5508	1,221	4.25	34.96	8.14	Yes
EX1905L2_D11_02B	12-Sep	18:42	<i>Swiftia</i> sp.?	39.8498	-69.5508	1,214	8.19	34.96	8.19	Yes
EX1905L2_D12_01B	Sep-14	14:38	Demospongiae	39.8204	-70.8523	1,177	4.26	34.96	8.18	Yes
EX1905L2_D12_01B_A01	Sep-14	14:38	Gastropoda	39.8204	-70.8523	1,177	4.26	34.96	8.18	
EX1905L2_D12_01B_A02	Sep-14	14:38	Polychaeta	39.8204	-70.8523	1,177	4.26	34.96	8.18	

Specimen code (cont.)	Date (UTC)	Time (UTC)	Field ID	Latitude	Longitude	Depth (m)	Temp. (°C)	Salinity (PSU)	Dissolved oxygen (mg/L)	DNA sub-sample
EX1905L2_D12_01B_A03	Sep-14	14:38	Holothuroidea	39.8204	-70.8523	1,177	4.26	34.96	8.18	
EX1905L2_D12_02B	Sep-14	15:21	<i>Acanthogorgia armata</i>	39.8202	-70.8526	1,165	4.30	34.96	8.15	Yes
EX1905L2_D12_02B_A01	Sep-14	15:21	Polychaeta	39.8202	-70.8526	1,165	4.30	34.96	8.15	Yes
EX1905L2_D12_03B	Sep-14	16:38	Primnoidae	39.8191	-70.8524	1,171	4.29	34.96	8.17	Yes
EX1905L2_D12_03B_A01	Sep-14	16:38	Gastropoda	39.8191	-70.8524	1,171	4.29	34.96	8.17	
EX1905L2_D12_03B_A02	Sep-14	16:38	Sipunculida	39.8191	-70.8524	1,171	4.29	34.96	8.17	
EX1905L2_D12_03B_A03	Sep-14	16:38	Caprellidae	39.8191	-70.8524	1,171	4.29	34.96	8.17	
EX1905L2_D12_03B_A04	Sep-14	16:38	Amphipoda A	39.8191	-70.8524	1,171	4.29	34.96	8.17	Yes
EX1905L2_D12_03B_A05	Sep-14	16:38	Isopoda	39.8191	-70.8524	1,171	4.29	34.96	8.17	
EX1905L2_D12_04B	Sep-14	17:36	<i>Acanthogorgia armata</i>	39.8187	-70.8527	1,138	4.26	34.96	8.19	Yes
EX1905L2_D12_04B_A01	Sep-14	17:36	Aplacophora	39.8187	-70.8527	1,138	4.26	34.96	8.19	Yes
EX1905L2_D12_04B_A02	Sep-14	17:36	Actinaria	39.8187	-70.8527	1,138	4.26	34.96	8.19	
EX1905L2_D12_04B_A03	Sep-14	17:36	Ophiacanthidae	39.8187	-70.8527	1,138	4.26	34.96	8.19	Yes
EX1905L2_D12_04B_A04	Sep-14	17:36	Polynoidae	39.8187	-70.8527	1,138	4.26	34.96	8.19	Yes
EX1905L2_D12_04B_A05	Sep-14	17:36	Polychaeta	39.8187	-70.8527	1,138	4.26	34.96	8.19	Yes
EX1905L2_D12_05B	Sep-14	19:07	<i>Parantipathes larix</i>	39.8188	-70.8529	1,092	4.29	34.96	8.32	Yes
EX1905L2_D12_05B_A01	Sep-14	19:07	Ophiacanthidae	39.8188	-70.8529	1,092	4.29	34.96	8.32	Yes
EX1905L2_D12_05B_A02	Sep-14	19:07	<i>Uroptycus</i> sp.	39.8188	-70.8529	1,092	4.29	34.96	8.32	Yes

### 3.4 Mapping Operations

Access to all mapping products can be obtained by looking up the expedition code (EX1905L2) at this portal: <https://service.ncddc.noaa.gov/website/EXAtlas/viewer.htm>.

#### 3.4.1 Multibeam Sonar (Kongsberg EM302)

Multibeam mapping operations covered an area of over 10,729 square kilometers of seafloor over a linear ship track distance of approximately 3,430 kilometers. Mapped seafloor areas included 7,221 square kilometers in the U.S. EEZ, 3,157 square kilometers in the EEZ of Canada, and 351 square kilometers in marine areas beyond national jurisdiction.

Mapping operations included several areas that had never before been mapped with high-resolution multibeam sonars, including deep-sea areas around the Northeast Channel, the Fundian Valley, North of Alvin Canyon, and along the U.S.-Canadian boundary. When

overnight transits between ROV dive locations did not enable surveying previously unmapped areas, surveys were conducted over areas mapped by other vessels with lower-resolution mapping capabilities.

When gathering data in unmapped or poorly mapped areas was not possible, some areas with high-resolution existing data were remapped to enable time-series analysis of potential seafloor changes and to obtain improved datasets on seafloor and water column backscatter. Seafloor mapping operations covered a range of geomorphic features, including submarine canyons, seamounts, escarpments, ridges, and submerged channels. The multibeam dataset for the expedition is archived at NOAA's NCEI, and is accessible from the following online map viewer service:

<https://maps.ngdc.noaa.gov/viewers/bathymetry/>.

### ***3.4.2 Sub-Bottom Profiler (Knudsen Chirp 3260)***

The sub-bottom profiler was not run during any ROV dive operations, but generally was operated during multibeam mapping operations. A linear distance of approximately 3,430 kilometers was mapped using the sub-bottom profiler during the expedition, including in areas to support the Extended Continental Shelf project. Geophysical data for the region covered by the expedition can be located at NOAA's NCEI's online Geophysical Data Viewer:

<https://maps.ngdc.noaa.gov/viewers/geophysics/>.

### ***3.4.3 Split-beam Sonars (Kongsberg EK60)***

These sonars were used continuously (aside from the 38 kHz frequency that interferes with multibeam operations) throughout the cruise during both overnight mapping operations and daytime ROV operations. A linear distance of approximately 3,430 kilometers was mapped using the EK60 and EK80 during the expedition. EK60 and EK80 water column data for the expedition can be accessed from the following online data portal:

[https://www.ngdc.noaa.gov/maps/water\\_column\\_sonar/index.html](https://www.ngdc.noaa.gov/maps/water_column_sonar/index.html).

### ***3.4.4 Acoustic Doppler Current Profiler (Teledyne Marine Workhorse Mariner ADCP)***

ADCP data for the expedition were collected at each ROV dive location, and can be accessed from this data portal: [https://www.nodc.noaa.gov/gocd/sadcp\\_oer\\_inv.html](https://www.nodc.noaa.gov/gocd/sadcp_oer_inv.html).

## **4. Engagement, Education, and Outreach**

In addition to working with partner scientists and resource managers to explore priority areas, one of OER's main goals is to engage diverse audiences in ocean exploration, including the public, teachers, and students. The goal is to inspire the next generation of ocean explorers, scientists, and engineers to pursue careers in ocean exploration and related fields, as well as to increase ocean literacy and stewardship. Several different tools

were used to engage diverse audiences around the world throughout the expedition. These included (1) webinar presentations by mission personnel prior to and after the expedition, (2) ship tours for resource managers, scientists and students prior to the expedition in Dartmouth, Nova Scotia, (3) live interactions with various groups throughout the expedition, (4) public displays of live video feeds from the expedition at various venues, (5) continuous updates of the expedition web page with up-to-date information on the expedition, as well as with background materials and mission logs about the science, data, and other relevant topics, (7) frequent expedition-related posts on several social media platforms (i.e., Facebook, Instagram, Twitter), and (8) articles with information relating to the expedition in media publications. Collectively, this resulted in reaching over 8,400 individuals in person, and over 152,000 views online. Information on the various engagement tools that were used throughout the expedition are summarized in Table 7 below.

**Table 7.** Summary information of the various engagement tools that were used throughout the expedition to engage diverse audiences from around the world.

Date	Venue	Location	No. of people or views
<b>Webinars</b>			
Jun. 24	Science Introduction Webinar	<a href="#">Online</a>	46
Jul. 22	Midwater Introduction Webinar	<a href="#">Online</a>	18
Aug. 15	Collaboration Tools Webinar	<a href="#">Online</a>	25
Sep. 20	Science Wrap-up Webinar	<a href="#">Online</a>	30
<b>Ship Tours</b>			
Aug. 23	NOAA Ship <i>Okeanos Explorer</i>	Dartmouth, Canada	83
<b>Live Interactions</b>			
Aug. 28	Congressional Visit at Silver Spring ECC	Silver Spring, Maryland	10
Sep. 3	Dr. Kinlan Tribute at Exploration Command Center	Silver Spring, Maryland	34
Sep. 7	Mystic Aquarium	Mystic, Connecticut	30
Sep. 10	Knauss Fellows at Silver Spring ECC	Silver Spring, Maryland	5
Sep. 12	New England Aquarium	Boston, Massachusetts	164
<b>Articles</b>			
Aug. 27	NOAA.gov feature story	<a href="#">Online</a>	15,800
<b>Public Video Displays</b>			
Aug 26-Sep. 15	YouTube Channel Live Video Feed Views	<a href="#">Online</a>	112,830
Aug. 28-Sep.1	Ottawa Museum of Nature	Ottawa, Canada	2,000

Date	Venue	Location	No. of people or views
Auf. 28-Sep.14	Natural History Museum of Halifax	Halifax, Canada	6,000
Auf. 28-Sep. 1	Bedford Institute of Oceanography Auditorium	Dartmouth, Canada	100
<b>Expedition Website</b>			
Aug 26-Sep. 15	Expedition Website Views	<a href="#">Online</a>	23,500

## 5. Acknowledgements

The planning and successful execution of the *Deep Connections 2019* expedition and its many accomplishments are the product of teamwork between many collaborators, including both ship-based and shore-based personnel. The spectacular seafloor images captured during the expedition would not have been possible without the exceptional talent, dedication and passionate work by the ROV team (Sean Kennison, Chris Ritter, Bobby Mohr, Dave Wright, Mark Durbin, Chris Wright, Dan Rogers, Levi Unema, Andrew O'Brien, and Lars Murphy) and video engineers (Brian Doros, Arthur Howard, Emily Narrow, and Caitlin Bailey). We are also grateful for all the hard work by the rest of the onboard mapping team (Dan Freitas and Charlie Wilkins), whose mapping efforts provided a great wealth of information that not only supported the mission, but will also be invaluable to future work in this region. The NOAA Ship *Okeanos Explorer's* officers (Nicole Manning, Faith Knighton, Rosemary Abbitt, John Katchenago, Kevin Tarazona, Nico Osborn, and Brian Caldwell) and crew (Vincent Palazzolo, Ric Gabona, Dave Blessing, Chris Remaley, William Rogeaux, Peter Brill, Mike Collins, Mike Sapien, Jerrod Hazendorf, Christian Lebron, Pedro Lebron, Sidney Dunn, Ray Capati, Eli Pacheco, James Scott, Celeste Morris, and Randy Collins) exhibited superb skills and utmost professionalism throughout the expedition.

The expedition was further supported by a hard-working and shore-based operations team that provided invaluable contributions to this mission. We are particularly thankful for all the support by Craig Russell, Mashkoor Malik, Christa Rabenold, Kelley Elliott, Kasey Cantwell, Christopher Dunn, Caitlin Adams, David McKinnie, Emily Crum, Adrienne Copeland, Matt King, Stephen Hammond, Amanda Netburn, Susan Gottfried, Catalina Martinez, Colleen Peters, and James Rawsthorne.

Additional support was provided by a great number of shore-based scientists and supporters, who contributed a great amount of information, expertise, and guidance throughout the expedition. Special thanks go to the OER science advisor Scott France, as well as the rest of the shore-based science team of the *Deep Connections 2019* expedition, which included Adrienne Copeland, Allen Collins, Amanda Netburn, Ana Riesgo, Asako

Matsumoto, Benjamin Frable, Bradley Stevens, Calvin Campbell, Camille Lirette, Carolyn Ruppel, Christopher Mah, Dhugal Lindsey, Ellen Kenchington, Heather Judkins, Jason Chaytor, Javier Murillo, Jessica Robinson, Jim Masterson, Joana Xavier, Kasey Cantwell, Kate Rose, Kelley Brumley, Kenneth Sulak, Kevin Kocot, Kristen Mello, Laura Anthony, Lauren Walling, Lindsay Beazley, Lisa Levin, Mary Wicksten, Mashkooor Malik, Megan McCuller, Michael Vecchione, Mike Ford, Nolan Barrett, Paco Cardenas, Paul Macnab, Robert Carney, Scott France, Sergio Taboada, Steve Ross, Steven Auscavitch, Tamara Frank, Tara Luke, Timothy Shank, Tina Molodtsova, Tom Hourigan, Tracey Sutton, Trevor Kenchington, and Veerle Huvenne. We especially thank Calvin Cambell, Derek Fenton, Paul Mcnab, Ellen Kenchington, and Lindsay Beazley for providing exceptional support that was essential to planning activities in Canadian waters during this expedition.

We further thank the staff of the Bedford Institute of Oceanography, who provided exceptional support to set up and staff the new exploration command center. Special thanks go to the outreach and education staff of the Canadian Museum of Nature, the Natural History Museum of Halifax, Fisheries and Oceans Canada, the U.S. Fish and Wildlife Service, the New England Aquarium, and the Mystic Aquarium, and particularly to Jean Marc Gagnon, Tara Donaghy, Terri Edwards, Keith Shannon, Katie Cubina, Mary MacDonald, and Maggie See for their exceptional support.

## 6. Appendices

### 6.1 Appendix A: EX1905L2 Data Management Plan.

#### OER data management objectives

Operate normal data pipelines, implement latest naming convention for specimens collected, formalize data management SOPs.

#### 1. General description of data to be managed

##### 1.1 Name and purpose of the data collection project

*Okeanos Explorer (EX1905-Leg 2): New England and Canada (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 multibeam sonar, EK60 split-beam fisheries sonars, Knudsen 3260 chirp sub-bottom profiler sonar, and Teledyne Acoustic Doppler Current Profiler), XBTs in support of multibeam sonar mapping operations, CTD casts, OER's two-body ROV system (Deep Discoverer and Seirios), and the ship's high-bandwidth satellite connection for continuous ship-to-shore communications. Operations will focus on exploring deep waters (>250 m) in the U.S. exclusive economic zone (EEZ) off the Northeast U.S. Coast, as well as the EEZ of Canada.

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

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

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

*Okeanos ROV Cruises*

##### 1.5 Temporal coverage of the data

Dates: 8/26/2019 to 9/15/2019

##### 1.6 Planned coverage of the data

Latitude boundaries: 39° 02.545' N to 43° 34.880' N  
Longitude boundaries: 72° 42.545' W to 60° 24.700' W

##### 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, ADCP, Bottom Backscatter, CTD (processed), CTD (product), CTD (raw), Dive Summaries, EK60 Singlebeam Data, EK80 Echosounder, Expedition Cruise Report, HDCS, Highlight Video, Images, Multibeam (image), Multibeam (processed), Multibeam (product), Multibeam (raw), NetCDF, 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 (raw)

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

NOAA Ship *Okeanos Explorer*, *Seirios* Camera Sled, *Deep Discoverer* ROV

### **2. Point of contact (POC) for this data producing project**

Overall POC: Dr. Daniel Wagner  
Title: Expedition Coordinator  
Affiliation: NOAA Office of Ocean Exploration and Research  
E-Mail: [daniel.wagner@noaa.gov](mailto:daniel.wagner@noaa.gov)  
Phone: 808-256-5014

### **3. Point of contact for managing the data**

Data POC Name: Andrew O'Brien and Megan Cromwell  
Title: Onboard/Shoreside Data Manager, Sample Data  
Manager/Stewardship Data Manager  
E-Mail: [andrew.obrien@tgfoe.org](mailto:andrew.obrien@tgfoe.org), [megan.cromwell@noaa.gov](mailto:megan.cromwell@noaa.gov)

### **4. Resources**

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

**4.2 Approximate percentage of the budget devoted to data management.** 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](http://explore.noaa.gov/okeanosatlas)).

## 6. Data documentation

**6.1 Does the metadata comply with the data documentation directive?** Yes

**6.1.1 If metadata are non-existent or non-compliant, please explain:** Not applicable

**6.2 Where will the metadata be hosted?**

Organization: An ISO format collection-level metadata record will be generated during pre-cruise planning and published in an OER catalog and Web Accessible Folder (WAF) hosted at NCEI-MS for public discovery and access. The record will be harvested by data.gov.

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

**7.1 Do the data comply with the data access directive?** Yes

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

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

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

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

Org: NOAA National Centers for Environmental Information

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

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

Hold time: none

Authority: not applicable

#### **7.4 Prepare a data access statement**

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

### **8. Data preservation and protection**

#### **8.1 Actual or planned long-term data archive location**

Data from this mission will be preserved and stewarded through the NOAA National Centers for Environmental Information. Refer to the Okeanos Explorer FY18 Data Management Plan at NOAA's EDMC DMP Repository (EX\_FY18\_DMP\_Final.pdf) for detailed descriptions of the processes, procedures, and partners involved in this collaborative effort.

#### **8.2 If no archive planned, why? Not applicable**

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

90-120 days from mission end

#### **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.

## 6.2 Appendix B: National Environmental Policy Act (NEPA) Categorical Exclusion.

### Categorical Exclusion (CE) Evaluation Worksheet

**Project Identifier:** EX-19-05-Leg 2

**Date Review Completed:** 5/10/2019

**Completed by:** Daniel Wagner, Expedition Manager

**OAR Functional Area:** OER

**Worksheet File Name:** 2019-05-OER-CE-EX-19-05-Leg 2

#### 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 NOAA Ship Okeanos Explorer's sonar systems, and conduct baseline characterization of unexplored areas using NOAA's two-body remotely operated vehicle (ROV) and CTD rosette system on NOAA Ship Okeanos Explorer. ROV operations will include collection of detailed high-resolution imagery, limited biological and geological specimens, and digital environmental sensor data. The expedition will conduct operations in unexplored deep water (>250 m) areas of the Atlantic Continental Margin in the exclusive economic zone (EEZ) of the U.S. and Canada. The expedition is currently scheduled to start in Halifax, Nova Scotia on August 26, 2019, and end in North Kingstown, Rhode Island on September 15, 2019.

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

- a.** E3: Activities to collect aquatic, terrestrial, and atmospheric data in a non-destructive manner.
- b.** The topical scope of this action is consistent with CE number E3 in Appendix E of the Companion Manual to NOAA Administrative Order (NAO) 216-6A: activities to collect

aquatic, terrestrial, and atmospheric data in a non-destructive manner. The expedition will use remote sensing, video, imagery, and a limited number of physical samples to collect baseline information on unexplored deep-water (>250 m) areas on the Atlantic Continental Margin in the exclusive economic zone (EEZ) of the U.S. and Canada.

## **Step 2. Extraordinary Circumstances Consideration**

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

No. NOAA Ship Okeanos Explorer will be operating exclusively in deep-sea (>250 m) areas during EX1905-Leg 2, an expedition which seeks to address research and management priorities of several U.S. and Canadian management agencies, as well as those of the broader scientific community. This action does not involve any procedures or outcomes known to result in impacts on human health and safety more than would be negligible.

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

This expedition will include limited operations within the Northeast Canyons and Seamounts Marine National Monument, which is co-managed by NOAA and the U.S. Fish and Wildlife Service. OER is working very closely with Monument staff to ensure that impacts will be negligible, and that operations will address the management and science needs of the Monument, as well as those of the broader region.

The expedition is being planned and conducted in partnership with NOAA National Marine Fisheries Service (NMFS), NOAA Deep Sea Coral Research and Technology Program (DSCRTP), NOAA National Centers for Coastal Ocean Science (NCCOS), U.S. Geological Survey, U.S. Fish and Wildlife Service, Fisheries and Oceans Canada, and other Management agencies of the region. OER will use input from these management authorities that are familiar with these areas in order 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 has taken measures to ensure that any effects on species or habitats protected by the ESA, MMPA, MSA or NMSA meet the definition of negligible. In 2018, an informal consultation was initiated under Section 7 of the Endangered Species Act (ESA), requesting NOAA Fisheries' Protected Resources Division concurrence with our Biological Evaluation determining that NOAA

Ship Okeanos Explorer operations conducted during the 2018-2019 field seasons, including those to be undertaken during the EX1905-Leg 2 expedition, are not likely to adversely affect ESA-listed marine species. The informal consultation was completed on August 8, 2018 when OER received a signed letter from the Chief ESA Interagency Cooperation Division in the NOAA Office of Protected Species, stating that NMFS concurs with OER's determination that operations conducted during NOAA Ship Okeanos Explorer 2018-2019 field seasons are not likely to adversely affect ESA-listed marine species. The ESA Section 7 letter of concurrence is provided as an Appendix D in the EX-19-05-Leg 2 project instructions.

Given the offshore focus of most of our proposed work, it is improbable that we will encounter marine mammals protected under the MMPA, or sea birds protected under the MBTA. If we did encounter any such protected animals, our impacts would be negligible because of the best management practices to which we adhere to avoid or minimize environmental impacts. These best management practices are all outlined in the appendices of the EX-19-05-Leg 2 project instructions.

OER also initiated a request for an abbreviated Essential Fish Habitat (EFH) consultation for expeditions by NOAA Ship Okeanos Explorer in 2018-2020 to the Greater Atlantic Region, including EX1905-Leg 2. On July 19, 2018, OER received a letter from the Assistant Regional Administrator for the NOAA Office of Habitat Conservation stating that these expeditions will not adversely impact EFH. This letter is provided in appendices of the EX-19-05-Leg 2 project instructions.

Additionally, OER also initiated a request for a letter of acknowledgement (LOA) from the NOAA Greater Atlantic Regional Office (GARFO) covering all activities to be conducted as part of this expedition. On April 24, 2019, OER received a signed LOA from the GARFO Assistant Regional Administrator for Sustainable Fisheries stating that expedition activities are all in accordance with NMFS regulations. This letter is provided in appendices of the EX-19-05-Leg 2 project instructions.

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

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

**8. Would the action result in adverse effects on properties listed or eligible for listing on the National Register of Historic Places authorized by the National Historic**

**Preservation Act of 1966, National Historic Landmarks designated by the Secretary of the Interior, or National Monuments designated through the Antiquities Act of 1906; Federally recognized Tribal and Native Alaskan lands, cultural or natural resources, or religious or cultural sites that cannot be resolved through applicable regulatory processes?**

During the expedition we will conduct some mapping operations in areas believed to contain shipwrecks or other underwater cultural heritage (UCH) sites. Should any potential UCH targets be discovered during mapping operations, an ROV dive may be conducted on the area to determine whether this is indeed an UCH. If any such areas are confirmed to be shipwrecks via ROV visual surveys, they can potentially be eligible for listing on the National Register of Historic Places. OER conducts non-invasive surveys on archaeology targets and has specific protocols for protecting sensitive location information of such UCH sites. These protocols and procedures are outlined in detail in the appendices of the EX-19-05-Leg 2 project instructions.

**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. NOAA Ship Okeanos Explorer will be operating in remote and offshore areas of the North Atlantic during the expedition (see Table 1 in EX-19-05-Leg 2 project instructions for bounding coordinates). There are no communities within or near the geographic scope of the expedition, and the mission 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-19-05-Leg 2, NOAA Ship Okeanos Explorer will not make landfall in areas other than commercial ports in Halifax, Nova Scotia and Kingstown, Rhode Island. The ship and OER mission team will comply with all applicable local and federal regulations regarding the preventing or spread of invasive species. At the completion of every ROV dive or CTD cast, the equipment will be thoroughly rinsed with freshwater and completely dried to prevent spreading organisms from one site to another. Also, the Engineering Department aboard the NOAA Ship Okeanos Explorer attends yearly Ballast Management Training in accordance with NOAA Form 57-07-13 NPDES VGP Annual Inspection and Report to prevent the introduction of invasive species.

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

The proposed action will not result in a potential violation of Federal, State, or local law or requirements imposed for protection of the environment. The expedition coordinator obtained authorizations for this expedition via several consultations on ESA Section-7 and EFH outlined in questions 4-7 above. Additionally, the expedition coordinator also obtained a CITES permit to collect deep-water coral specimens in Canadian waters, and export these into the U.S. via the ship. The CITES permit is provided in the appendices of the EX-19-05-Leg 2 project instructions.

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

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

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

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

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

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

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

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

## CE Determination

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

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

Signature:



Signed by: Frank Cantelas

Date Signed: May, 15, 2019

## 6.3 Appendix C: Endangered Species Act (ESA) Section 7 Concurrence Letter.



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

AUG 08 2018

Refer to NMFS No: FPR-2018-9276

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

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

Dear Mr. Mowitt:

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

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

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



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

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

Sincerely,



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

### Literature Cited

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

## 6.4 Appendix D: Essential Fish Habitat (EFH) Concurrence Letter.



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

JUL 19 2018

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

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

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

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

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

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



**6.5 Appendix E: Greater Atlantic Regional Fisheries Office (GARFO) Letter of Acknowledgement (LOA).**



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

**SCIENTIFIC RESEARCH LETTER OF ACKNOWLEDGMENT**

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 (469) 265-2908  
 Hoy.Shannon@gmail.com

Issuance Date: April 22, 2019

Acknowledged Study Period: August 6, 2019, through September 15, 2019

Vessel Owner or Operator	Vessel Name	Hull ID	Federal Permit Number
NOAA	R/V <i>Okeanos Explorer</i>	R337	N/A

This letter acknowledges that the above vessel is acting as a scientific research vessel, and is not subject to the Atlantic Coastal Fisheries Cooperative Management Act, the Magnuson-Stevens Fishery Conservation and Management Act, and fishery regulations published in 50 CFR parts 648 and 697. This acknowledgement applies only while the vessel is participating in research activities described in the Scientific Research Plan, within the specified study period, and while under the control of NOAA’s Office of Ocean Exploration and Research (OER).

**Project Description**

The R/V *Okeanos Explorer* will be conducting mapping and survey operations covering waters of Canada, the U.S. Mid-Atlantic and Northeast Regions. Research will consist of multibeam and sonar mapping, CTD (conductivity, temperature, and depth) casts, and remotely operated vehicle (ROV) operations at selected sites throughout the study area, in water depths ranging from 250 m to approximately 5,000 m. Target sites will include seamounts, undersea canyon and slope areas, deep-sea coral and sponge habitats, chemosynthetic communities, and unmapped or poorly mapped areas.



## **SCIENTIFIC RESEARCH LETTER OF ACKNOWLEDGMENT**

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Cruise operations will take place 24 hours a day, with daytime ROV dives and overnight mapping. The CTD casts will record the chemical and physical properties of the water column at sample sites, and the ROV dives will include high-resolution visual surveys of seafloor and water-column habitats, as well as sampling of rocks and biological specimens. The OER will direct all research operations. No fishing gear will be deployed during research cruises.

### **Requirements**

Please carry copies of the Scientific Research Plan and this Letter of Acknowledgment (LOA) on board the vessel(s) while conducting this research. In addition, we recommend that a copy of this LOA be kept with any fish or fish parts retained for research on and off of the vessel.

Any participating vessel subject to vessel monitoring system reporting requirements must declare out of fishery (DOF-SCI) while operating under this LOA.

Research personnel and project participants should take steps to minimize the mortality of all fish caught during this research project. Catch that is not necessary for research activities should be avoided when possible, and returned to the sea as quickly as practicable. Research landings will be monitored. This letter does not acknowledge any activities, including the landing of fish, conducted outside the scope of the Scientific Research Plan; including those which may not be considered scientific research activities and require a separate permit. This letter is not intended to inhibit or prevent any scientific research activity conducted by the research vessel(s). In addition, state requirements apply to the above vessel(s).

This letter is separate and distinct from any permit or consultation required under the Marine Mammal Protection Act, the Endangered Species Act, or any other applicable law. If research will occur within NOAA's Stellwagen Bank National Marine Sanctuary, additional permits may be required. All necessary permits should be obtained prior to embarking on any research activity.

Acknowledged by:



Sarah Heil  
Assistant Regional Administrator  
for Sustainable Fisheries

## 6.6 Appendix F: Global Affairs Canada permit for expedition activities within Canadian waters.



Affaires mondiales  
Canada

Global Affairs  
Canada

UNCLASSIFIED  
IGR-910

July 23, 2019

Mr. Michael Layne  
Deputy Director  
Ocean Science Policy and Authorizations  
Office of Ocean and Polar Affairs  
United States Department of State  
2201 C Street NW  
Washington, D.C. 20520

Dear Mr. Layne,

**Authorization for the Research Ship OKEANOS EXPLORER** (July 26 – October 18, 2019).

I am pleased to advise that the Government of Canada grants its consent to the request for the research ship **OKEANOS EXPLORER** to undertake marine scientific research in areas under Canadian jurisdiction or sovereignty during the above mentioned dates.

Certain specifics outlining the marine scientific activities of the **OKEANOS EXPLORER** are contained in the attached Foreign Vessel Fisheries Research Licence (**352729**). This licence must be signed by the vessel's master and kept on board during activities in Canadian waters (territorial sea or internal waters) or in Canada's exclusive economic zone.

Should there be any research activity taking place inside Canadian waters (territorial sea or internal waters), please be aware of the Canada Border Services Agency (CBSA) marine reporting requirements:

### **Canada Border Services Agency (CBSA) - marine reporting requirements:**

Foreign expeditions arriving in Canada by research vessel and entering Canadian waters (territorial sea or internal waters) are required to report to the nearest Canada Border Services Agency (CBSA) Marine Reporting office.

CBSA Marine Reporting Offices: (**Atlantic**) Phone: 902-426-5738 / Fax: 902-426-1007

Vessels are required to transmit the following completed forms: **Form A6** General Declaration and **Form A6A** Freight/Cargo Manifest. The forms can be obtained electronically via the links below:

**Canada**

**Form A6:** <http://www.cbsa-asfc.gc.ca/publications/forms-formulaires/a6.pdf>  
**Form A6A:** <http://www.cbsa-asfc.gc.ca/publications/forms-formulaires/a6a.pdf>

**Port Calls:** Please note, a [Pre-Arrival Notice](#) must be submitted to the CBSA at [CBSA-ASFC-PANS/AA@cbsa-asfc.gc.ca](mailto:CBSA-ASFC-PANS/AA@cbsa-asfc.gc.ca)

We are pleased that Canadian participants would be welcome to join the project, and that the scientific results and all the data from this cruise will be freely and generously shared. We request copies of the preliminary and final cruise reports.

Yours sincerely,



Meghan Hanley,  
Deputy Director  
Defence and Security Relations Division

## 6.7 Appendix G: Fisheries and Oceans Canada registration for expedition activities within the Exclusive Economic Zone of Canada.

 <b>Fisheries and Oceans Canada</b> <b>Pêches et Océans Canada</b>		Document No: 11763533 Page 1 of 5
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**REGISTRATION(S) AND/OR FISHING LICENCE(S)**

This document authorizes the registration card holder and/or licence holder to engage in fishing and related activities on the Atlantic coast of Canada subject to the provisions of the Fisheries Act and Regulations made thereunder.

This licence and/or registration is issued under the authority of the Minister of Fisheries and Oceans Canada.

FIN <input type="text" value="700020317"/>	CALENDAR YEAR 2019 ISSUANCE DATE: JULY 16, 2019
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OKEANOS EXPLORER  
 NOAA OFFICE OF OCEAN EXP  
 1315 EAST-WEST HWY SSMC3  
 SILVER SPRING, MD 20910, UN

HOMEPORT <input type="text" value="12101 HALIFAX"/>
--

Licence(s) - 2019

Licence #	Species	Areas	Licence Type	Gear Permitted	Amt	VRN	LOA
352729	ITEMS UNSPECIFIED						

AGENT:

NATHAN KEITH  
 NOAA NATIONAL MARINE FISHERIES SERVICE/NEFSC  
 166 WATER STREET  
 WOODS HOLE, MASS US  
 (508-495-2224)  
 NATHAN.KEITH@NOAA.GOV

MASTER:

COMMANDER NICOLE MANNING, NOAA, COMMANDING OFFICER

NOAA OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH, OFFICE OF OCEAN EXPLORATION AND RESEARCH  
 168 WAPPOO ROD, CHARLESTON, SOUTH CAROLINA 29407 US

Research objectives: Galway - Canada US Boundary ROV and Mapping - F2019-025

Location of fishing activity: 5Ze, 4X, 5Y and 4VsW

Dates of fishing activity: JULY 26 TO OCTOBER 18, 2019

Gear: Oceanographic and meteorological equipment including the following:

Kongsberg EM 302 multibeam sonar (30 kHz); Kongsberg EK60 split-beam sonars (18 kHz, 38 kHz, 70 kHz, 120 kHz, 200 kHz, and 333 kHz - note that the 38 kHz and 333 kHz are installed but will not be operational due to transceiver limitations), Knudsen chirp subbottom profiler (3.5 kHz); and Teledyne acoustic doppler current profilers (38 kHz and 300 kHz).

SBE 45 micro-thermosalinograph (TSG); Seabird Electronics Model 9/11+ CTD sensors with additional light scattering (LSS), dissolved oxygen (DO) and oxygen-reduction potential (ORP) sensor; CTD-rosette carousel containing 12 x 10L Niskin bottles; Lockheed Martin Sippican MK-21 expendable bathythermograph

The Okeanos Explorer is equipped with a full set of meteorological sensors that continuously record from the deck while the ship is operating. Radiometer; Spectral Pyranometer; Precision Infrared Radiometer; Microtops II sun photometers

Two-body ROV system. More details are in the attached "Mission Capabilities of NOAA Ship Okeanos Explorer" document

Purpose: A team of scientists and engineers will conduct exploratory investigations on the diversity and distribution of deep-sea habitats in the North Atlantic Ocean off the east coasts of the U.S. and Canada

Special Condition -



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FIN 700020317

CALENDAR YEAR: 2019  
ISSUANCE DATE: JULY 16, 2019

OKEANOS EXPLORER  
NOAA OFFICE OF OCEAN EXP  
1315 EAST-WEST HWY SSMC3  
SILVER SPRING, MD 20910, UN

HOMEPORT  
12101 HALIFAX

Licence #	Species	Areas	Licence Type	Gear Permitted	Amt	VRN	LOA
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summary report will also provide information on any detections of interference made by the sonar system that were potentially from the above listed marine mammals and the resulting mitigation measures that were implemented (Reference: SARA letter of advice to survey leads under separate cover).

Special Conditions - Resource Management

C & P Conditions:

- " Exercise extreme caution while conducting any operations inside Canadian Waters, the Lobster Fishery is very active and there is significant set gear (traps) in the water. There have been complaints in the past of damage to Canadian Fisher's gear.
- " Every precaution is required to ensure activities do not interfere with Canadian fishing gear and/or equipment.
- " Pelagic longline gear will most likely be in the area of Georges Bank on the Shelf Edge - along Southern side of Georges Bank. Swordfish gear may also be found in the Fundian Channel area. Caution is to be taken to ensure pelagic longlines which run near the surface for distances of 30 nm are not crossed by the research vessel, as it may entangle and destroy set fishing gear.
- " Swordfish longline gear may be in other areas.
- " Gear have AIS beacons attached.
- " Beacons from a licence holder have the same vessel prefix on each beacon.
- " There will be a string of beacons on a line. It is not possible to sample between the beacons.
- " It would be possible to sample a suitable distance alongside a set.
- " Contact Robert MacDougall at 506-755-5042 if there are any interactions with Canadian Lobster gear around New Brunswick.
- " Contact Chris Sperry at 902-521-0896 if there are any interactions with Canadian Lobster gear off coast of Nova Scotia
- " Contact Brad Pye at 902-499-0923 for any other gear interactions

1.0 REGIONAL DIRECTOR-GENERAL

THE REGIONAL DIRECTOR-GENERAL DESIGNATED UNDER THE COASTAL FISHERIES PROTECTION REGULATIONS FOR THE PURPOSES OF THIS LICENCE IS THE REGIONAL DIRECTOR-GENERAL OF THE DEPARTMENT OF FISHERIES AND OCEANS FOR THE MARITIMES REGION.

1.2 TERMS AND CONDITIONS OF LICENCE

EVERY LICENCE IN RESPECT OF A FOREIGN FISHING VESSEL IS SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS:

- (A) THE VESSEL AND ITS CREW SHALL ENGAGE ONLY IN THE ACTIVITIES THAT ARE AUTHORIZED BY THE LICENCE;
- (B) THE ACTIVITIES AUTHORIZED BY THE LICENCE SHALL BE CARRIED OUT ONLY AT THE TIMES AND IN THE AREAS OF CANADIAN FISHERIES WATERS OR PORTS SET OUT IN THE LICENCE;
- (C) WHERE FISHING IS AUTHORIZED BY THE LICENCE
  - (I) THE CREW OF THE VESSEL SHALL FISH ONLY FOR A SPECIES OF FISH SPECIFIED IN THE LICENCE,



**REGISTRATION(S) AND/OR FISHING LICENCE(S)**

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This licence and/or registration is issued under the authority of the Minister of Fisheries and Oceans Canada.

FIN

CALENDAR YEAR: 2019  
ISSUANCE DATE: JULY 16, 2019

OKEANOS EXPLORER  
NOAA OFFICE OF OCEAN EXP  
1315 EAST-WEST HWY SSMC3  
SILVER SPRING, MD 20910, UN

HOMEPORT

Licence #	Species	Areas	Licence Type	Gear Permitted	Amt	VRN	LOA
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BE RETURNED TO THE WATER, ALIVE IF POSSIBLE,  
(III) THE CREW OF THE VESSEL SHALL FISH ONLY BY MEANS OF FISHING EQUIPMENT AND GEAR OF A KIND SET OUT IN THE LICENCE, AND  
(IV) WHERE A QUANTITY OF GEAR AND EQUIPMENT IS SET OUT IN A LICENCE, THE CREW OF THE VESSEL SHALL NOT FISH WITH A QUANTITY OF GEAR AND EQUIPMENT THAT EXCEEDS THE QUANTITY SET OUT IN THE LICENCE;  
(D) WHERE THE TRANSPORTING OF FISH FROM FISHING GROUNDS IS AUTHORIZED BY THE LICENCE  
(I) ONLY THE SPECIES AND QUANTITIES OF FISH SET OUT IN THE LICENCE SHALL BE TAKEN ON BOARD THE VESSEL FOR THAT PURPOSE,  
(II) THE FISH MAY BE TAKEN ON BOARD ONLY FROM VESSELS OF A CLASS SET OUT IN THE LICENCE, AND  
(III) THE MASTER OF THE VESSEL SHALL CAUSE WRITTEN RECORDS TO BE MAINTAINED ON A DAILY BASIS OF THE FISH TAKEN ON BOARD THE VESSEL FOR TRANSPORTATION;  
(E) THE VESSEL SHALL HAVE ON BOARD AT ALL TIMES DURING THE PERIOD IT IS IN CANADIAN FISHERIES WATERS EQUIPMENT AND GEAR, INCLUDING COMMUNICATIONS EQUIPMENT, DESCRIBED IN THE LICENCE AS "REQUIRED EQUIPMENT";  
(F) WHERE THE MINISTER REQUESTS THE FLAG STATE OF THE VESSEL TO CARRY OUT, FROM TIME TO TIME, A PROGRAM OF SAMPLING, OBSERVATION OR RESEARCH IN CONNECTION WITH FISHERIES IN CANADIAN FISHERIES WATERS, THE MASTER SHALL COMPLY WITH INSTRUCTIONS ISSUED TO HIM BY THE AUTHORIZED OFFICIALS OF THAT FLAG STATE IN RESPECT OF THAT PROGRAM;  
(G) THE MASTER OR CREW OF THE VESSEL SHALL NOT CARRY OUT ANY ACTIVITY IN ANY AREA OF CANADIAN FISHERIES WATERS THAT IS CONTRARY TO THE FISHERIES ACT OR REGULATIONS MADE UNDER THAT ACT.

1.3 THE MASTER OF A FOREIGN VESSEL IN RESPECT OF WHICH A LICENCE HAS BEEN ISSUED SHALL NOT CONTRAVENE OR FAIL TO COMPLY WITH ANY CONDITION SET OUT IN THAT LICENCE.

2.0 AUTHORIZED ACTIVITIES

THE ABOVE MENTIONED VESSEL, IS AUTHORIZED TO ENTER THAT PORTION OF CANADIAN FISHERIES WATERS KNOWN AS FISHING ZONES 2 AND 4 AND TO ENGAGE IN FISHING FOR THE PURPOSES OF SCIENTIFIC RESEARCH AS DESCRIBED ABOVE.

3.0 AUTHORIZED GEAR AND EQUIPMENT:

THE VESSEL IS AUTHORIZED TO USE ONLY THE GEAR AND EQUIPMENT THAT IS IDENTIFIED ABOVE.

4.0 REPORTING REQUIREMENTS

THE FOLLOWING REPORTS SHALL BE MADE VIA ONE OF THE TWO FOLLOWING METHODS:-

- VIA FAX (902) 426-8003, OR,
- VIA E-MAIL DMP-NATIONALPROGRAMS.XMAR@DFO-MPO.GC.CA

4.1 IN ACCORDANCE WITH THE COASTAL FISHERIES PROTECTION REGULATIONS THE MASTER OF THIS VESSEL SHALL:-

(A) AT LEAST 24 HOURS PRIOR TO THE ENTRY OF THIS VESSEL INTO CANADIAN FISHERIES WATERS, NOTIFY THE REGIONAL DIRECTOR-GENERAL OF THE ESTIMATED TIME OF ENTRY OF THE VESSEL INTO SUCH WATERS AND THE LOCATION OF SUCH ENTRY.



**REGISTRATION(S) AND/OR FISHING LICENCE(S)**

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This licence and/or registration is issued under the authority of the Minister of Fisheries and Oceans Canada.

FIN

CALENDAR YEAR: 2019  
ISSUANCE DATE: JULY 16, 2019

OKEANOS EXPLORER  
NOAA OFFICE OF OCEAN EXP  
1315 EAST-WEST HWY SSMC3  
SILVER SPRING, MD 20910, UN

HOMEPORT

Licence #	Species	Areas	Licence Type	Gear Permitted	Amt	VRN	LOA
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OF THE VESSEL FROM SUCH PORT.

(C) AT LEAST 72 HOURS PRIOR TO THE DEPARTURE FROM CANADIAN FISHERIES WATERS, THIS VESSEL SHALL NOTIFY THE REGIONAL DIRECTOR-GENERAL OF THE ESTIMATED TIME OF DEPARTURE OF THE VESSEL FROM SUCH WATERS, AND THE LOCATION OF SUCH DEPARTURE.

COPIES OF THE ORIGINAL RESEARCH DATA COLLECTED DURING EACH TRIP MUST BE MADE AVAILABLE TO CANADIAN SCIENTISTS UPON REQUEST.

5.0 SPECIAL CONDITIONS

5.1 WHILE OPERATING UNDER THIS LICENCE THE VESSEL MUST COMPLY WITH ALL APPLICABLE CANADIAN LAWS AND REGULATIONS INCLUDING:

- (A) FISHERIES ACT
- (B) COASTAL FISHERIES PROTECTION ACT AND REGULATIONS
- (C) FOREIGN VESSEL FISHING REGULATIONS
- (D) FISHERY (GENERAL) REGULATIONS
- (E) EASTERN CANADA TRAFFIC ZONES REGULATIONS
- (H) SPECIES AT RISK ACT
- (I) OCEANS ACT

5/2 CETACEANS. SEA TURTLES AND SHARKS:

R/V to report sightings of North Atlantic right whales (same day if possible) to DFO Maritimes Region. Contact: 1-844-800-8568; XMARWhalesightings@dfo-mpo.gc.ca. Post voyage, all whale records, including location, date and photos, to be submitted to DFO Maritimes Region using the same contact information.

R/V to report any collisions with whales, entangled whales or dead whales to the whale emergency hotline (1-866-567-6277), VHF Channel 16, or Fundy Traffic VHF Channel 14.

R/V to adhere to guidance contained in Canadian Coast Guard Annual Notices to Mariners: A2 - 5. GENERAL GUIDELINES FOR AQUATIC SPECIES AT RISK AND IMPORTANT MARINE MAMMAL AREAS. See: <https://www.notmar.gc.ca/annual-annuel-en.ph>

Post voyage, all sea turtle records including location, date and photos, to be submitted to Canadian Sea Turtle Network. Contact: 1-888-729-4667; info@seaturtle.ca.

Post voyage, all White Shark records to be submitted to DFO Maritimes Region. Contact: 1-844-400-7870; Shark.MAR@dfo-mpo.gc.ca or via the DFO website (<http://www.dfo-mpo.gc.ca/species-especes/sharks/report-mar-form-eng.asp>)

5.2 SENSITIVE BENTHIC AREAS AND CONSERVATION AREAS (FISHERIES ACT)

DFO has established a series of Sensitive Benthic Area closures under the Fisheries Act in the Maritimes Region: Northeast Channel Coral Conservation Area; Corsair and Georges Canyons Conservation Area; Jordan Basin Conservation Area; Emerald Basin and Sambro Bank Sponge Conservation Areas; and Lophelia Coral Conservation Area (see: <http://www.dfo-mpo.gc.ca/oceans/ceccsr-cerceef/measure-mesures-eng.html>). R/V is prohibited from using bottom-contact gear and mid-water trawl gear in these areas. In addition, known/expected coral concentrations occur in areas of greater than 200 meters depth in Northeast Channel, along the edges of Georges Bank, and in the Jordan Basin area. RV is to exercise caution and avoid damage to these structures. (Contact: Koren Spence; 1-902-818-0894; Koren.Spence@dfo-mpo.gc.ca).

DFO has established the Western and Emerald Banks Conservation Area to conserve groundfish species and benthic habitat (see <http://www.dfo-mpo.gc.ca/oceans/oeabcm->



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This licence and/or registration is issued under the authority of the Minister of Fisheries and Oceans Canada.

FIN

CALENDAR YEAR 2019  
ISSUANCE DATE: JULY 16, 2019

OKEANOS EXPLORER  
NOAA OFFICE OF OCEAN EXP  
1315 EAST-WEST HWY SSMC3  
SILVER SPRING, MD 20910, UN

HOMEPORT

Licence #	Species	Areas	Licence Type	Gear Permitted	Amt	VRN	LOA
Verna.Docherty@dfo-mpo.gc.ca).							

5.4 MARINE PROTECTED AREAS (OCEANS ACT)

Research activities are not permitted in Oceans Act Marine Protected Areas without an approved activity application. The following Marine Protected Areas are established in DFO Maritimes Region: The Gully, St. Anns Bank and Musquash Estuary (see: <http://www.dfo-mpo.gc.ca/oceans/mpa-zpm/index-eng.html>).

6.0 EXPLANATORY NOTES

WHERE IN THIS LICENCE A REFERENCE IS MADE TO A NAFO SUBAREA, DIVISION OR SUBDIVISION IT MEANS THAT SUBAREA, DIVISION OR SUBDIVISION DESCRIBED IN ANNEX 111 OF THE "CONVENTION ON FUTURE MULTILATERAL COOPERATION IN THE NORTHWEST ATLANTIC FISHERIES" THAT WAS RATIFIED BY CANADA ON NOVEMBER 30, 1978 AND CAME INTO FORCE ON JANUARY 1, 1979.

THE MASTER MUST SIGN TO ACKNOWLEDGE THAT HE/SHE HAS READ THESE CONDITIONS:

MASTER'S SIGNATURE *nicole manning*

 MANNING, NICOLE Digitally signed by MANNING, NICOLE DN: cn=MANNING, NICOLE, o=DFO, ou=MPA, email=MANNING.NICOLE@DFO.MPGC.CA  
 MARNE.1174538201 DN: cn=MANNING, NICOLE, o=DFO, ou=MPA, email=MANNING.NICOLE@DFO.MPGC.CA

The use of ALL of these licence(s) is subject to any conditions which are issued by D.F.O. The licence holder must ensure that they have received the licence conditions, and may NOT conduct any fishing activity with any of these licence(s) unless in receipt of the licence conditions.

## 6.8 Appendix H: Fisheries and Oceans Canada permit for activities within the Gully Marine Protected Area.



Fisheries and Oceans Canada  
Pêches et Océans Canada

PO Box 1006  
Dartmouth, NS  
B2Y 4A2

**File / Référence**  
GMPA-2019-05

August 20, 2019

Dr. Ellen Kenchington  
Fisheries and Oceans Canada  
Bedford Institute of Oceanography  
1 Challenger Drive, Dartmouth, NS

Dear Dr. Ellen Kenchington:

**RE: Gully Marine Protected Area (MPA) Activity Approval**  
**Deep Connections 2019**

I am pleased to inform you that your request to conduct scientific operations in Zone 1 of the Gully MPA during the last week of August has been approved under Section 6(1) of the *Gully MPA Regulations*. Based on the information provided in your submission and obtained through correspondence with NOAA officials, Fisheries and Oceans Canada (DFO) has determined that your activities meet the regulatory conditions required for issuance of Ministerial Approval. Any changes to the approved activities must be discussed with the Oceans Management Program prior to commencement.

While in the MPA, you will be expected to comply with all applicable federal legislation. In particular, we'd like to emphasize that holding a Ministerial Approval issued pursuant to the *Gully MPA Regulations* does not satisfy any requirements of the *Species at Risk Act* or the *Fisheries Act*. Neither does the MPA Approval given here substitute for any permits or licences required under those statutes. It is your responsibility to ensure any necessary authorizations are acquired prior to undertaking the approved MPA activities.

To support conservation and protection of the MPA ecosystem, you are asked to adhere to the following requests while undertaking the approved research:

1. Maintain a watch during daylight hours for turtles, marine mammals and marine debris (e.g., abandoned fishing gear, plastics, other garbage or pollutants). Provide any sightings information to the Oceans Management Program.
2. Report any marine mammal collisions, entanglements, distressed or dead animals to the marine animal emergency hotline (1-866-567-6277) or via VHF channel 16.
3. Sightings of northern bottlenose, Sowerby's beaked, blue or North Atlantic right whales including location, date, and photos should be reported to [XMARwhalesightings@dfo-mpo.gc.ca](mailto:XMARwhalesightings@dfo-mpo.gc.ca).

4. Report any sea turtle sightings to the turtle hotline (1-888-729-4667). Sightings of sea turtles including date, location, species, condition, and photos should be submitted at <http://seaturtle.ca/turtle-sighting/>.
5. Report environmental emergencies or other incidents, including unintentional discharges, to the Canadian Coast Guard within two hours of the occurrence. Notify the Oceans Management Program as soon as possible and file an incident report.
6. Provide a post activity report to the Oceans Management Program that details MPA arrival and departure dates & times, and outlines operations undertaken within the MPA.

We have enclosed a set of templates and instructions to assist with the documentation being sought in the requests attached to this Approval. The activity report, incident notifications and any sightings data should be submitted to Sean Smith in Oceans Management at:

Sean C. Smith  
Fisheries and Oceans Canada  
Bedford Institute of Oceanography  
1 Challenger Dr., B500  
Dartmouth, NS  
B2Y 2V9

Phone: (902) 225-9462  
E-mail: [sean.smith@dfo-mpo.gc.ca](mailto:sean.smith@dfo-mpo.gc.ca)

In addition please find attached a 'Letter of Advice' from Ecosystem Management regarding SARA requirements.

Please feel free to follow-up with Sean should you have any questions or need further clarification. Thank you for your continued interest in research and ecological monitoring support for the Gully MPA. Best wishes for a successful mission in collaboration with NOAA.

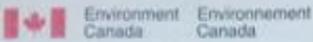
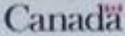
Yours sincerely,



Glen Herbert  
A/Director, Oceans Management  
Oceans and Coastal Management Division  
Ecosystem Management Branch  
Fisheries and Oceans Canada  
Maritimes Region

Attachments: Activity and Incident Report Template

**6.9 Appendix I:** Environment of Canada export permit for species listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES).

						
 Convention on International Trade in Endangered Species of Wild Fauna and Flora / Convention sur le commerce international des espèces de faune et de flore sauvages menacées d'extinction		<b>EXPORT PERMIT PERMIS D'EXPORTATION</b>				
6. Permittee / Détenteur NOAA Office of Ocean Exploration and Research c/o Daniel Wagner 1315 East-West Hwy, SSMC3 Rm 10262 Silver Spring, Maryland 20910 USA  Tel: 808 256 5014 Fax: 301.713.1967		1. Permit/Certificate No. / N° du permis/certificat 19CA00050FONHQ				
		2. Date of issue / Date de délivrance 2019/05/07 (y-m/d-j)	3. Valid until / Valable jusqu'au 2019/11/07 (y-m/d-j)			
		4. Purpose of the transaction / But de la transaction S				
7. Consignee or supplier / Destinataire ou fournisseur NOAA Office of Ocean Exploration and Research c/o Daniel Wagner 1315 East-West Hwy, SSMC3 Rm 10262 Silver Spring, Maryland 20910 USA  Tel: 808 256 5014 Fax: 301.713.1967		5. Special conditions and other information / Conditions particulières et autres renseignements  For validation by US Customs: to be sent to Canadian CITES permitting office by the permit holder. Confirmation of quantities of each item is to be provided by NOAA to the Canadian CITES permitting office.  Endorsement by Customs compulsory / Validation par les douanes obligatoire				
8/9. Scientific name (genus and species) and common name / Nom scientifique (genre et espèce) et nom commun	10. Description of specimens, including mark (signature, if any) / Description des spécimens, y compris les marques (signature, si y a lieu)	11. Appendix / Annexe	12. Source / Source	13. Quantity (ind. unit) / Quantité (en unité)	14. Exported-Quota / Exporté-Quota	
A	8/9 Antipatharia spp. Live Animal Part, Branchlets & polyps Black Corals	B	W	25	N/A	
15a. Country of origin / Pays d'origine	Permit No. / N° de permis	Date (y-m/d-j)	15b. Country of last receipt / Pays de provenance	Certificate No. / N° de certificat	Date (y-m/d-j)	16. Pre-Convention date / d'acquisition
Canada	19CA00050FONHQ	2019/05/07				N/A
B	8/9 Scleractinia spp. Live Animal Part, Branchlets & polyps Stony Corals	B	W	25	N/A	
15a. Country of origin / Pays d'origine	Permit No. / N° de permis	Date (y-m/d-j)	15b. Country of last receipt / Pays de provenance	Certificate No. / N° de certificat	Date (y-m/d-j)	16. Pre-Convention date / d'acquisition
Canada	19CA00050FONHQ	2019/05/07				N/A
<del>C</del>						
15a. Country of origin / Pays d'origine	Permit No. / N° de permis	Date (y-m/d-j)	15b. Country of last receipt / Pays de provenance	Certificate No. / N° de certificat	Date (y-m/d-j)	16. Pre-Convention date / d'acquisition
17. FOR CUSTOMS USE ONLY / RÉSERVE AUX DOUANES Bill of Lading Air Waybill no. / Numéro total de lettres expéditives Customs Endorsement / Validation par les douanes Block / Section Section / Quantité A B C				18. THIS PERMIT/CERTIFICATE IS ISSUED BY / CE PERMIS OU CERTIFICAT EST DÉLIVRÉ PAR Holly Gaudet Name / Nom 2019/05/07 Date of issue / Date de délivrance (y-m/d-j)		
Stamp / Estampille Signature of Issuing Officer / Signature de l'agent inspecteur				 Management Authority Stamp / Estampille de l'organe de gestion		
This permit/certificate is issued under the authority of the Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act / Ce permis/certificat est délivré en vertu de la Loi sur la protection d'espèces animales et végétales sauvages et la réglementation de leur commerce international et interprovincial.						

**6.8 Appendix J:** Dive summary forms for all ROV dives completed during the expedition.

**Dive 1**

<p>General Location Map</p>	
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Gully Canyon</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

**ROV Dive Name**

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE01</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	The ROV had trouble purging air from the suction sampler hose on descent, and as a result lost roughly 10 minutes on the way down. There were no other equipment issues.		
ROV Dive Summary Data (from Processed ROV)	<p>In Water: 2019-08-29T16:38:31.205285 43°, 54.093' N ; 58°, 56.454' W</p> <p>On Bottom: 2019-08-29T17:57:06.310209 43°, 53.987' N ; 58°, 56.435' W</p> <p>Off Bottom: 2019-08-29T21:56:03.153147 43°, 54.106' N ; 58°, 56.381' W</p> <p>Out Water: 2019-08-29T22:39:26.881961 43°, 54.075' N ; 58°, 56.198' W</p> <p>Dive duration: 6:0:55</p> <p>Bottom Time: 3:58:56</p> <p>Max. depth: 1348.0 m</p>		
Special Notes	N/A		

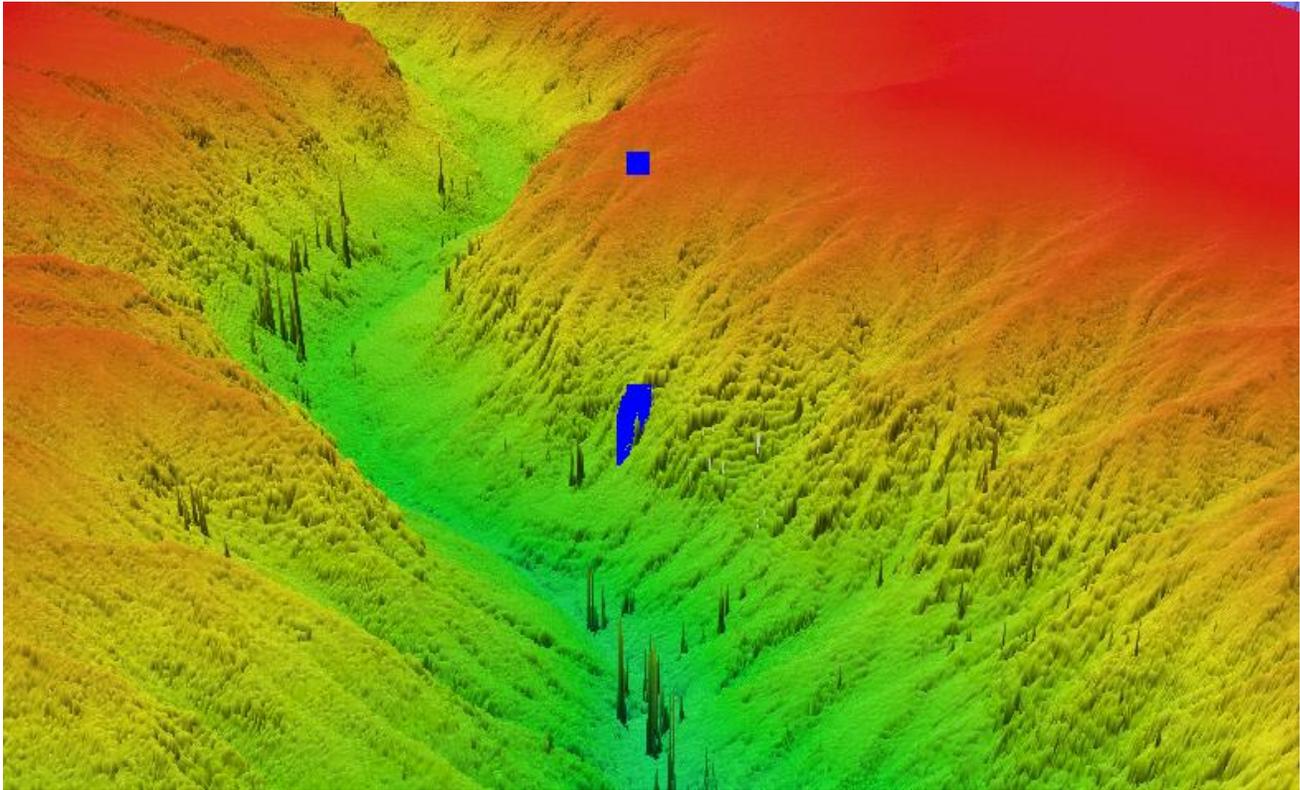
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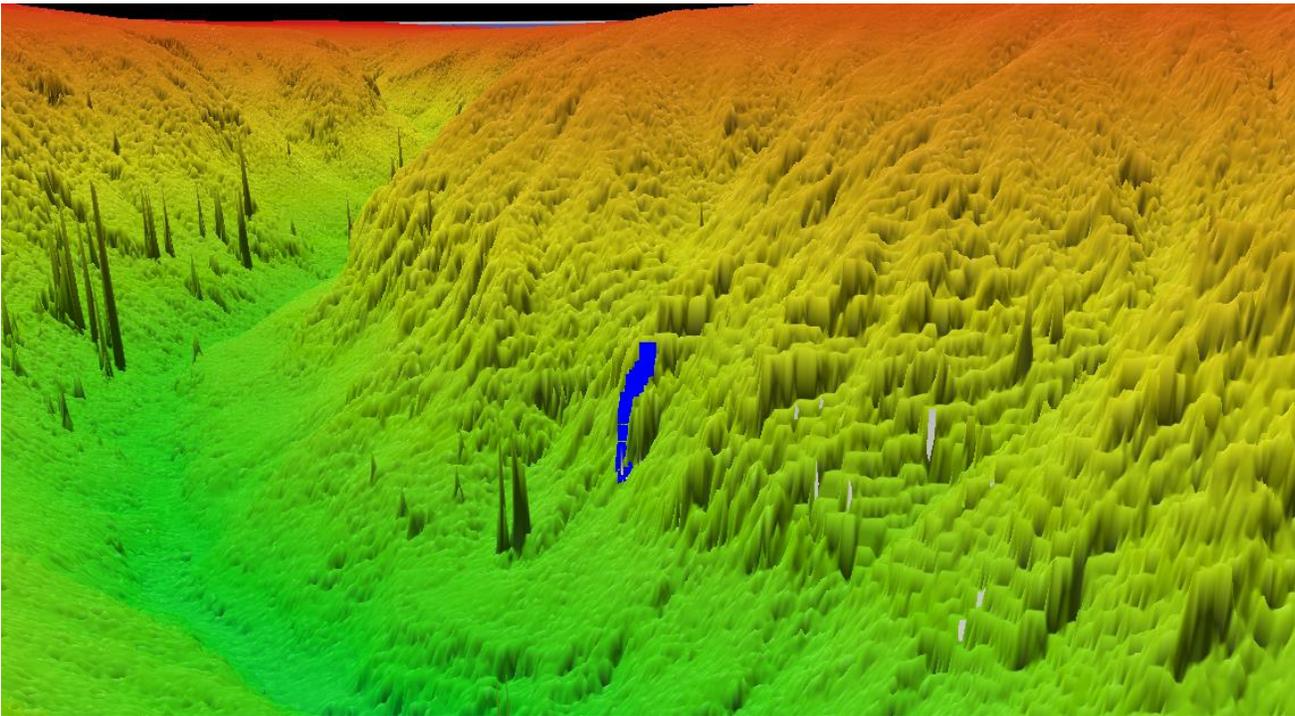
## Dive Purpose and Description

Dive Purpose	This dive was located within the Gully Marine Protected Area (MPA), which protects the largest submarine canyon in the Western North Atlantic. This productive environment is host to a number of protected fish and marine mammal species, and assessment of biodiversity is critical for effective MPA management. The dive was meant to explore the eastern wall of the Gully Canyon, which has never been surveyed with deep-sea submersibles. Additionally, this dive sought to document and collect several species of sponges and corals which are thought to be new to science. Furthermore, this dive sought to explore the recent geological activity of the canyon in the form of seabed ripples, fresh debris fields, and axial canyon incision.
Dive Description	Shortly after reaching the seafloor near the eastern canyon wall (1350 m), a large boulder was sighted, which was encrusted with sessile fauna, including bamboo corals ( <i>Keratoisis</i> sp.), anemones ( <i>Phorosoma placenta</i> ), soft corals ( <i>Anthomastus</i> sp.), and soloniferous corals ( <i>Hexadella</i> sp.). The transit up the eastern wall of the canyon began soon thereafter, but vigorous bottom currents made maneuvering and positioning of the ROV for photography difficult. Bamboo corals were observed in high abundance, which had not been documented during previous explorations on the western flank of the Gully Canyon. Two undescribed specimens of glass sponge were collected, a euplectellid vase sponge ( <i>Dictyaulus/Euplectella</i> ) and a ruffled sponge in the subfamily Corbitellinae. The canyon wall morphology was distinctive, with steep slopes and sheer cliffs in addition to slope parallel rills and abundant evidence of mass wasting. Several corals were also observed that were previously not recorded from this region, including a nodal branching bamboo coral and bubblegum coral ( <i>Paragorgia</i> ), which were collected as samples. The ROV left the seafloor at a final depth of approximately 1100 m, after having collected five total samples.
Notable Observations	<ul style="list-style-type: none"> <li>- Collected three specimens of sponges identified as high priority by Fisheries and Oceans Canada</li> <li>- Several corals observed that were not previously known from this region</li> <li>- Steep and rugose canyon wall topography, including slope parallel rills</li> </ul>
Community Presence/Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>☹ Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>☹ Active Seep or Vent</li> <li>☹ Extinct Seep or Vent</li> <li>☹ Hydrates</li> </ul>

**Overall Map of the ROV Dive Area**



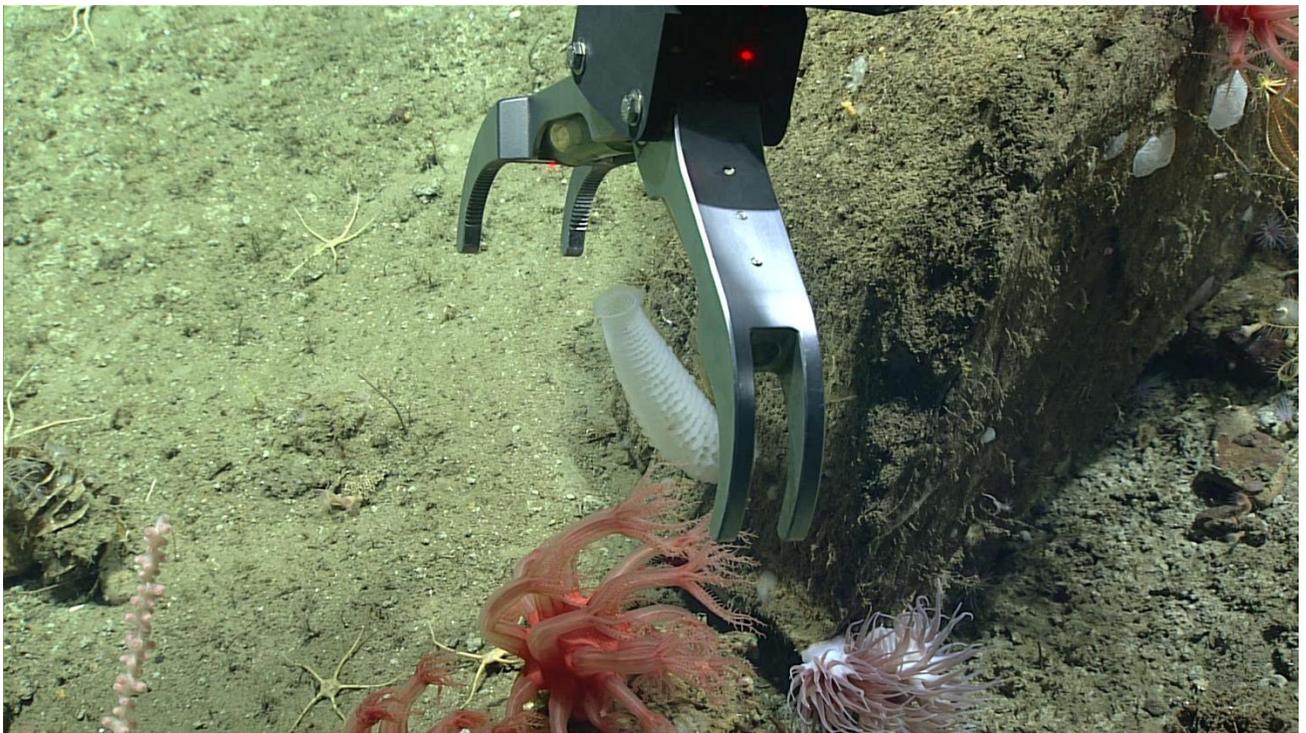
**Close-up Map of Main Dive Site**



## Representative Photos of the Dive



Large clast in proximity of east canyon wall encrusted with bamboo corals, mushroom corals, stoloniferous coral, crinoids, demosponges sponges, and anemones.



Sampling euplectellid vase glass sponge (*Dicytaulus/Euplectella*) which likely represents new species.



Slope parallel rills abundant on eastern canyon walls.



Dense deep-sea coral community on the eastern wall of Gully Canyon featuring an abundance of *Keratoisis* bamboo corals, parazoanthids, *Anthomastus* mushroom coral, and various invertebrate associates.

## Samples Collected



Sample ID	EX1905L2_D01_01B		
Date (UTC)	20190829		
Time (UTC)	184539		
Latitude	43.90010		
Longitude	-58.94060		
Depth (m)	1317.1		
Temp. (°C)	3.931		
Field ID(s)	<i>Dictyaulus</i> sp.		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D01_01B_A01	Decapoda shrimp white	2
Comments	N/A		



Sample ID	EX1905L2_D01_02B		
Date (UTC)	20190829		
Time (UTC)	190300		
Latitude	43.90020		
Longitude	-58.94070		
Depth (m)	1315.6		
Temp. (°C)	3.968		
Field ID(s)	<i>Paragorgia</i> sp.		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D01_02B_A01	Asteroschematidae	2
	EX1905L2_D01_02B_A02	Pycnogonidae	1
	EX1905L2_D01_02B_A03	Amphipoda	4
	EX1905L2_D01_02B_A04	Polychaeta	19



Sample ID	EX1905L2_D01_03B
Date (UTC)	20190829
Time (UTC)	193837
Latitude	43.90040
Longitude	-58.94060
Depth (m)	1294.1
Temp. (°C)	3.969
Field ID(s)	<i>Geodia barretti</i>
Commensals	No commensals
Comments	N/A

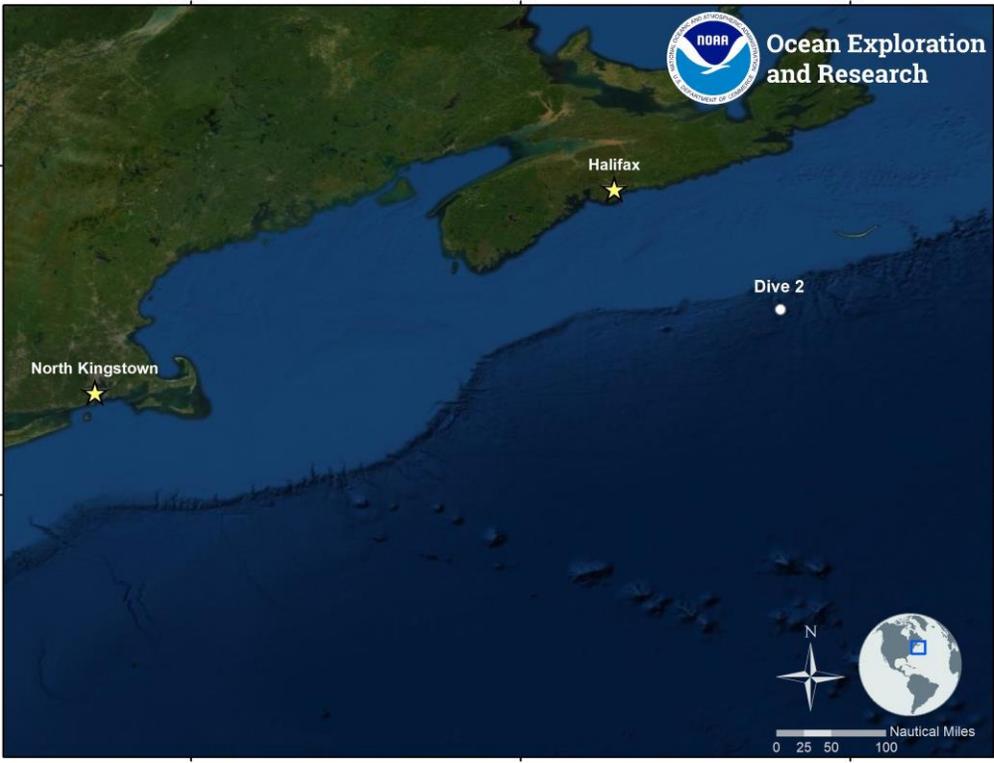


Sample ID	EX1905L2_D01_04B		
Date (UTC)	20190829		
Time (UTC)	205816		
Latitude	43.90120		
Longitude	-58.94020		
Depth (m)	1142.5		
Temp. (°C)	4.040		
Field ID(s)	Corbitellinae new genus		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D01_04B_A01	<i>Keratoisis</i> sp.	1
Comments	N/A		



Sample ID	EX1905L2_D01_05B		
Date (UTC)	20190829		
Time (UTC)	215415		
Latitude	43.90170		
Longitude	-58.93970		
Depth (m)	1084.9		
Temp. (°C)	4.131		
Field ID(s)	Keratoisidinae nodal		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D01_05B_A01	Mysida	1
	EX1905L2_D01_05B_A02	Decapoda shrimp	1
Comments	N/A		

## Dive 2

<p>General Location Map</p>	
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Verrill Steps</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE02</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	N/A		
ROV Dive Summary Data (from Processed ROV)	<p>In Water: 2019-08-30T14:25:08.171316 42°, 51.893' N ; 61°, 12.464' W</p> <p>On Bottom: 2019-08-30T15:56:59.103811 42°, 52.085' N ; 61°, 12.225' W</p> <p>Off Bottom: 2019-08-30T19:10:21.309162 42°, 52.183' N ; 61°, 12.434' W</p> <p>Out Water: 2019-08-30T20:37:14.988051 42°, 51.76' N ; 61°, 13.243' W</p> <p>Dive duration: 6:12:6</p> <p>Bottom Time: 3:13:22</p> <p>Max. depth: 2506.0 m</p>		
Special Notes	N/A		

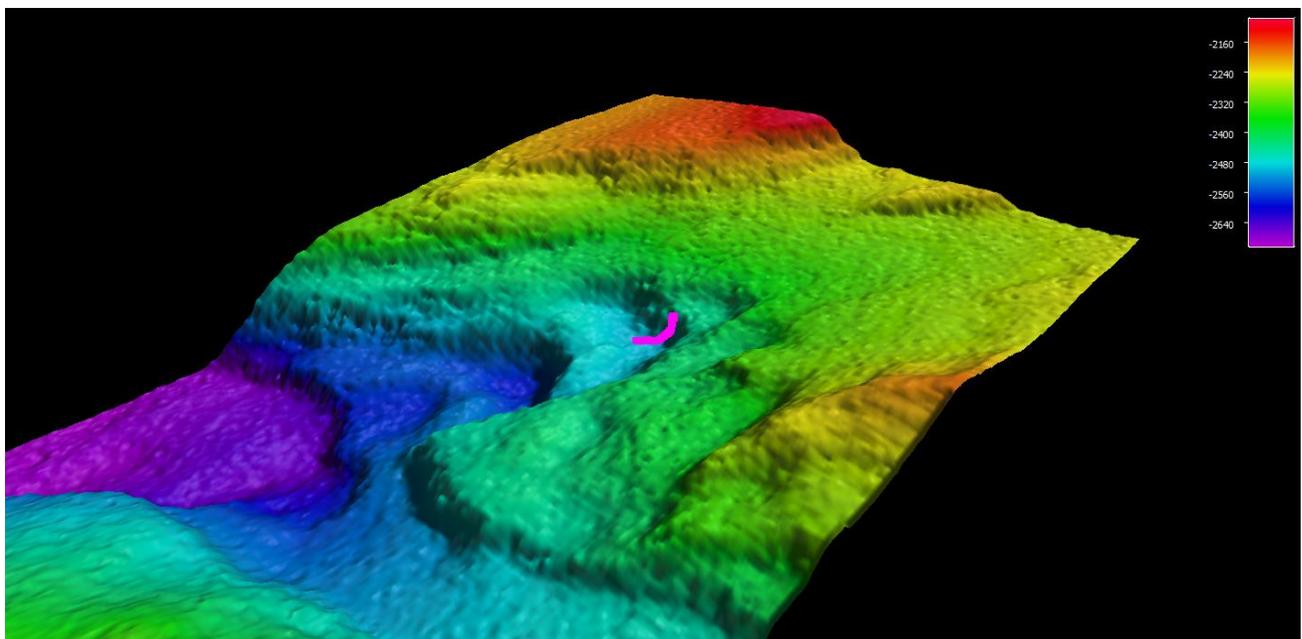
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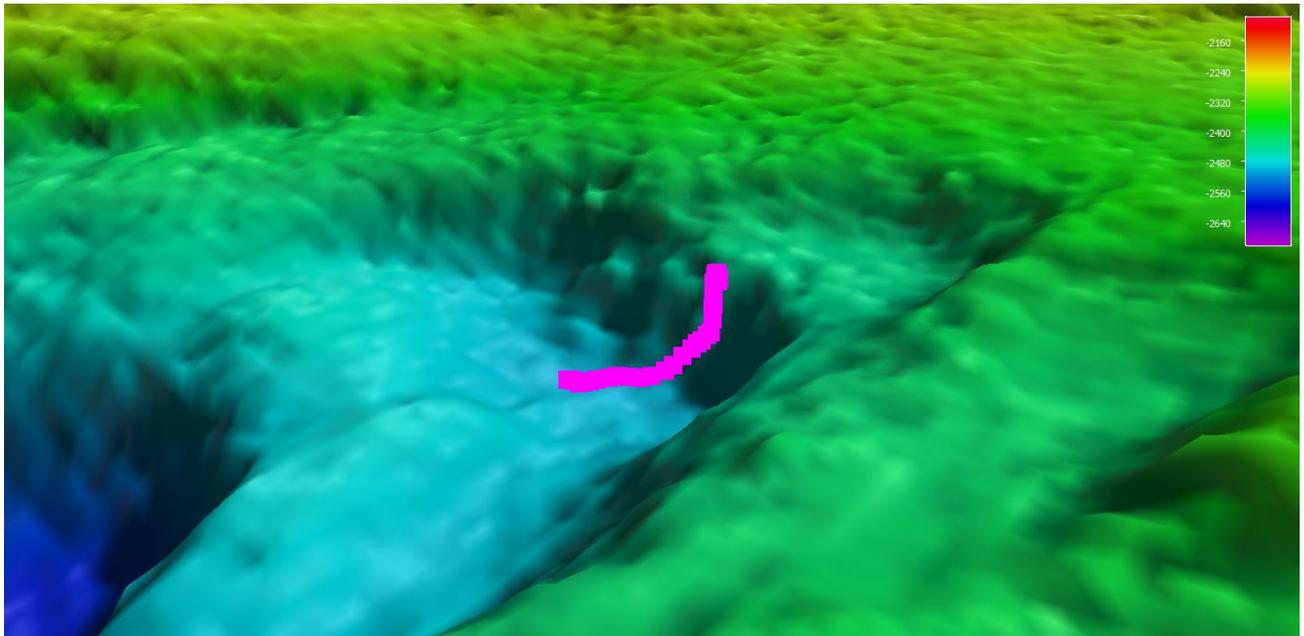
## Dive Purpose and Description

Dive Purpose	The purpose of this dive was to explore deeper depths (~2500 m) inside Verrill Canyon, which have not previously been surveyed. Specifically, this dive sought to explore step-like features of Verrill Canyon, thought to have been formed by turbidity currents; the steep relief between steps was expected to provide suitable habitat for deep-sea corals and sponges. The dive further sought to explore the geological setting of the steps, as well as survey and sample biological communities along them.
Dive Description	The start of Verrill Steps dive was delayed slightly due to rough weather in transit. Bottom was reached at approximately 1600 UTC. The flat bench we landed on was relatively unremarkable, characterized by fine grained, unconsolidated sediment and sparse benthos, including sea stars, sea pens and urchins. Human generated debris was also observed at various points in this area. At approximately 1730 UTC, the toe of the “step” was reached, where seafloor substrate shifted to boulders, cobbles, and debris mantled in fine grained sediment. Two large vase-like glass sponges were sampled from sheer step walls, Chonelasmatinae and Farriedae. Geological samples of interest were also obtained, including (1) an oblong, rounded, friable clast plucked from the steep face of a step, believed to be a chemical concretion, and (2) a flattened cylinder-shaped clast believed to be precipitate from subsurface fluid flow, exiting the canyon wall.
Notable Observations	<ul style="list-style-type: none"> <li>- Fine grained, soft sediment on top of step, combination of sheer walls and fine grained sediment on face of step</li> <li>- Two possible new species of sponges or known species in a new geographical range</li> <li>- Geological samples of various chemical precipitates</li> </ul>
Community Presence/Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>🚫 Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>🚫 Active Seep or Vent</li> <li>🚫 Extinct Seep or Vent</li> <li>🚫 Hydrates</li> </ul>

## Overall Map of the ROV Dive Area



### Close-up Map of Main Dive Site



### Representative Photos of the Dive



Chonelasmata vase glass sponge anchored to sheer step face.



The toad fish *Chaunacops coloratus* swimming through the water column after first observed on the seabed.



Cementation nodule in step face being sampled during the dive.

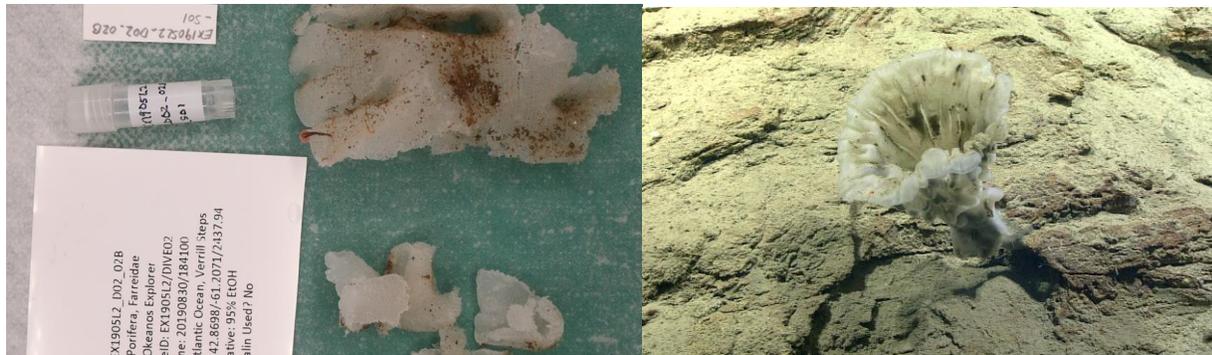


Pipe-like fluid channels on step face. One of these was sampled.

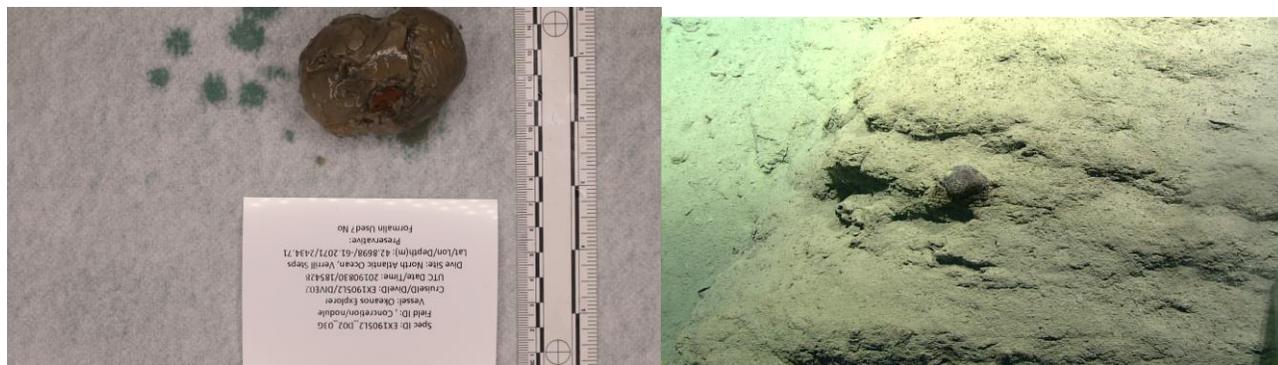
## Samples Collected



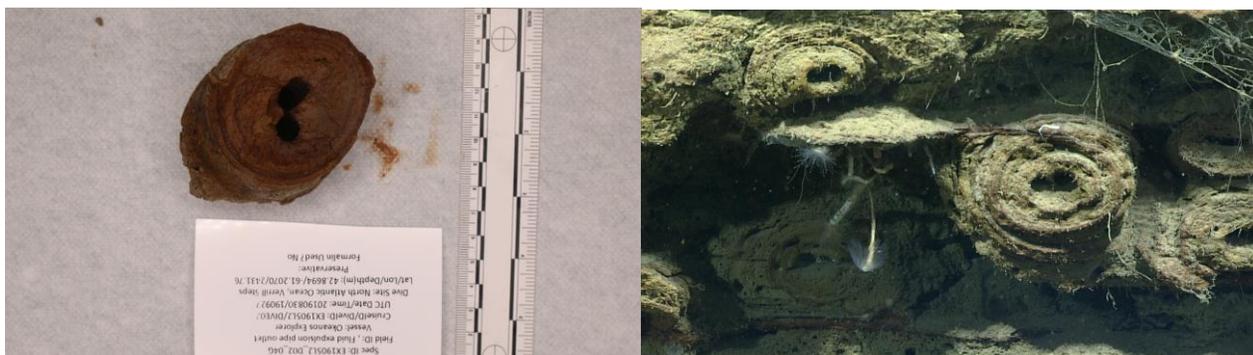
Sample ID	EX1905L2_D02_01B		
Date (UTC)	20190830		
Time (UTC)	181816		
Latitude	42.86980		
Longitude	-61.20690		
Depth (m)	2447.6		
Temp. (°C)	3.062		
Field ID(s)	Chonelasmatinae		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D02_01B_A01	Aplacophora	4
Comments	N/A		



Sample ID	EX1905L2_D02_02B		
Date (UTC)	20190830		
Time (UTC)	184100		
Latitude	42.86980		
Longitude	-61.20710		
Depth (m)	2437.9		
Temp. (°C)	3.059		
Field ID(s)	Farreidae		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D02_02B_A01	Tubularidae	1
Comments	N/A		



Sample ID	EX1905L2_D02_03G		
Date (UTC)	20190830		
Time (UTC)	185428		
Latitude	42.86980		
Longitude	-61.20710		
Depth (m)	2434.7		
Temp. (°C)	3.058		
Field ID(s)	Concretion/nodule		
Commensals	No commensals		
Comments	N/A		



Sample ID	EX1905L2_D02_04G
Date (UTC)	20190830
Time (UTC)	19027
Latitude	42.86940
Longitude	-61.20700
Depth (m)	2431.8
Temp. ( °C)	3.064
Field ID(s)	Fluid expulsion pipe outlet
Commensals	No commensals
Comments	N/A

## Dive 3

<p>General Location Map</p>	
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p><i>"Vazella Sponge Grounds"</i></p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE03</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	The ROV descent was paused for approximately 10 minutes during the descent to 50 m in order to reset the Phins positions system. There were no other equipment issues on this dive.		
ROV Dive Summary Data (from Processed ROV)	In Water: 2019-08-31T13:06:05.036112 42°, 40.818' N ; 64°, 13.001' W On Bottom: 2019-08-31T14:12:48.648982 42°, 40.953' N ; 64°, 13.174' W Off Bottom: 2019-08-31T20:06:54.363090 42°, 41.674' N ; 64°, 13.355' W Out Water: 2019-08-31T20:32:55.490651 42°, 41.718' N ; 64°, 13.635' W Dive duration: 7:26:50 Bottom Time: 5:54:5 Max. depth: 360.0 m		
Special Notes	N/A		

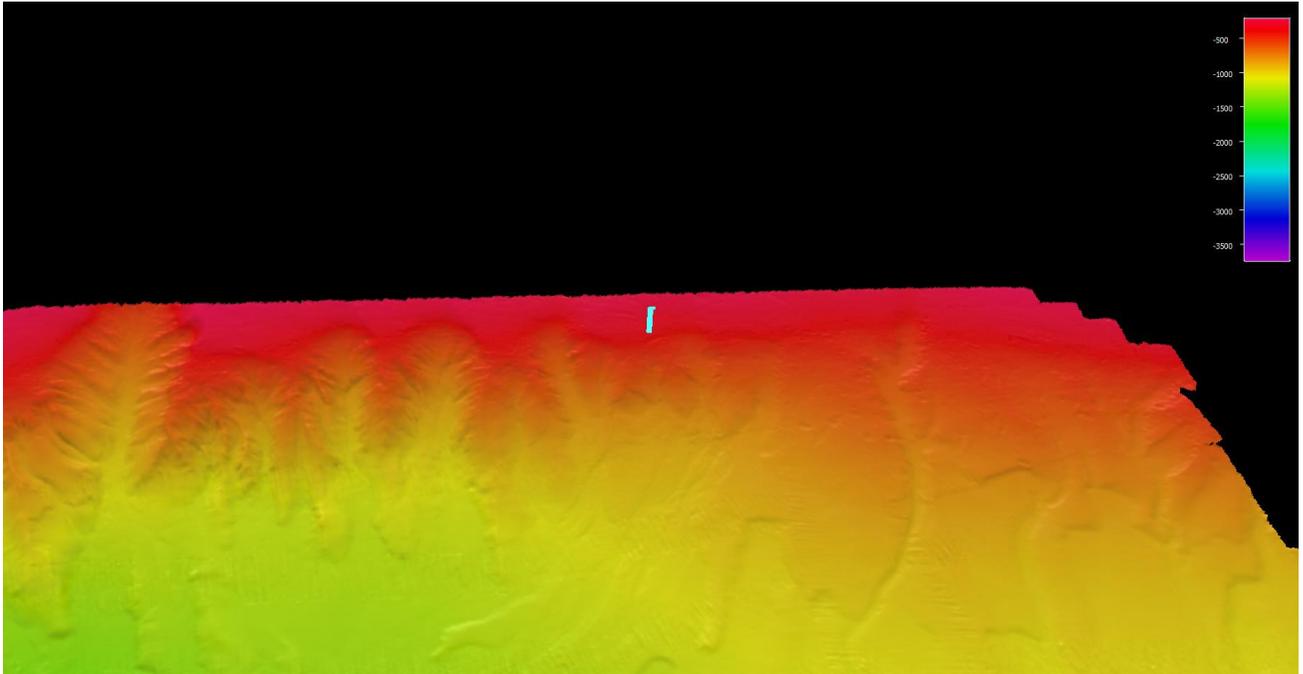
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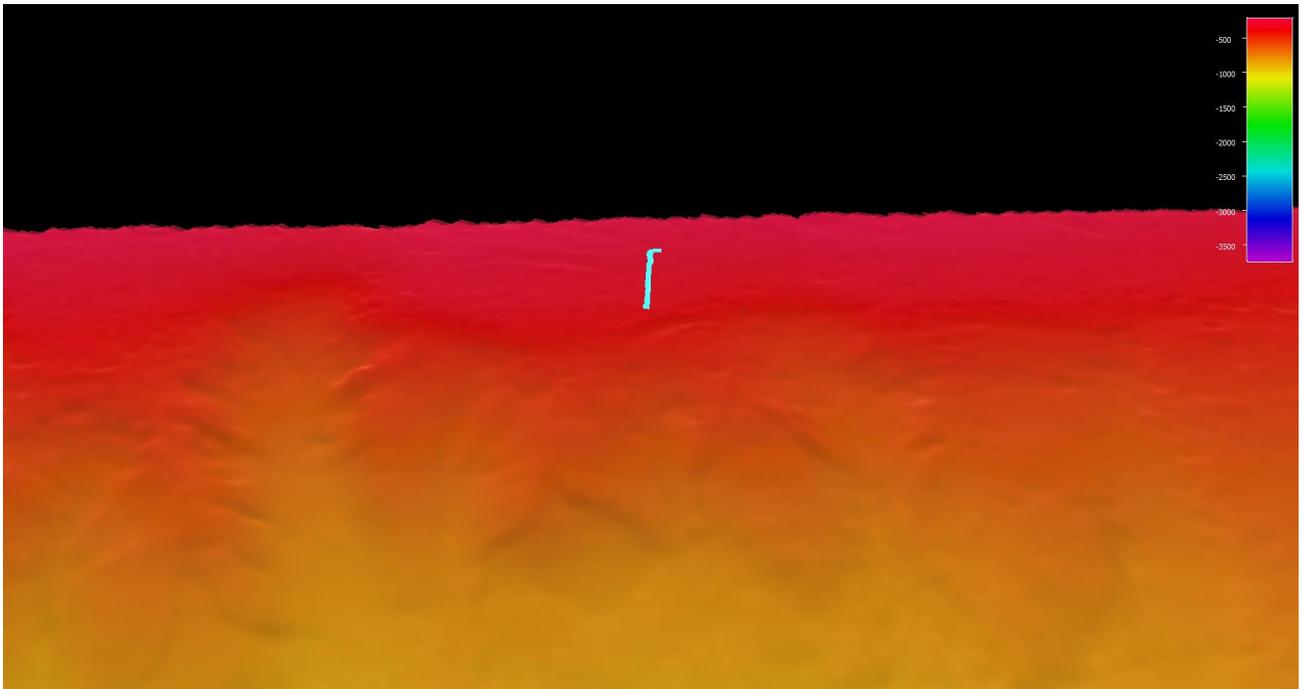
## Dive Purpose and Description

Dive Purpose	This location on the Scotian Shelf was predicted to have high habitat suitability for <i>Vazella</i> sponges by models. This dive sought to test those habitat suitability models and add data (presence or absence) for future model iterations.
Dive Description	The dive reached the seafloor at approximately 360 m depth on soft substrate that characterized the majority of the dive. Benthic fauna included abundant sea pens, fishes, polychaete worms, anemones, and crabs. Sparse clasts were observed among the predominantly fine sediment, which were tentatively interpreted to be ice rafted debris. A large group of shortfin squid ( <i>Illex illecebrosus</i> ) were present during the majority of the dive, apparently attracted by the ROV lights. The squid fed on swarms of krill, <i>Meganytiphanes norvegica</i> , and the illuminated benthic fauna. Numerous predation events were observed throughout the dive, including (1) squid feeding on krill, squid, and various fish, (2) an anemone feeding on a fish, and (3) a <i>Homarus</i> sp. lobster feeding on a squid. Anemones and few sponges, an encrusting demosponge and <i>Hyalonema</i> sp. glass sponge, were present in the debris fields we transversed, but no <i>Vazella</i> specimens were observed during this dive. Two derelict lobster traps were spotted during the dive, which were encrusted with hydrozoans and anemones. A single suction sample was taken of a suspected foraminifera, and a squid sample was unintentionally collected because it was attached to the ROV.
Notable Observations	<ul style="list-style-type: none"> <li>- No <i>Vazella</i> sponges were recorded on this dive</li> <li>- Abundant sea pens and squid</li> <li>- Predominantly soft substrate</li> </ul>
Community Presence/Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>☹ Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>☹ Active Seep or Vent</li> <li>☹ Extinct Seep or Vent</li> <li>☹ Hydrates</li> </ul>

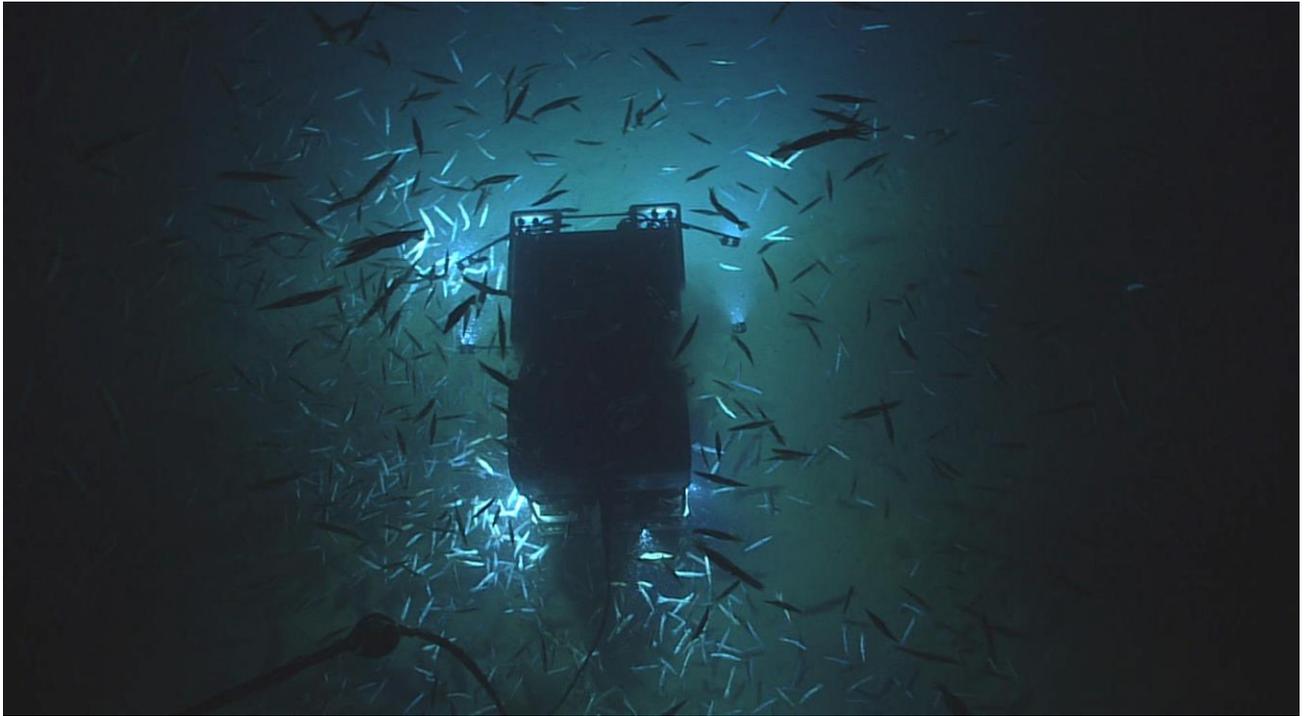
## Overall Map of the ROV Dive Area



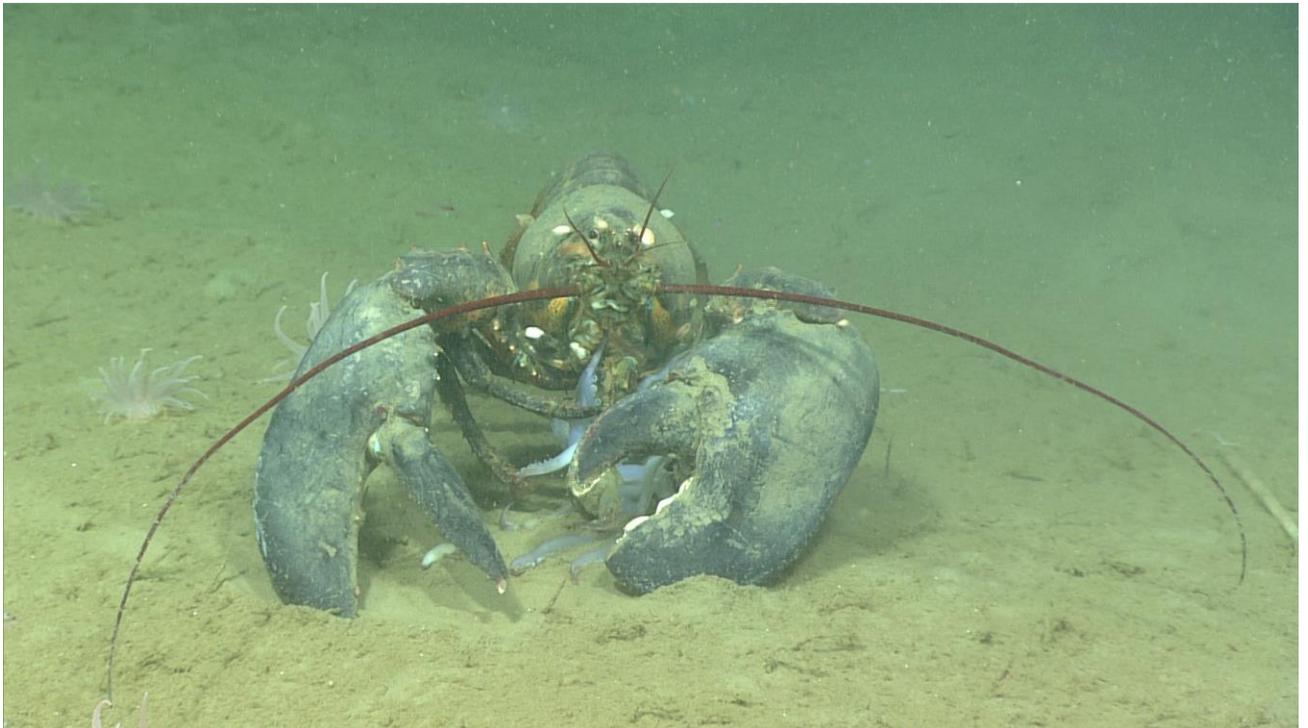
## Close-up Map of Main Dive Site



## Representative Photos of the Dive



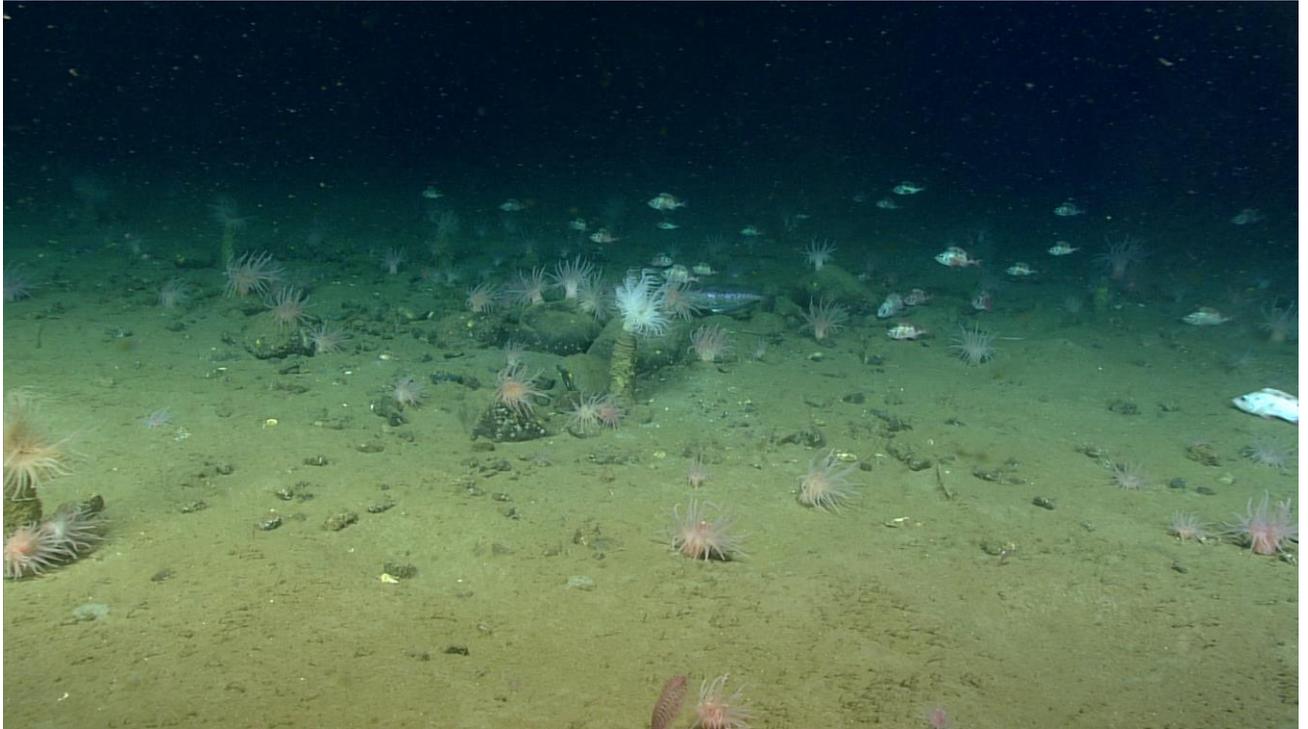
Swarms of the shortfin squid *Illex illecebrosus* feeding on the krill *Meganyctiphanes norvegica* during the descent of *Deep Discoverer* to the seafloor.



The lobster *Homarus* sp. feeding on a squid tentacle.

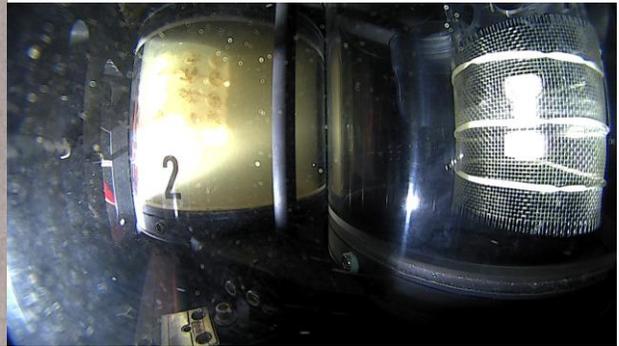


Derelict lobster trap covered with anemones, hydrozoans, and zoanthids.



Dense aggregation of anemones, blackbelly rosefish (*Helicolenus dactylopterus*), and seapens (*Pennatula* sp.) around a field of glacial dropstones.

## Samples Collected



Sample ID	EX1905L2_D03_01B
Date (UTC)	20190831
Time (UTC)	144248
Latitude	42.68270
Longitude	-64.21980
Depth (m)	356.6
Temp. (°C)	8.305
Field ID(s)	Foraminifera?
Commensals	No commensals
Comments	N/A



Sample ID	EX1905L2_D03_02B
Date (UTC)	20190831
Time (UTC)	210000
Latitude	42.69564
Longitude	-64.22597
Depth (m)	surface
Temp. (°C)	N/A
Field ID(s)	<i>Illex illecebrosus</i>
Commensals	No commensals
Comments	Unintentional sample, came up with ROV

## Dive 4

<p>General Location Map</p>	
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Northeast Channel</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE04</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	N/A		
ROV Dive Summary Data (from Processed ROV)	In Water: 2019-09-01T12:28:18.227840 41°, 59.026' N ; 65°, 22.896' W On Bottom: 2019-09-01T13:46:07.553405 41°, 59.029' N ; 65°, 22.525' W Off Bottom: 2019-09-01T19:38:01.942448 41°, 59.41' N ; 65°, 22.654' W Out Water: 2019-09-01T20:36:45.076804 41°, 59.73' N ; 65°, 22.108' W Dive duration: 8:8:26 Bottom Time: 5:51:54 Max. depth: 1496.0 m		
Special Notes	N/A		

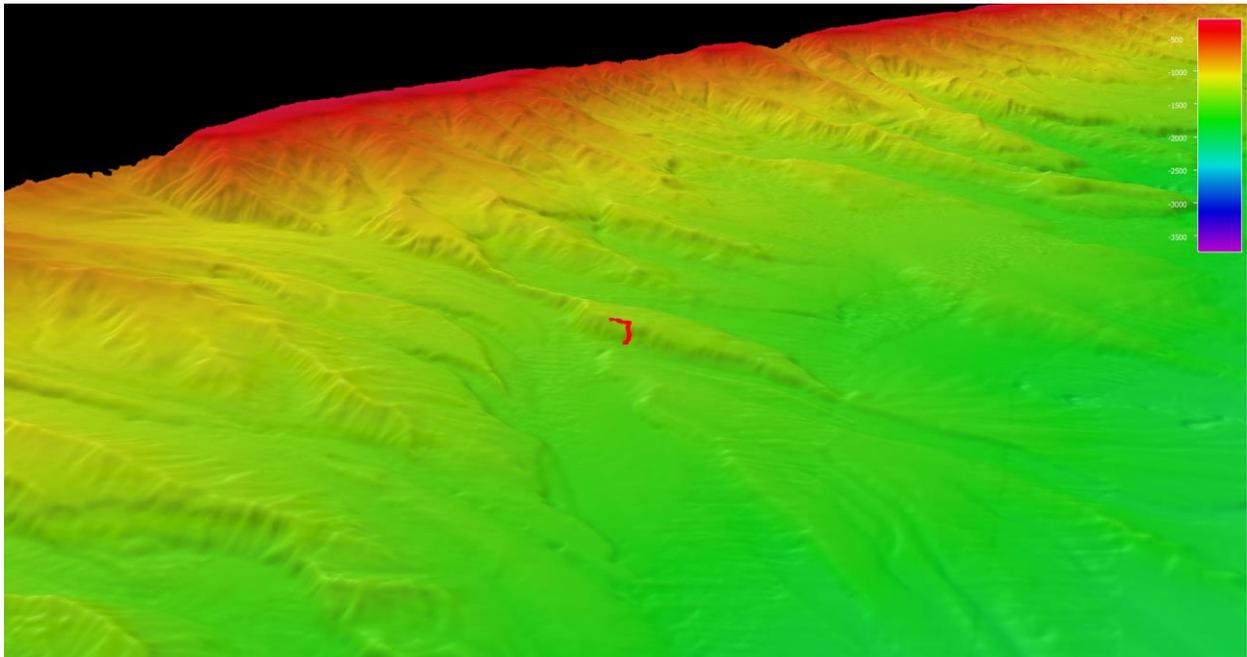
## Scientists Involved

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Tina Molodtsova	P. P. Shirshov Institute of Oceanology	tina@ocean.ru
Veerle Huvenne	National Oceanography Centre	vaih@noc.ac.uk

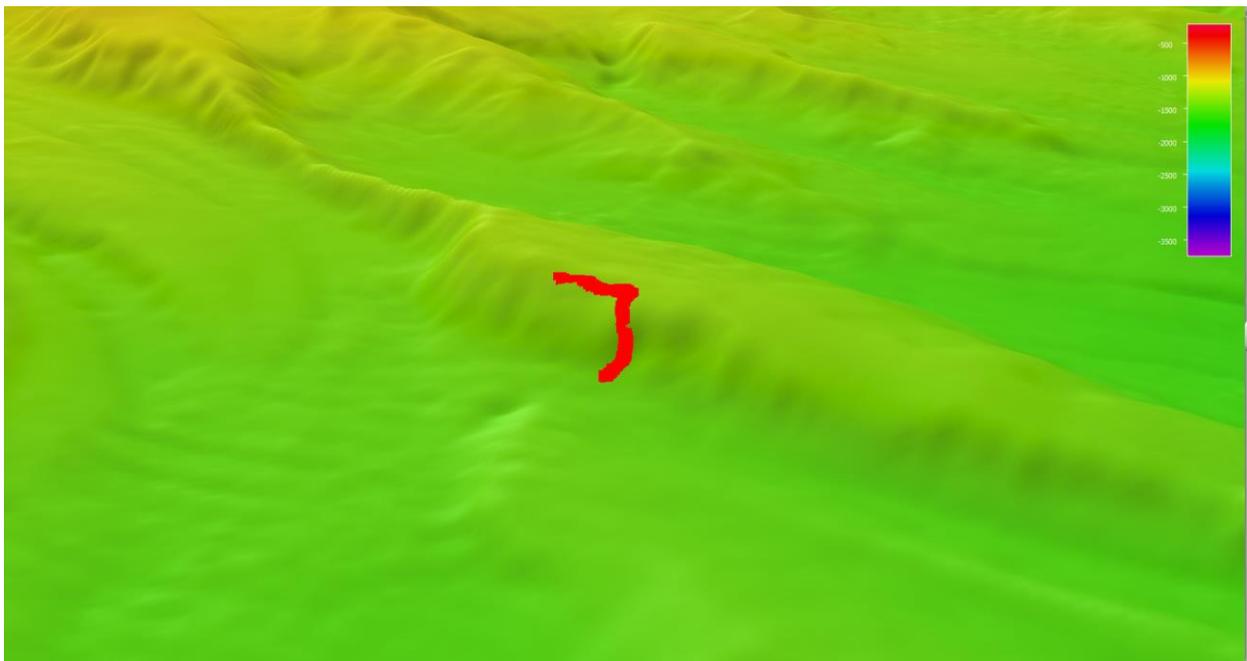
## Dive Purpose and Description

Dive Purpose	The Northeast Channel dive site was located immediately proximal to the Northeast Channel Coral Conservation Area, designed to protect deep-water coral and sponge communities from bottom contact fishing. The purpose of the dive was to characterize the deep-sea benthic community inside this current area of interest, which is under consideration for expansion of the protected area. Furthermore, the dive sought to investigate the geological origins of this site, presumed to be composed of glacial trough mouth fan materials.
Dive Description	The ROV reached the seafloor on a relatively flat, soft substrate adjacent to the submarine plateau slope we targeted for the dive. This area was characterized by the presence of halosaur ( <i>Aldrovandia gracilis</i> ), bamboo corals ( <i>Acanella arbuscula</i> ), sabellid polychaete tube worms, xenophyphores ( <i>Syringammia</i> sp.), and lantern sharks ( <i>Centroscymnus</i> sp.). This community was significantly different than that seen at shallower depths during the dive, despite similar substrate and slope. The toe of the slope was reached and ascent began, with a noted difference in bottom type from almost exclusively fine grained sediment to interspersed fine grained mantle with poorly sorted grains and debris ranging from silt sized to cobbles. The benthic community also shifted with slope and substrate, changing to a higher frequency of soft corals and small sponges. A small juvenile fish was spotted, ~1 cm in length, which is thought to be a juvenile sculpin or toadfish. Shortly after, a fathead sculpin ( <i>Cottunculus</i> sp.), a fish in the same family as the blobfish, was observed resting on the bottom. The crest of the plateau was reached and the community shifted mostly back to that seen in the submarine channel axis at the start of the dive. Four biological samples were collected: a <i>Hyalonema</i> sp. glass sponge, a <i>Phakellia</i> sp.? demosponge with at least 11 distinct species of associates, <i>Paragoria</i> sp. with a euryalid associate, and small round demosponges.
Notable Observations	<ul style="list-style-type: none"> <li>- Relatively steep slopes surficially composed of poorly sorted sediment and hemipelagic drape</li> <li>- Sparse observations of bamboo corals, bubblegum corals, and glass sponges</li> </ul>
Community Presence/Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>☹ Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>☹ Active Seep or Vent</li> <li>☹ Extinct Seep or Vent</li> <li>☹ Hydrates</li> </ul>

## Overall Map of the ROV Dive Area



## Close-up Map of Main Dive Site



## Representative Photos of the Dive



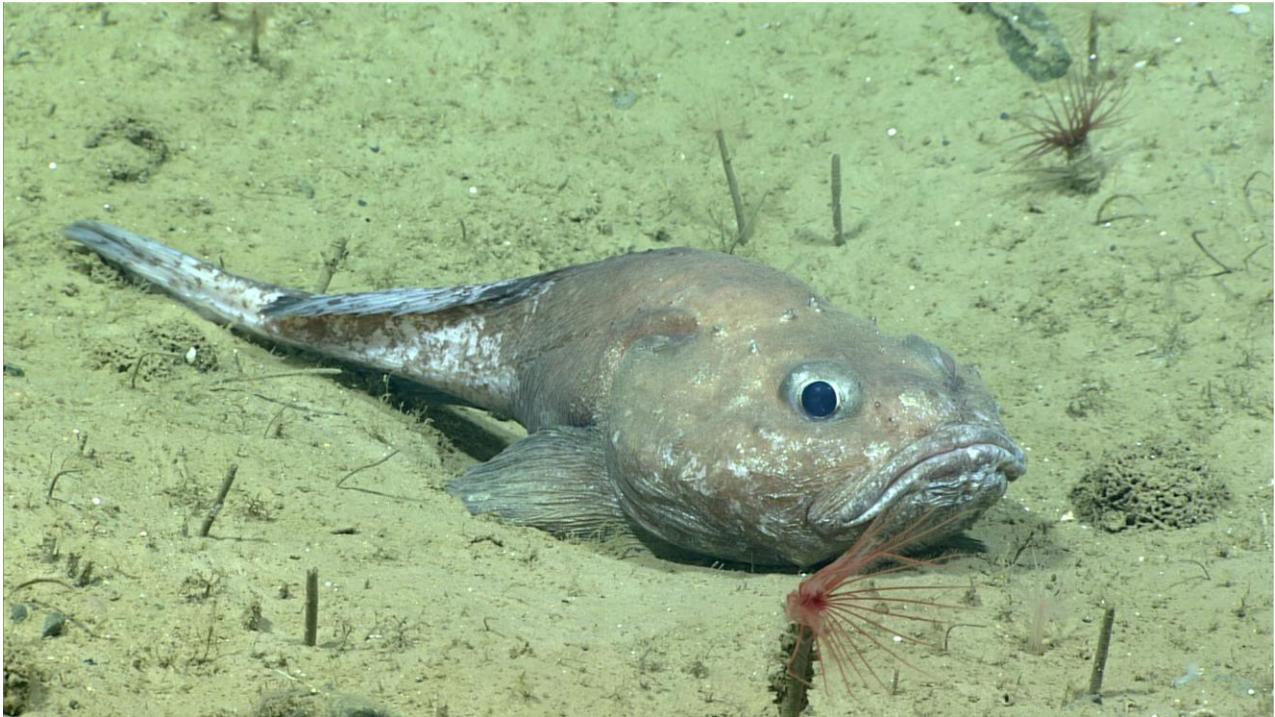
Ruffled glass sponge, *Asconema foliata*, on dropstone at the Northern Channel dive site located just outside an area of interest for deep-coral and sponge conservation.



Mated pair of deep-sea red crabs, *Chaceon quinquidens*.

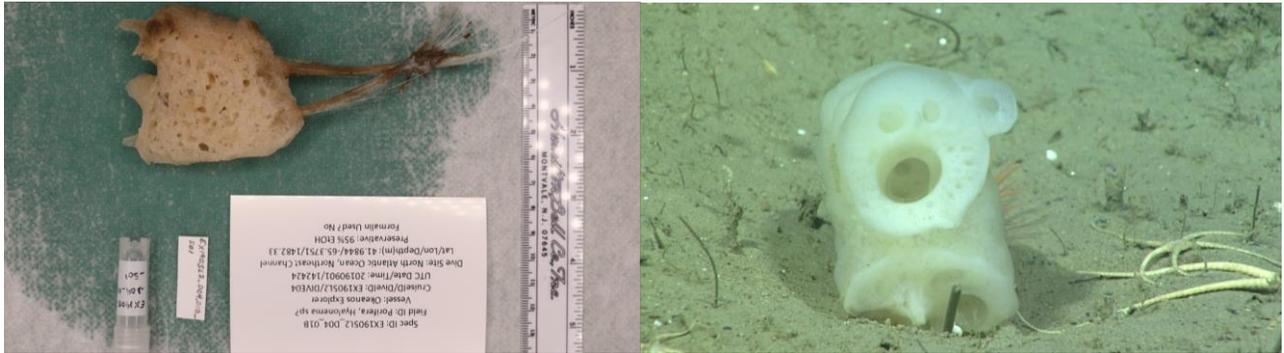


Large boulder, possibly a glacial dropstone, heavily encrusted with *Anthomastus* sp. mushroom corals, glass sponges and demosponges. A female octopus, *Granelodonne* sp., gently cares for her brood of eggs on the underside of the boulder.



A fathead sculpin, *Cottunculus* sp., was spotted resting on the soft sediment bottom. This fish is in the same family as the blobfish.

## Samples Collected



Sample ID	EX1905L2_D04_01B
Date (UTC)	20190901
Time (UTC)	142424
Latitude	41.98440
Longitude	-65.37510
Depth (m)	1482.3
Temp. (°C)	3.858
Field ID(s)	<i>Hyalonema</i> sp.?
Commensals	No commensals
Comments	N/A

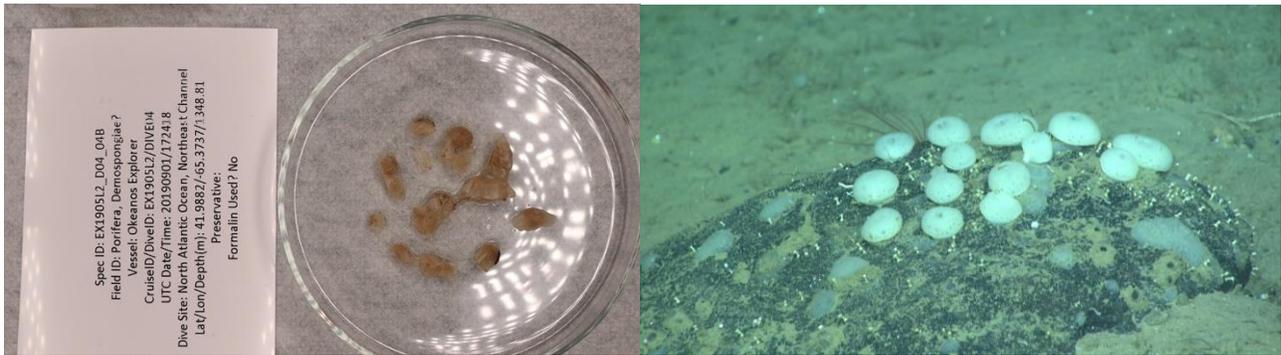


Sample ID	EX1905L2_D04_02B												
Date (UTC)	20190901												
Time (UTC)	145520												
Latitude	41.98500												
Longitude	-65.37370												
Depth (m)	1455.2												
Temp. (°C)	3.865												
Field ID(s)	<i>Phakelia</i> sp.?												
Commensals													
	<table border="1"> <thead> <tr> <th>Commensal Sample ID</th> <th>Field Identification</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>EX1905L2_D04_02B_A01</td> <td>Slate</td> <td>1</td> </tr> <tr> <td>EX1905L2_D04_02B_A02</td> <td>Isopoda</td> <td>40</td> </tr> <tr> <td>EX1905L2_D04_02B_A03</td> <td>Ophiacanthidae</td> <td>3</td> </tr> </tbody> </table>	Commensal Sample ID	Field Identification	Count	EX1905L2_D04_02B_A01	Slate	1	EX1905L2_D04_02B_A02	Isopoda	40	EX1905L2_D04_02B_A03	Ophiacanthidae	3
Commensal Sample ID	Field Identification	Count											
EX1905L2_D04_02B_A01	Slate	1											
EX1905L2_D04_02B_A02	Isopoda	40											
EX1905L2_D04_02B_A03	Ophiacanthidae	3											

	EX1905L2_D04_02B_A04	Gastropoda	2
	EX1905L2_D04_02B_A05	Polychaeta	1
	EX1905L2_D04_02B_A06	Polychaeta red	1
	EX1905L2_D04_02B_A07	Sipunculida	3
	EX1905L2_D04_02B_A08	Tubularidae	1
	EX1905L2_D04_02B_A09	Amphipoda A	2
	EX1905L2_D04_02B_A10	Amphipoda B	6
	EX1905L2_D04_02B_A11	Amphipoda C	4
	EX1905L2_D04_02B_A12	Isopoda	2
Comments	N/A		



Sample ID	EX1905L2_D04_03B		
Date (UTC)	20190901		
Time (UTC)	160615		
Latitude	41.98670		
Longitude	-65.37370		
Depth (m)	1378.3		
Temp. (°C)	3.899		
Field ID(s)	<i>Paragorgia</i> sp.		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D04_03B_A01	Euryalida	1
	EX1905L2_D04_03B_A02	Polychaeta	1
Comments	N/A		



Sample ID	EX1905L2_D04_04B		
Date (UTC)	20190901		
Time (UTC)	172418		
Latitude	41.98820		
Longitude	-65.37370		
Depth (m)	1348.8		
Temp. ( °C)	3.896		
Field ID(s)	Demospongiae?		
Commensals			
	Commensal Sample ID	Field Identification	Count
	EX1905L2_D04_04B_A01	Mysida	3
Comments	N/A		

## Dive 5

<p>General Location Map</p>	<p>The map displays the Atlantic Continental Margin from North Kingstown, Maine, to Halifax, Nova Scotia. A white dot labeled 'Dive 5' is located on the continental shelf. The NOAA logo and 'Ocean Exploration and Research' text are in the top right. A scale bar and a small globe are in the bottom right.</p>
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Unnamed Canyon</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE05</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	N/A		
ROV Dive Summary Data (from Processed ROV)	In Water: 2019-09-02T12:34:31.437175 40°, 54.483' N ; 66°, 30.327' W On Bottom: 2019-09-02T13:35:29.320403 40°, 54.343' N ; 66°, 30.028' W Off Bottom: 2019-09-02T20:10:47.070757 40°, 54.046' N ; 66°, 30.233' W Out Water: 2019-09-02T20:36:06.896178 40°, 53.906' N ; 66°, 30.061' W Dive duration: 8:1:35 Bottom Time: 6:35:17 Max. depth: 758.0 m		
Special Notes	N/A		

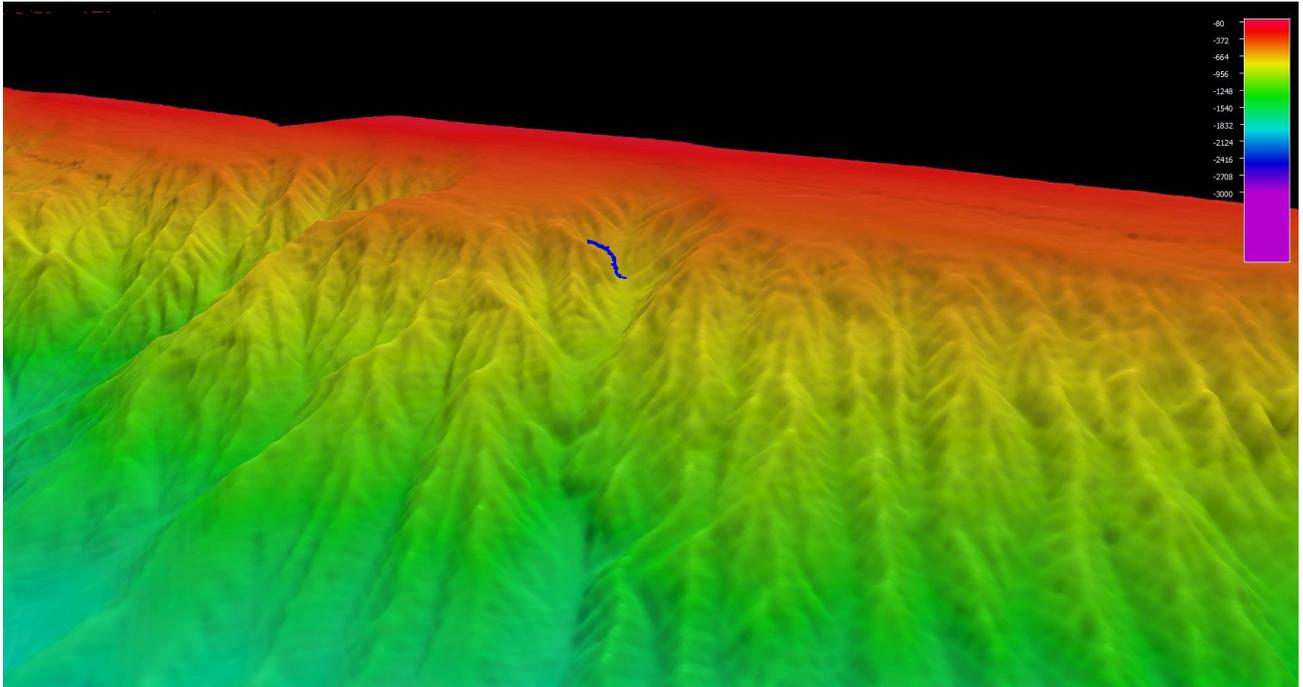
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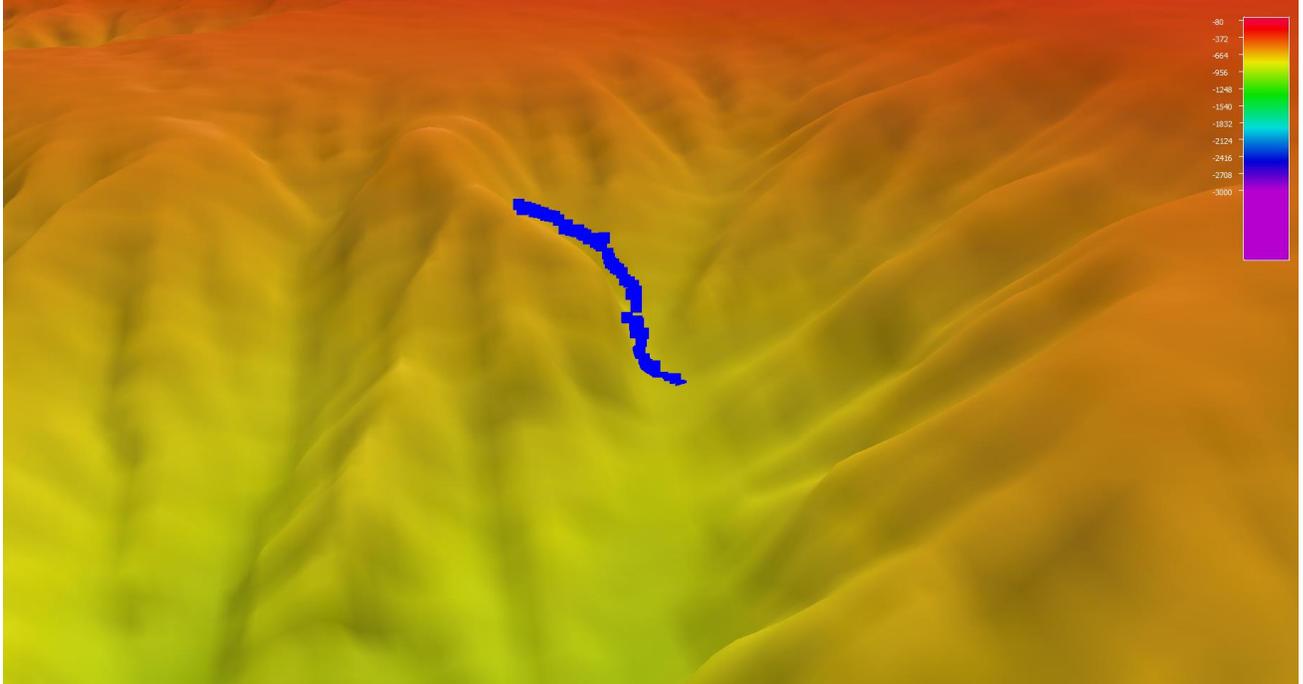
## Dive Purpose and Description

Dive Purpose	This unnamed canyon, as well as many nearby shelf-sourced minor canyons in this region have mostly been unexplored. Kinlan Canyon, located south of this unnamed canyon, is known to be suitable habitat for <i>Lophelia pertusa</i> coral communities. The planned dive track was designed to cross the canyon axis and thereby sought to assess the geologically recent sediment transport history of the canyon, as well as investigate the benthic communities of the area.
Dive Description	<i>Deep Discoverer</i> landed on the seafloor at approximately 1330 UTC proximal to the northern wall of the unnamed canyon axis. The current was relatively strong, likely in excess of 50 cm/s. The floor of the canyon was predominantly soft sediment, with a similar biological assemblage as that observed at the <i>Vazella</i> sponge grounds site, with quill worms ( <i>Hyalinocia tubicola</i> ), lantern sharks ( <i>Centrosymnus</i> sp.), schools of fin squid ( <i>Illex illecebrosus</i> ), and deep-sea red crabs ( <i>Chaceon quinquidens</i> ). Several clumps of <i>Lophelia pertusa</i> skeleton were observed in the axis of the canyon with sediment displaced around them, suggesting that they fell off the northern canyon wall. As we transversed the canyon axis, we observed abundant evidence for slope failure in the form of large boulders, which hosted sponges, <i>Desmophyllum</i> cup corals, yellow plexauid corals, and hormathiid anemones. Upon reaching the southern wall of the canyon, where our ascent path was planned, we discovered sheer walls of sandstone and limestone heavily encrusted with corals, sponges, and other invertebrates. Three large specimens of Atlantic Halibut ( <i>Hippoglossus hippoglossus</i> ) were observed, an endangered species. The planned ascent up the southern canyon wall was halted to clear a suspended fishing line, and abundant evidence of fishing gear was spotted along the bottom. Shortly after beginning our ascent along the wall, the canyon wall abruptly transitioned to a more mildly sloping, fine sediment environment similar to the Northeast Channel dive site. We collected four total samples: one krill ( <i>Meganytiphanes norvegica</i> ) that unintentionally swam into the suction tube chamber, a couple shrimp ( <i>Plesionika hotulssi</i> ) that was particularly abundant at this site, a siphonophore, and an <i>Acanthogorgia</i> sp. coral.
Notable Observations	<ul style="list-style-type: none"> <li>- Several specimens of the endangered Atlantic Halibut</li> <li>- High-density coral and sponge community on the sheer southern walls also heavily encrusted with other invertebrates (but no living <i>Lophelia pertusa</i>)</li> </ul>
Community Presence/ Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>☹ Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>☹ Active Seep or Vent</li> <li>☹ Extinct Seep or Vent</li> <li>☹ Hydrates</li> </ul>

## Overall Map of the ROV Dive Area



## Close-up Map of Main Dive Site



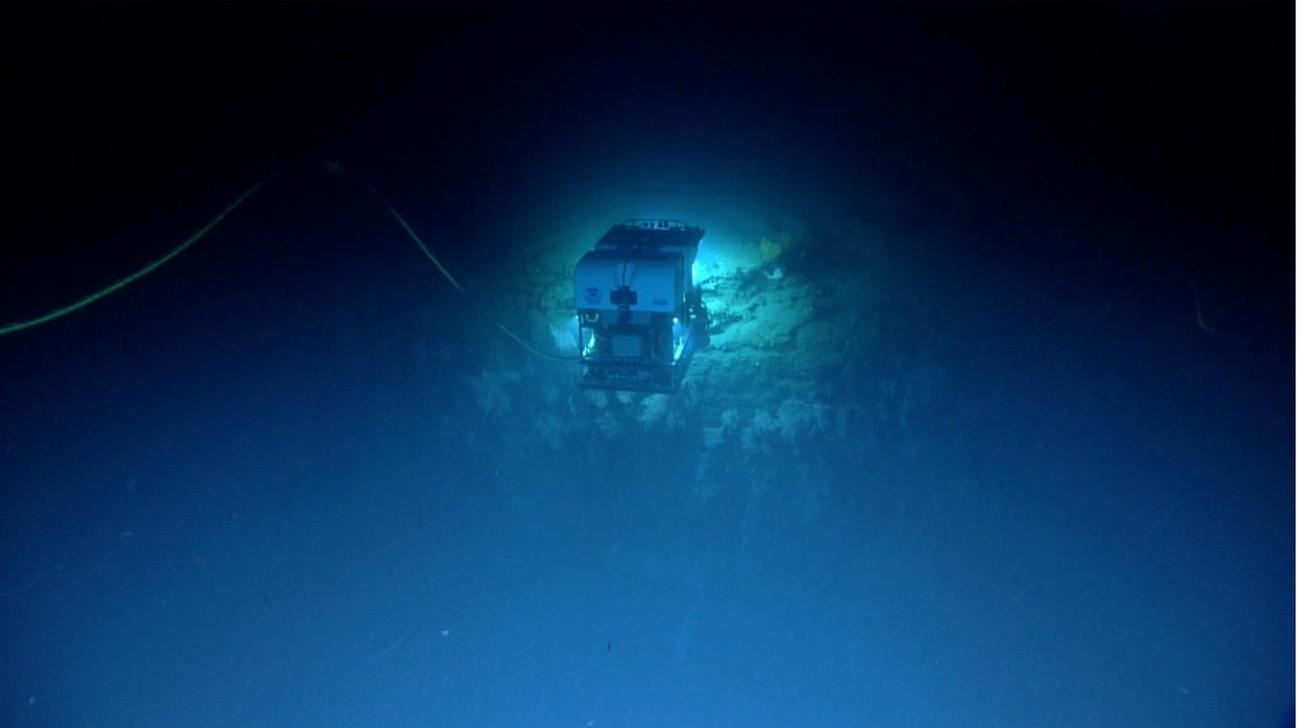
## Representative Photos of the Dive



Small bobtail squid (*Rossia* sp.) nestled between clumps of dead *Lophelia pertusa* in the canyon axis.



Dense deep-sea coral and sponge community observed on a sheer wall located on the southern slope of the unnamed canyon.

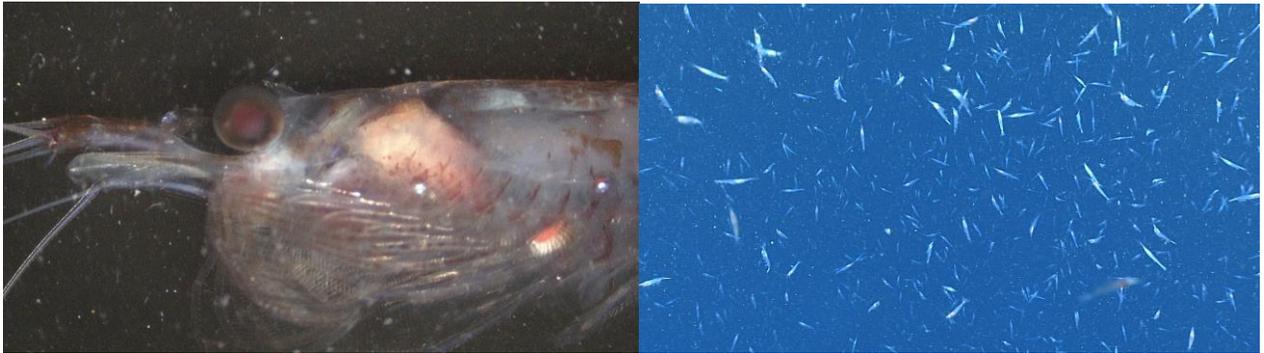


*Deep Discoverer* documenting the high-density community on the sheer wall face of the unnamed canyon.



Endangered Atlantic Halibut (*Hippoglossus hippoglossus*) observed resting on the sandy bottom.

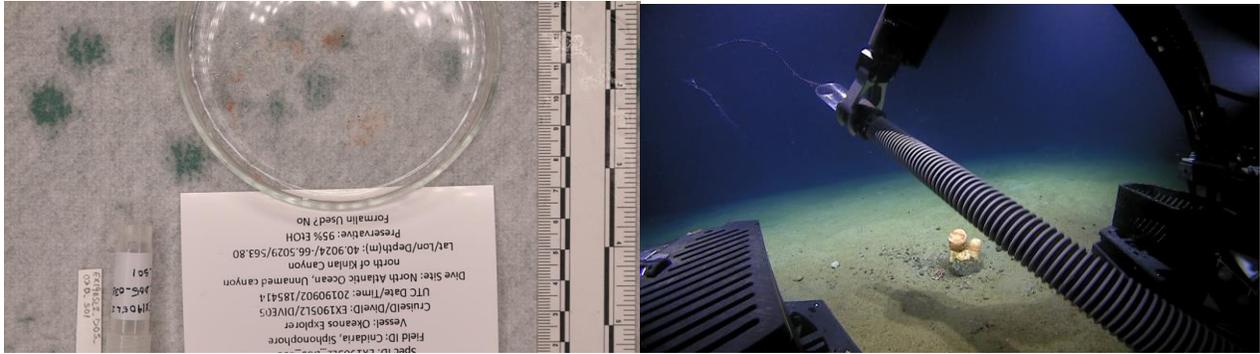
## Samples Collected



Sample ID	EX1905L2_D05_01B
Date (UTC)	20190902
Time (UTC)	140529
Latitude	40.90520
Longitude	-66.50120
Depth (m)	748.2
Temp. (°C)	5.118
Field ID(s)	Krill
Commensals	No commensals
Comments	Unintentional sample, swam into suction canister



Sample ID	EX1905L2_D05_02B		
Date (UTC)	20190902		
Time (UTC)	185125		
Latitude	40.90240		
Longitude	-66.50290		
Depth (m)	564.0		
Temp. (°C)	5.364		
Field ID(s)	Plesionika holthuisi		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D05_02B_A01	Hydroidolina	1
	EX1905L2_D05_02B_A02	Gastropoda	4
	EX1905L2_D05_02B_A03	Amphipoda	5
	EX1905L2_D05_02B_A04	Animalia	1
Comments	N/A		

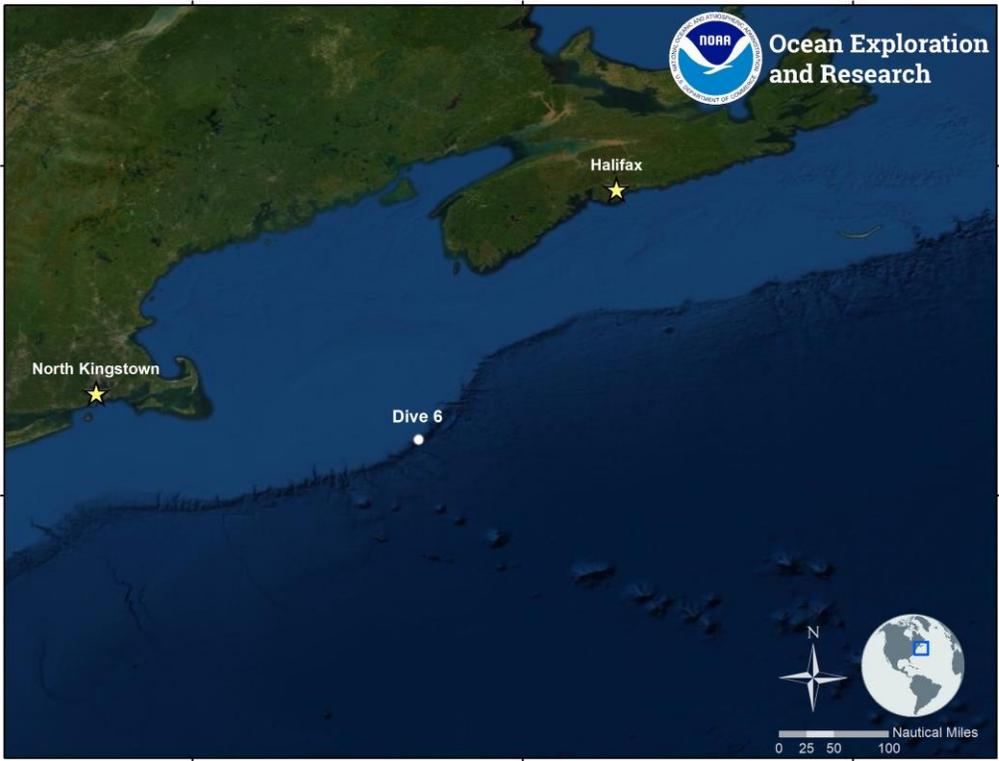


Sample ID	EX1905L2_D05_03B
Date (UTC)	20190902
Time (UTC)	185414
Latitude	40.90240
Longitude	-66.50290
Depth (m)	563.8
Temp. (°C)	5.391
Field ID(s)	Siphonophore
Commensals	No commensals
Comments	N/A



Sample ID	EX1905L2_D05_04B		
Date (UTC)	20190902		
Time (UTC)	194330		
Latitude	40.90120		
Longitude	-66.50340		
Depth (m)	540.7		
Temp. (°C)	5.390		
Field ID(s)	Acanthogorgia sp.		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D05_04B_A01	Polynoidae	1
	EX1905L2_D05_04B_A02	Amphipoda	2
Comments	N/A		

## Dive 6

<p>General Location Map</p>	
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Kinlan Canyon</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE06</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	N/A		
ROV Dive Summary Data (from Processed ROV)	In Water:	2019-09-03T14:26:02.717985 40°, 51.107' N ; 66°, 32.501' W	
	On Bottom:	2019-09-03T15:21:22.997190 40°, 51.01' N ; 66°, 32.52' W	
	Off Bottom:	2019-09-03T19:48:31.441119 40°, 51.206' N ; 66°, 32.38' W	
	Out Water:	2019-09-03T20:32:06.965881 40°, 50.805' N ; 66°, 32.5' W	
	Dive duration:	6:6:4	
	Bottom Time:	4:27:8	
	Max. depth:	1076.0 m	
Special Notes	N/A		

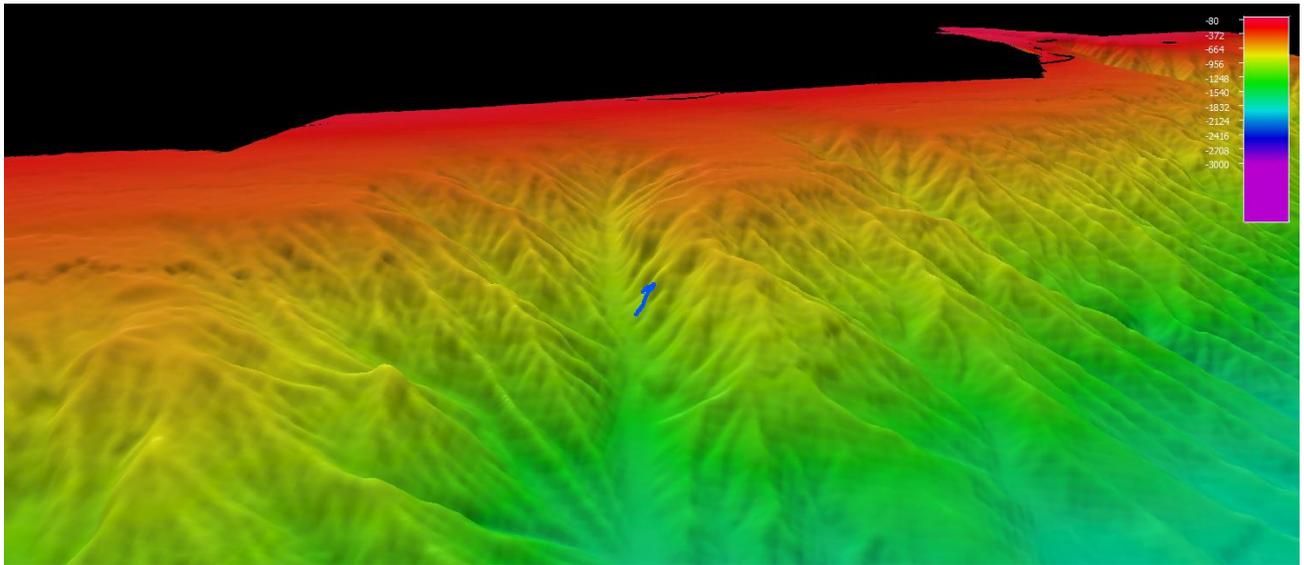
## Scientists Involved

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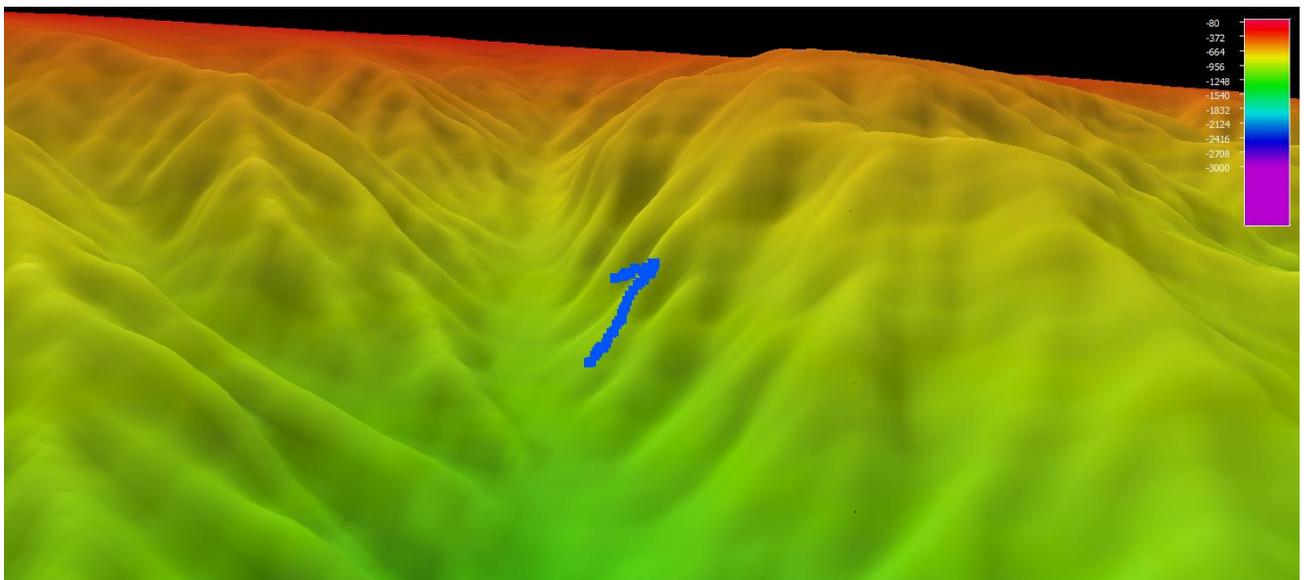
## Dive Purpose and Description

Dive Purpose	Two previous dives have been conducted in Kinlan Canyon, including a ROV <i>Deep Discoverer</i> dive in 2013 and a ROV <i>ROPOS</i> dive in 2017. Both of those dives documented communities of the reef-building coral <i>Lophelia pertusa</i> . The purpose of this dive was to assess the intra-canyon extent of <i>Lophelia pertusa</i> and other coral and sponge communities. This was also a tribute dive dedicated to the memory of Dr. Brian Kinlan, a former NOAA scientist who pioneered the use of predictive habitat suitability modeling for scientific exploration and conservation, after whom this canyon was named.
Dive Description	The ROV reached the seafloor at 1520 UTC; the substrate was soft with a community of fishes, such as cutthroat eels ( <i>Synaphobranchus gracilis</i> ) and long-finned hake ( <i>Phycis chesteri</i> ), as well as various invertebrates, including spiney “lobsterette” ( <i>Sabinea hystrix</i> ), short-finned squid ( <i>Illex illecebrosus</i> ), red crabs, and pancake urchins (Echinothruidae). The northern canyon wall was reached, but the landing point was slightly away from the planned one, so an adjustment was made to ascend the canyon wall on a ridge arm, instead of a gully. At approximately 1800 UTC, at ~1060 m water depth, the slope transitioned from relatively smooth, blanketed with fine grained sediments, to large boulders and cobbles encrusted with corals, sponges, and other invertebrates. This transitioned into sheer cliff walls of poorly sorted sandstone matrix, likely from the same geological formation as that observed at the base of the minor unnamed canyon on dive 5. We decided to transit along the canyon walls, so as to stay within the same geological unit and maximize our chances of observing <i>Lophelia pertusa</i> predicted to be within the canyon. The walls supported a dense deep-sea coral and sponge community consisting of stoloniferous octocorals, bamboo coral (Keratoisidnae), bubblegum coral ( <i>Paragorgia</i> ), stony corals ( <i>Lophelia pertusa</i> and other single polyp scleractinians), demosponges (both large colonies and encrusting Poeciloscerida), and glass sponges. Five total samples were obtained: Euplectellidae vase sponge, <i>Hertwigia</i> sp. glass sponge, yellow plate-like demosponge, <i>Geodia</i> sp. demosponge, and <i>Paragorgia</i> sp. bubblegum coral.
Notable Observations	<ul style="list-style-type: none"> <li>- Sheer cliff walls similar to those observed in the minor unnamed canyon on dive 5, at similar depths</li> <li>- <i>Lophelia pertusa</i> and numerous other corals</li> <li>- Potentially undescribed sponges collected during dive</li> </ul>
Community Presence/Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>☹ Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>☹ Active Seep or Vent</li> <li>☹ Extinct Seep or Vent</li> <li>☹ Hydrates</li> </ul>

### Overall Map of the ROV Dive Area



### Close-up Map of Main Dive Site



## Representative Photos of the Dive



Cutthroat eel (*Synaphobranchus gracilis*) with a large copepod parasite. The long yellow streamers are the reproductive structures of the copepod.



Grouping of flame scallops (*Acesta cryptadelphe*) on the wall of Kinlan Canyon.

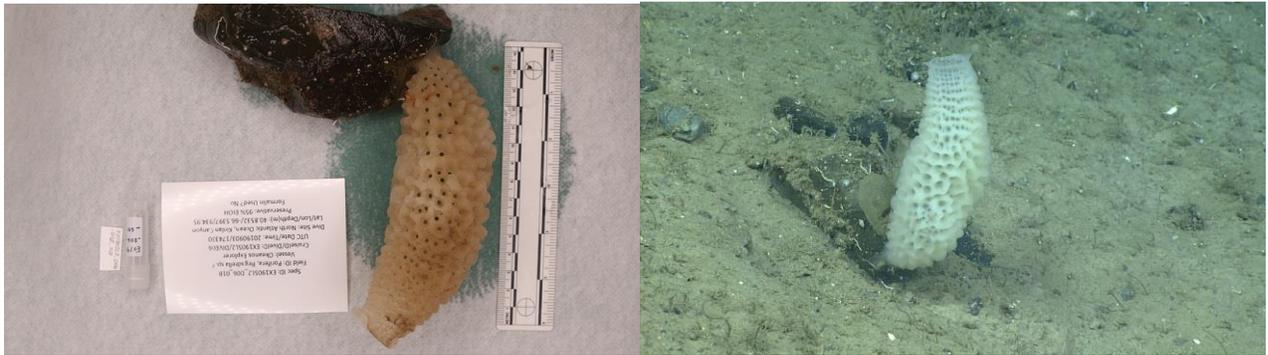


Large bubblegum coral (*Paragorgia* sp.) with a number of snakestar (*Euryalida*) associates in its branches.

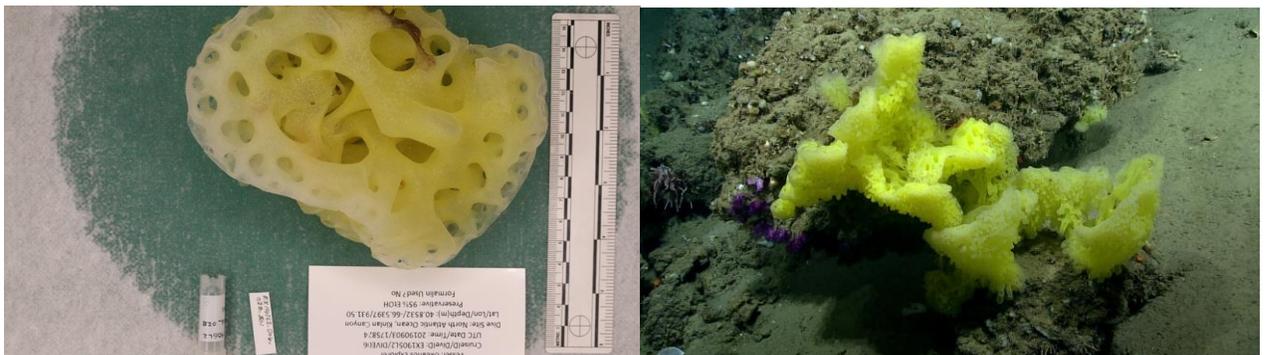


Two cutthroat eels (*Synphobranchus gracilis*) fight a crab for a piece of short-finned squid.

## Samples Collected



Sample ID	EX1905L2_D06_01B		
Date (UTC)	20190903		
Time (UTC)	174330		
Latitude	40.85320		
Longitude	-66.53970		
Depth (m)	935.0		
Temp. (°C)	4.534		
Field ID(s)	<i>Regadrella</i> sp.?		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D06_01B_A01	Decapod shrimp	2
	EX1905L2_D06_01B_A02	Polychaete	1
	EX1905L2_D06_01B_A03	Ophiuroidea	2
	EX1905L2_D06_01B_A04	Gastropoda A	1
	EX1905L2_D06_01B_A05	Gastropoda B	1
	EX1905L2_D06_01B_A06	Poecilasmatidae	1
	EX1905L2_D06_01B_A07	Rock?	1
Comments	N/A		



Sample ID	EX1905L2_D06_02B		
Date (UTC)	20190903		
Time (UTC)	175824		
Latitude	40.85320		
Longitude	-66.53970		
Depth (m)	931.5		

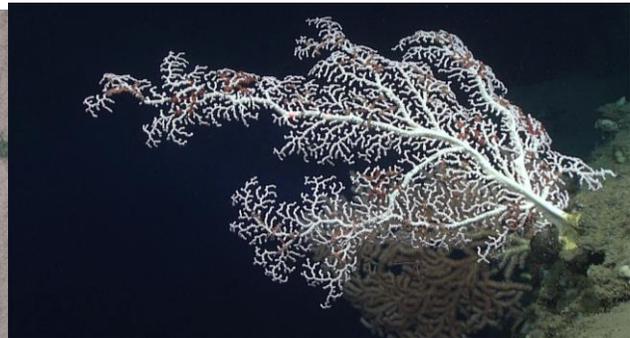
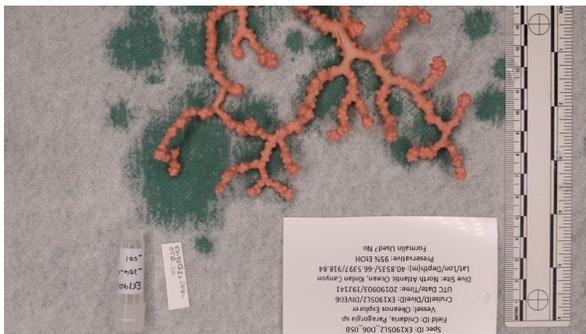
Temp. (°C)	4.568		
Field ID(s)	<i>Hertwigia</i> sp. yellow		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D06_02B_A01	Polynoidae	2
	EX1905L2_D06_02B_A02	Polychaeta	1
	EX1905L2_D06_02B_A03	Gastropoda	1
	EX1905L2_D06_02B_A04	Ophiacanthidae	1
	EX1905L2_D06_02B_A05	Isopoda	2
	EX1905L2_D06_02B_A06	Amphipoda	4
	EX1905L2_D06_02B_A07	Polychaeta	3
Comments	N/A		



Sample ID	EX1905L2_D06_03B		
Date (UTC)	20190903		
Time (UTC)	184249		
Latitude	40.85330		
Longitude	-66.53960		
Depth (m)	923.7		
Temp. (°C)	4.552		
Field ID(s)	<i>Pocillastra</i> sp.? yellow		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D06_03B_A01	Ophiurida	1
	EX1905L2_D06_03B_A02	Amphipoda	1
	EX1905L2_D06_03B_A03	Polychaeta	2
Comments	N/A		



Sample ID	EX1905L2_D06_04B		
Date (UTC)	20190903		
Time (UTC)	190715		
Latitude	40.85350		
Longitude	-66.53960		
Depth (m)	919.4		
Temp. (°C)	4.574		
Field ID(s)	Geodiidae		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D06_04B_A01	<i>Placiphorella atlantica</i>	2
	EX1905L2_D06_04B_A02	<i>Hanleya nagelfar</i>	1
	EX1905L2_D06_04B_A03	Ophiurida	2
	EX1905L2_D06_04B_A04	Polychaeta	1
	EX1905L2_D06_04B_A05	Polychaeta B	1
Comments	N/A		



Sample ID	EX1905L2_D06_05B		
Date (UTC)	20190903		
Time (UTC)	192141		
Latitude	40.85350		
Longitude	-66.53970		
Depth (m)	918.8		
Temp. (°C)	4.576		
Field ID(s)	<i>Paragorgia</i> sp.		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D06_05B_A01	Eurylida	1
	EX1905L2_D06_05B_A02	Ctenophore	2

## Dive 7

<p>General Location Map</p>	
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Oceanographer Canyon</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE07</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	Low visibility on the seafloor made it difficult to view <i>D2</i> from <i>Seirios</i> , so the the team proceeded with the dive lights on <i>Seirios</i> off in order to bring out <i>D2</i> .		
ROV Dive Summary Data (from Processed ROV)	In Water: 2019-09-04T17:16:08.750654 40°, 23.953' N ; 68°, 7.839' W On Bottom: 2019-09-04T18:06:32.202610 40°, 23.861' N ; 68°, 7.939' W Off Bottom: 2019-09-04T20:00:38.707406 40°, 23.845' N ; 68°, 7.841' W Out Water: 2019-09-04T20:35:32.511490 40°, 23.697' N ; 68°, 7.853' W Dive duration: 3:19:23 Bottom Time: 1:54:6 Max. depth: 600.0 m		
Special Notes	This dive was shorter than usual, as the ship's engineers worked on the stern thruster in the morning, so the deployment of the ROV was delayed until the early afternoon.		

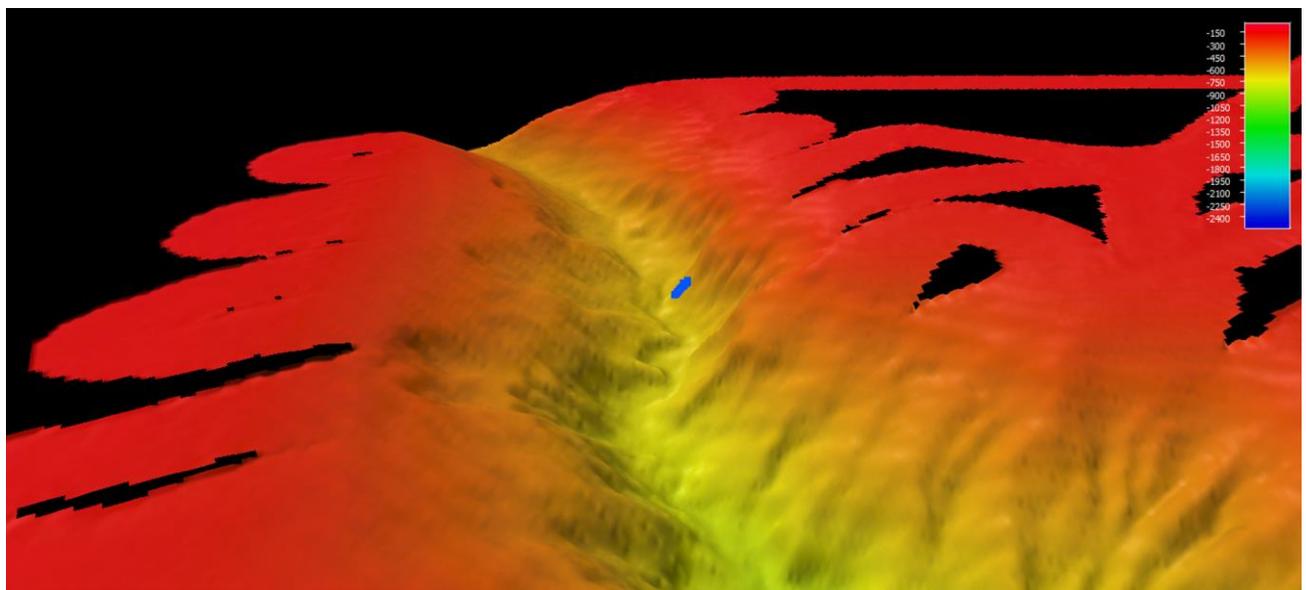
## Scientists Involved

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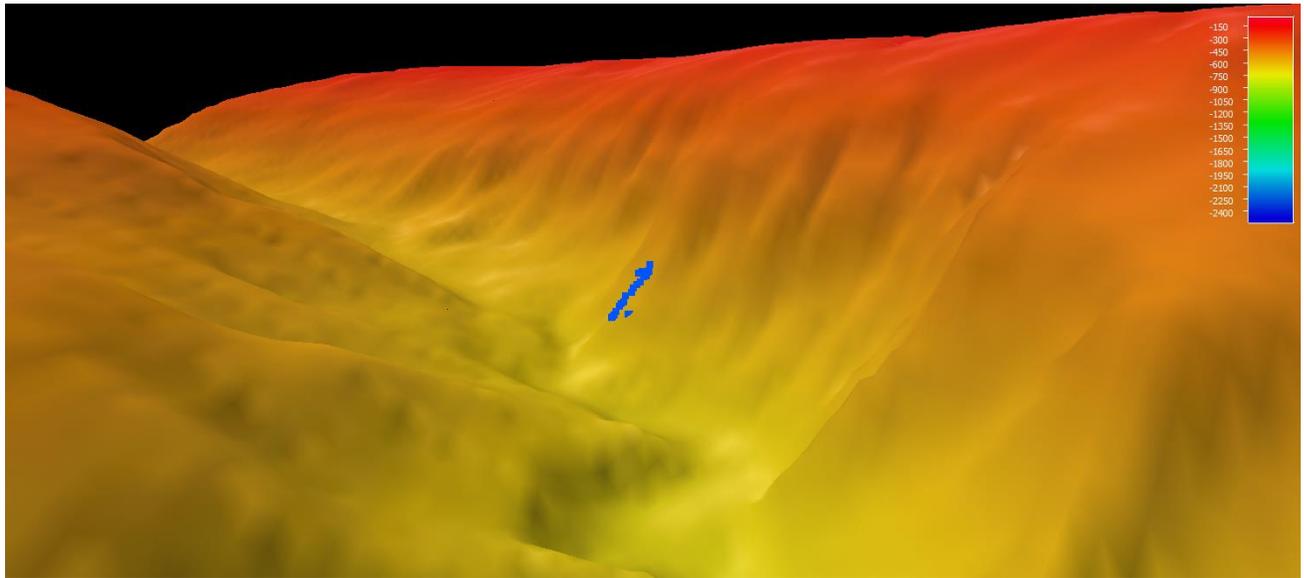
## Dive Purpose and Description

Dive Purpose	This site was located within the canyons unit of the Northeast Canyons and Seamounts Marine National Monument. Previous dives within Oceanographer Canyon documented dense deep-sea coral communities, and the dive location was predicted to be highly suitable for coral habitat. This dive also sought to expand knowledge on coral distribution within the canyon.
Dive Description	This dive was relatively short in duration, approximately 2 hours of bottom time, due to a late start. For the first time in the expedition, bottom substrate upon landing was not fine grained sediment, instead composed of a poorly sorted mix of hemipelagic drape, sand, and cobble to boulder sized clasts. The current was relatively strong throughout the entire dive (estimated at 30-50 cm/s), which hindered ROV positioning and resulted in poor visibility due to suspended sediment. Bottom fauna was dominated by striped shrimp ( <i>Plesionika</i> sp.), monkfish ( <i>Lophius americanus</i> ), deep-sea red crabs ( <i>Chaceon quinquidens</i> ) and shortfin squid ( <i>Illex illecebrosus</i> ). The area was notable for the abundance of hard substrate, but relative scarcity of live corals and sponges; evidence of dead or dying coral was prevalent in the canyon axis and lower canyon walls. Live primnoid coral colonies and some encrusting demosponges were observed approximately 50 m off the floor of the canyon. The only sample collected on this dive was a consolidated clay clast from a distinctively pyramid-shaped structure, which appeared to be from a partially dewatered clay layer eroded by canyon currents and debris flows.
Notable Observations	<ul style="list-style-type: none"> <li>- Strong (30-50 cm/s) currents and high turbidity</li> <li>- Presence of primnoid coral on canyon walls, but not in canyon axis or lower canyon walls</li> </ul>
Community Presence/Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>⚠ Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>⚠ Active Seep or Vent</li> <li>⚠ Extinct Seep or Vent</li> <li>⚠ Hydrates</li> </ul>

## Overall Map of the ROV Dive Area



## Close-up Map of Main Dive Site



## Representative Photos of the Dive



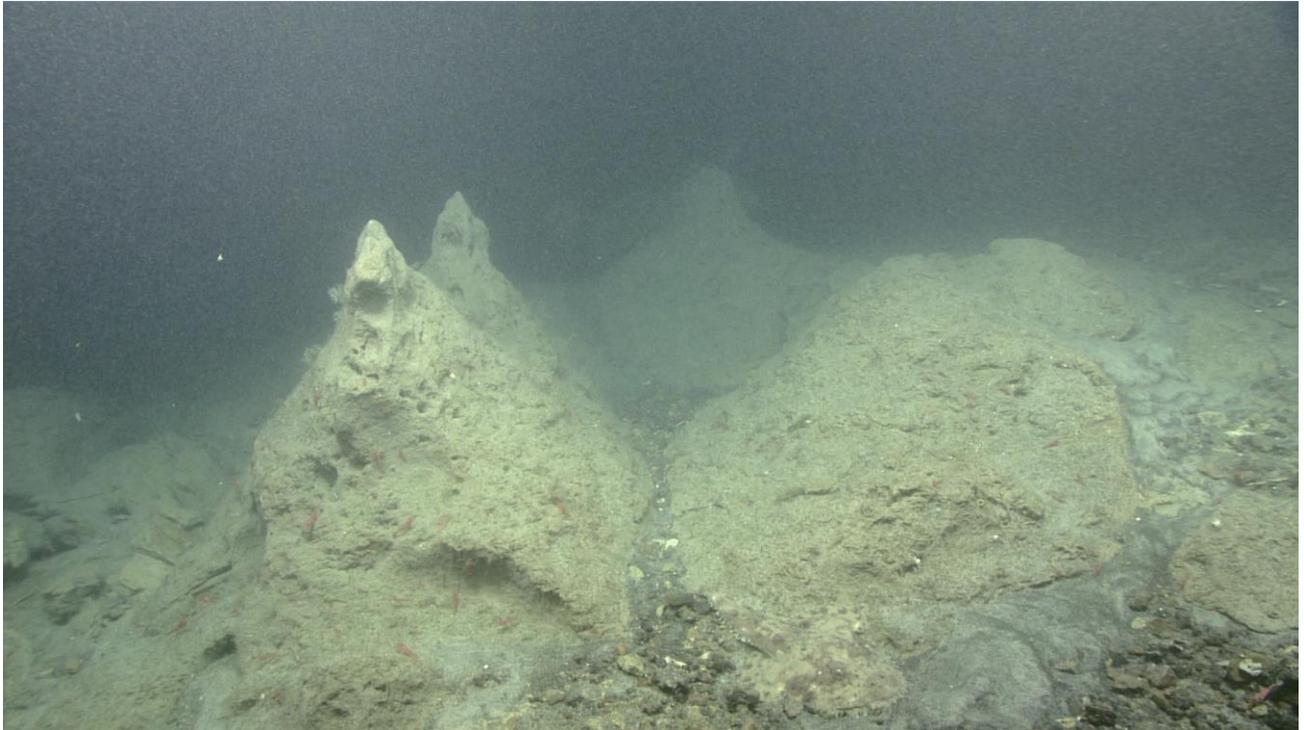
The ROV landing site with a short-finned squid (*Illex illecebrosus*) resting on the seabed. The dominant substrate was poorly sorted gravel.



Considerable water turbidity was present throughout the dive on Oceanographer Canyon. Some corals and sponges were observed on the most prominent features, like these primnoid corals.

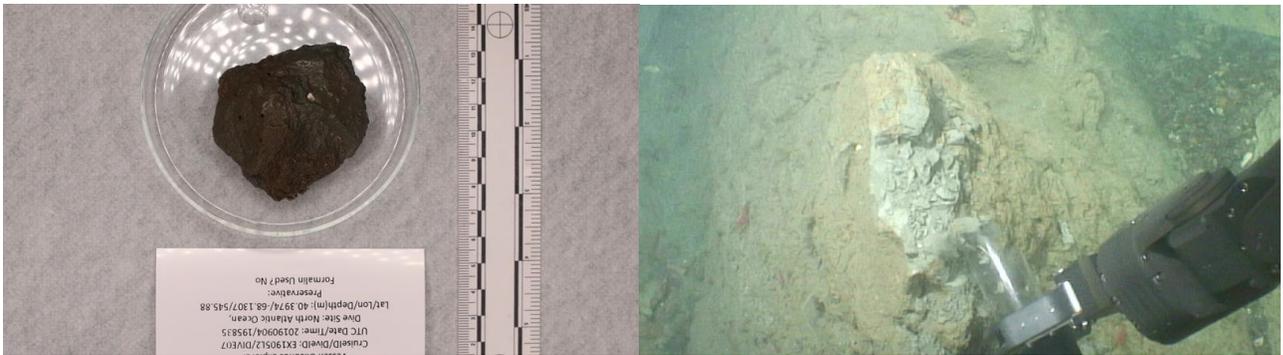


An interesting color morph of the sea star, *Chondraster grandis*. These sea stars, which are usually a rare sight, are particularly abundant in the northeast Atlantic canyons. Sediment ripples can also be seen to upper right.



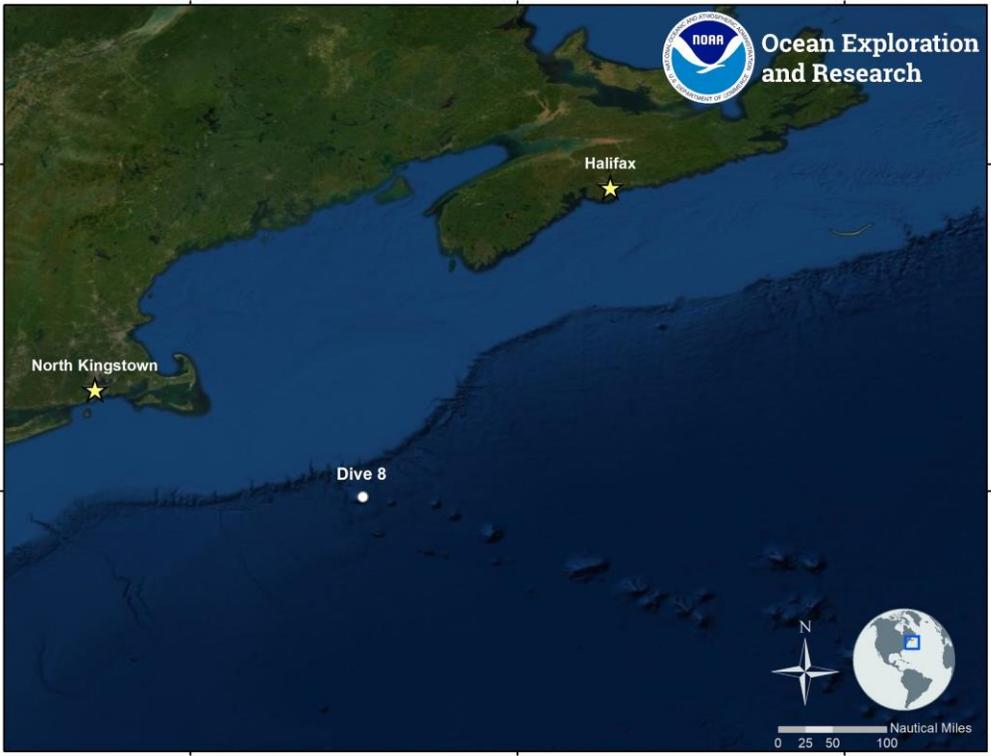
Pyramids-like structures on the seafloor of Oceanographer Canyon. These were composed of consolidated clay and were highly friable.

## Samples Collected



Sample ID	EX1905L2_D07_01G
Date (UTC)	20190904
Time (UTC)	195835
Latitude	40.39740
Longitude	-68.13070
Depth (m)	545.9
Temp. (°C)	6.815
Field ID(s)	Consolidated clay
Commensals	No commensals
Comments	N/A

## Dive 8

<p>General Location Map</p>	
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Bear Seamount eastern slope</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE08</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	No samples were collected on this dive due to low hydraulic oil temperature, which prevented the use of the manipulator arms.		
ROV Dive Summary Data (from Processed ROV)	In Water: 2019-09-09T13:21:04.210958 39°, 53.029' N ; 67°, 20.747' W On Bottom: 2019-09-09T15:51:23.292788 39°, 53.119' N ; 67°, 20.344' W Off Bottom: 2019-09-09T21:09:43.267035 39°, 53.109' N ; 67°, 20.702' W Out Water: 2019-09-09T22:39:05.279669 39°, 53.931' N ; 67°, 19.753' W Dive duration: 9:18:1 Bottom Time: 5:18:19 Max. depth: 2139.0 m		
Special Notes	N/A		

## Scientists Involved

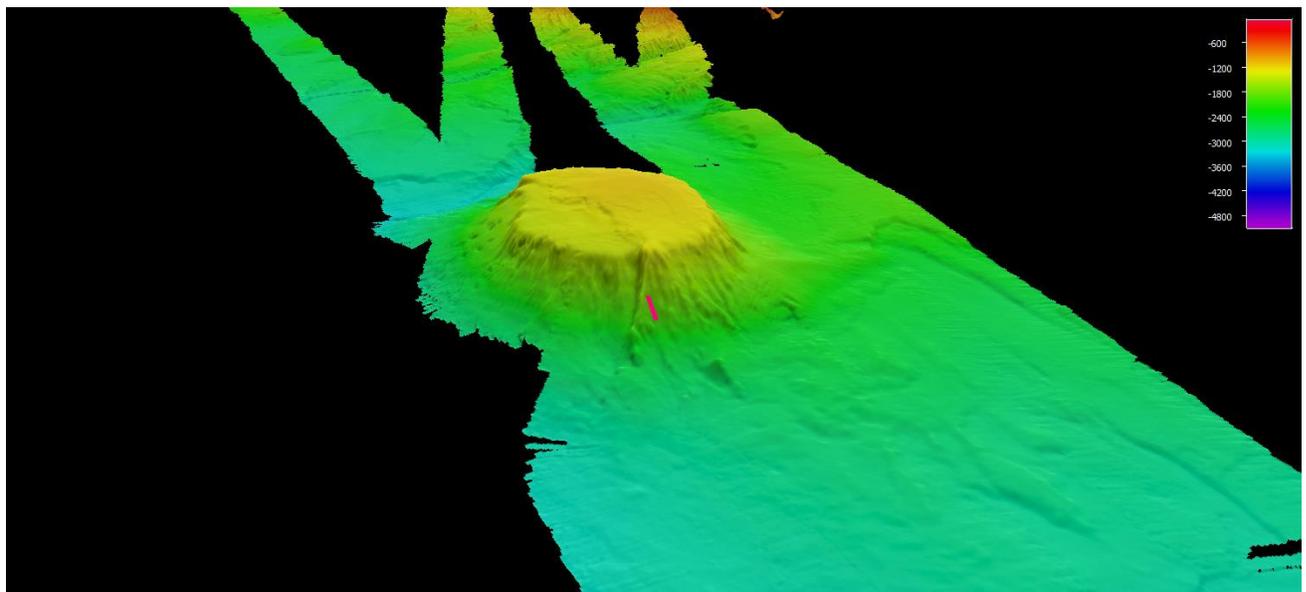
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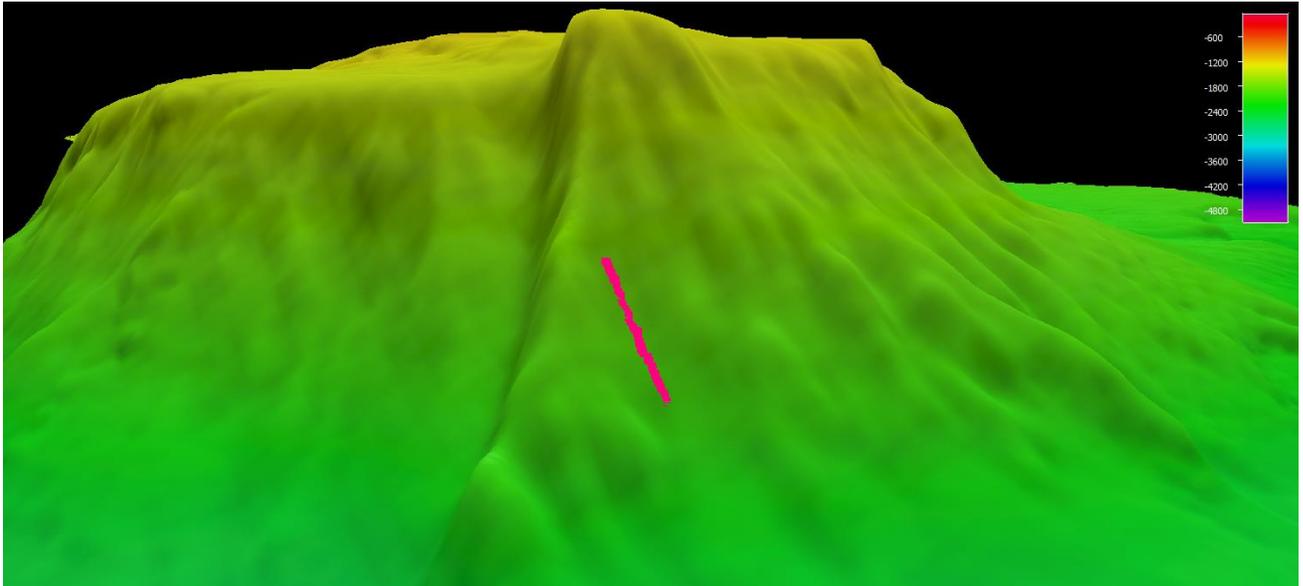
## Dive Purpose and Description

Dive Purpose	The purpose of this dive was to explore a previously unsurveyed area on the southeast corner of Bear Seamount for deep-sea corals and sponges. Additionally, this dive sought to Investigate whether there is surficial evidence for apparent normal faulting cutting across the width of Bear Seamount.
Dive Description	The ROV reached the seafloor at 1545 UTC in approximately 2150 m water depth. The ROV landed north of the planned first waypoint, so transit up the ridge arm was changed to transit up the eastern wall instead. The bottom substrate generally consisted of talus sourced from the seamount walls, interspersed with fine pelagic sediments. Igneous rock was the predominant rock type, with both basalts and light-colored tuffs noted. A wide variety of glass sponges and demosponges were noted throughout the dive, with particularly dense aggregations on exposed rock faces. Interspersed between the sponges were long bamboo coral ( <i>Keratoisidinae</i> B clade) and bushy bamboo ( <i>Keratoisis</i> sp.), golden coral ( <i>Metallogorgia melanotricos</i> and <i>Chrysogorgia</i> sp.), black coral ( <i>Bathypathes</i> sp. and <i>Stauropathes arctica</i> ), and <i>Paramuricea</i> sp. plexaurid coral. Cold bottom temperatures resulted in low hydraulic oil temperatures, which prevented manipulator arm function and sample collection during this dive.
Notable Observations	<ul style="list-style-type: none"> <li>- Abundant evidence of slope failures</li> <li>- Dense and diverse deep-sea coral and sponge community</li> </ul>
Community Presence/Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>☹ Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>☹ Active Seep or Vent</li> <li>☹ Extinct Seep or Vent</li> <li>☹ Hydrates</li> </ul>

## Overall Map of the ROV Dive Area



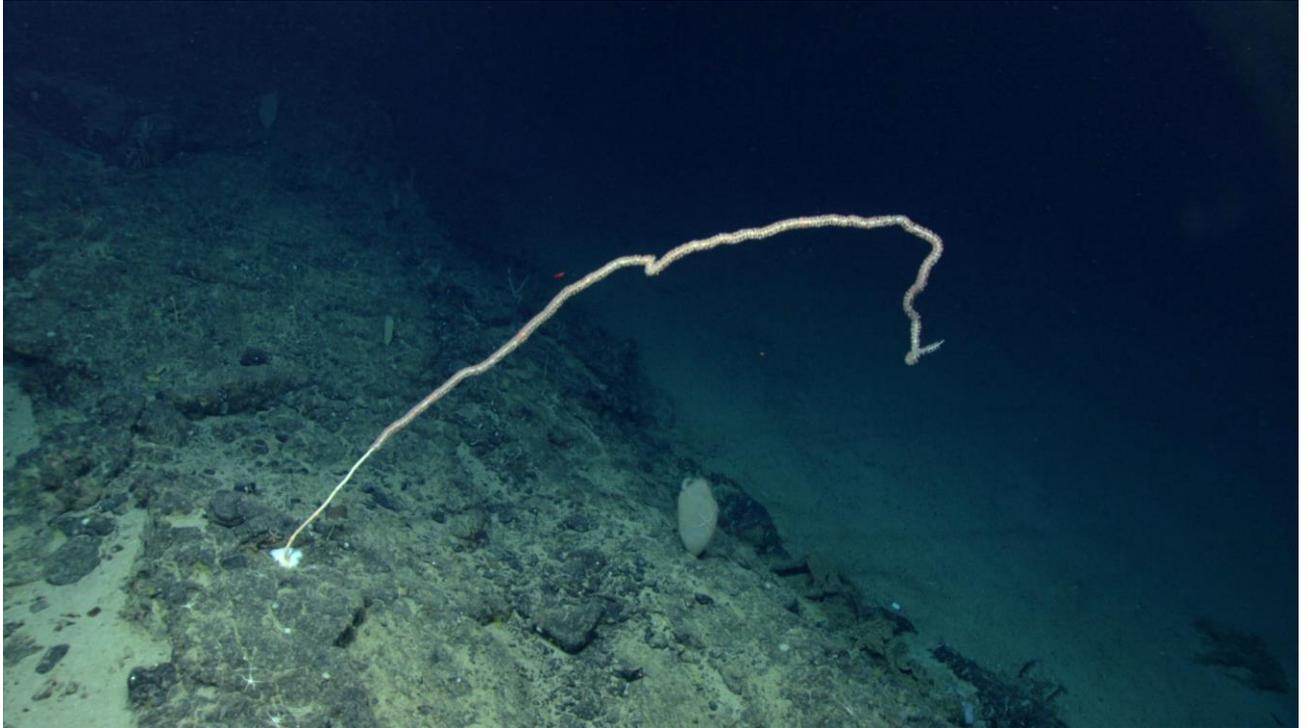
## Close-up Map of Main Dive Site



## Representative Photos of the Dive



Slopes of manganese crusted basalt on Bear Seamount were characterized by a high diversity of deep-sea corals and sponges.



Reaching a length over 2 m long, this whip-like bamboo coral (Keratoisidinae B clade) colonized what appears to be an old pillow lava flow.



This *Graneledone verrucosa* octopus was seen on a steep sediment-covered slope on Bear Seamount.



*Polymastia* sp. demosponge with many conspicuous tube-like projections called papillae nestled in a field of talus.

## **Samples Collected**

No samples were collected on this dive.

## Dive 9

<p>General Location Map</p>	<p>The map displays the Atlantic Continental Margin from North Kingstown, Maine, to Halifax, Nova Scotia. A white dot labeled 'Dive 9' is located in the deep ocean south of the continental shelf. The map includes a NOAA logo, the text 'Ocean Exploration and Research', a compass rose, and a scale bar in Nautical Miles (0, 25, 50, 100). Latitude lines for 40°N and 45°N and longitude lines for 60°W, 65°W, and 70°W are marked.</p>
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Retriever Seamount</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE09</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	There was a fault on the ROVs thruster, but this did not affect dive operations.		
ROV Dive Summary Data (from Processed ROV)	In Water: 2019-09-10T12:30:54.099268 39°, 48.49' N ; 66°, 12.774' W On Bottom: 2019-09-10T14:22:14.438642 39°, 48.242' N ; 66°, 12.85' W Off Bottom: 2019-09-10T19:00:31.211312 39°, 48.267' N ; 66°, 12.962' W Out Water: 2019-09-10T20:37:42.549384 39°, 49.128' N ; 66°, 11.85' W Dive duration: 8:6:48 Bottom Time: 4:38:16 Max. depth: 2671.0 m		
Special Notes	N/A		

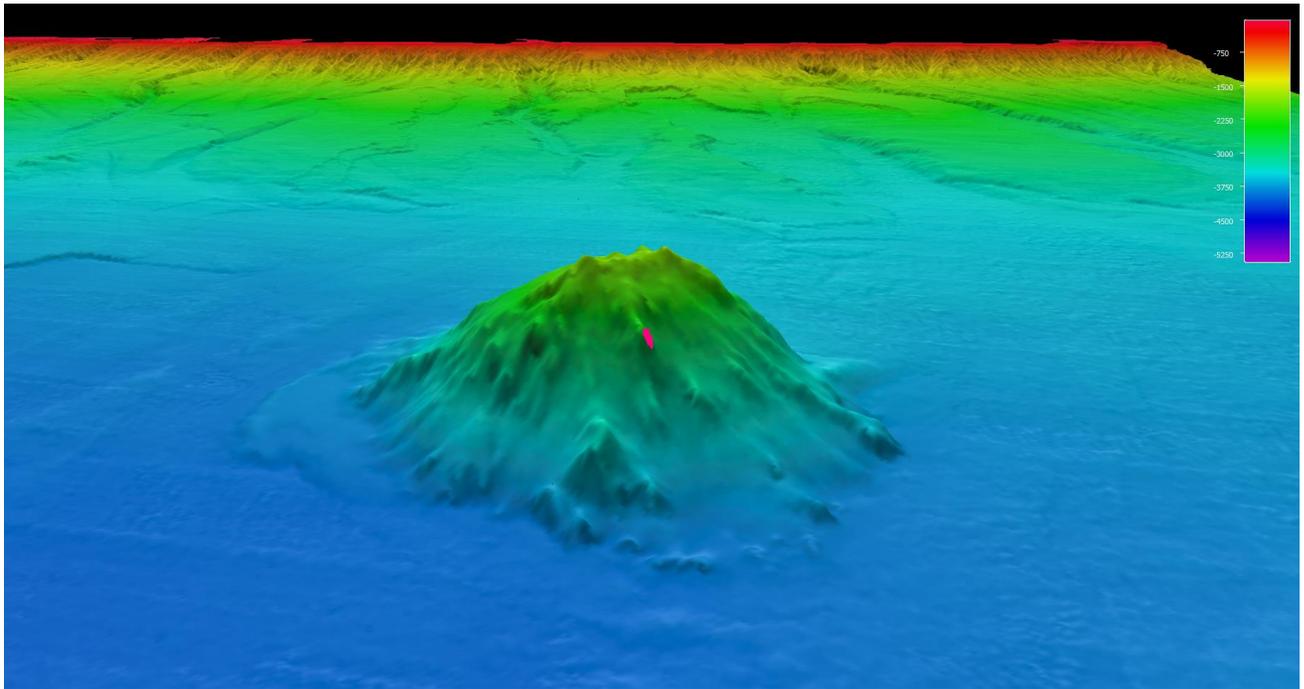
## Scientists Involved

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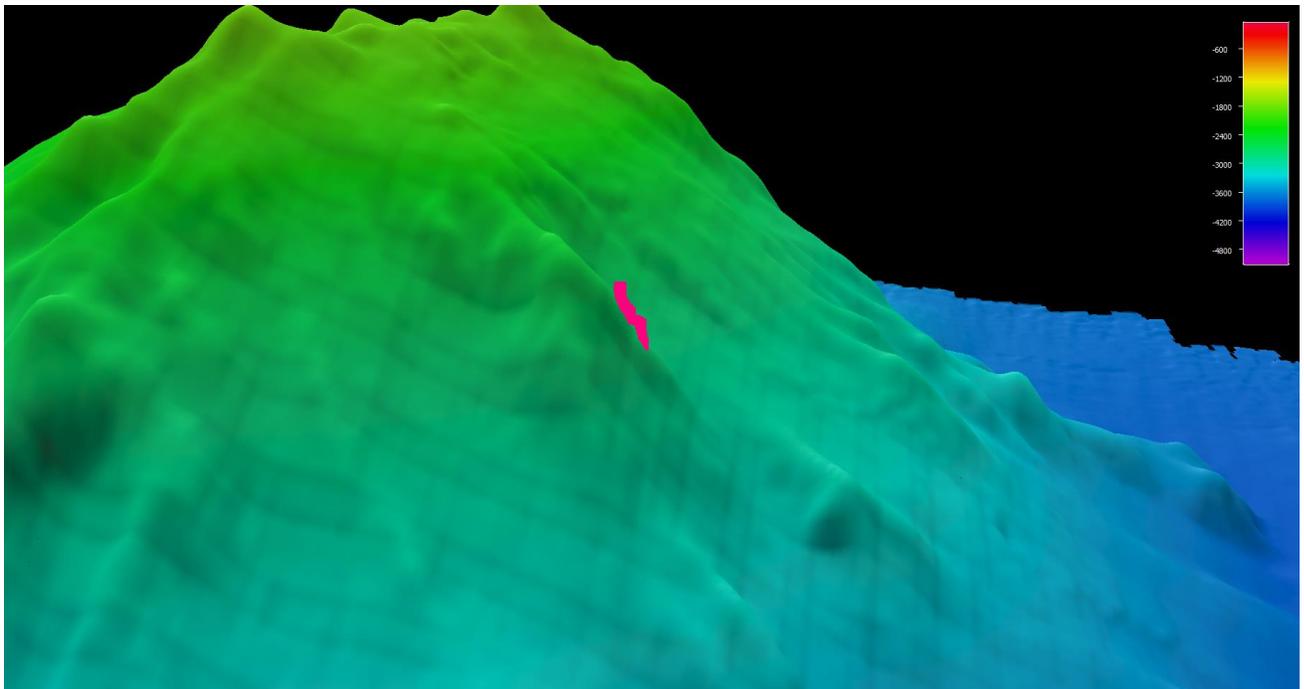
## Dive Purpose and Description

Dive Purpose	Previous dives on Retriever Seamount targeted depths >3,800 m and <2,400 m. This dive sought to explore the depth range between those two previous dives in order to add valuable new information on the diversity of habitats across various depth ranges of Retriever Seamount. Additionally, this dive explored the southeast corner of Retriever Seamount, an area of the seamount which has also not been explored. The site was expected to be highly suitable habitat for deep-sea corals and sponges as a result of the steepness of its slopes identified via seafloor mapping.
Dive Description	The ROV reached the seafloor at approximately 1430 UTC at a depth of ~2,650 m. The geological character of this dive was very uniform, consisting of igneous talus and sheer (at times vertical or overhanging) seamount walls. The igneous rock appeared to have large crystals of a deep blue or gray color within a matrix of fine black crystals. Both corals and sponges were observed in high densities on this dive, with a particularly large abundance and diversity of sponges. Observed sponges included Euplectellid glass sponges, Rossellid vase sponges, fragile Euretoid wide-mouth vase sponges, <i>Polymastia</i> sp. demosponges, <i>Geodia</i> sp. demosponges, encrusting demosponges, and a number of unknown sponges. The deep-sea coral community consisted of bottlebrush golden coral ( <i>Chrysogorgia abludo</i> ), pink coral ( <i>Corallium niobe</i> and <i>Corallium bathyrubrum</i> ), large fans of bubblegum coral ( <i>Paragorgia</i> sp.), soft coral (Nidaliidae), and stoloniferous corals. Mobile benthic fauna included halosaurs ( <i>Aldrovandia</i> sp.), cusk eels (Ophidiidae), rattail fish (Macrouridae), juvenile king crabs ( <i>Neolithodius</i> sp.), and squat lobsters ( <i>Munidopsis</i> sp.). Samples collected were primarily focused on documenting the wide range of sponges observed, but also included the collection of Nidaliidae soft coral growing on a large Euretoid sponge.
Notable Observations	<ul style="list-style-type: none"> <li>- Extremely high-density and diversity of sponges</li> <li>- Almost exclusively steep and rugose igneous terrain</li> </ul>
Community Presence/Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>☹ Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>☹ Active Seep or Vent</li> <li>☹ Extinct Seep or Vent</li> <li>☹ Hydrates</li> </ul>

## Overall Map of the ROV Dive Area



## Close-up Map of Main Dive Site



## Representative Photos of the Dive



A stunning array of corals and sponges adorning every surface on the eastern slope of Retriever Seamount. This high diversity and density was characteristic of the entire dive.



Dense aggregation of sponges. A sample of the large sponge in the center view was collected.

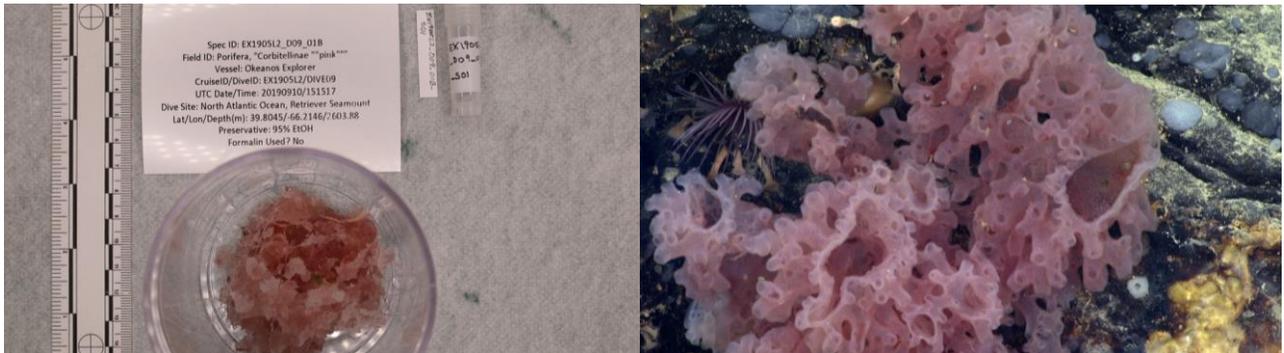


A Juvenile king crab (*Neolithodes* sp.), which was commonly observed on this dive at Retriever Seamount.



A new collection method was used for collecting this fragile glass sponge (*Euretidae*) with associated soft corals (*Nidaliidae*); the sponge was tapped with suction sampler.

## Samples Collected



Sample ID	EX1905L2_D09_01B		
Date (UTC)	20190910		
Time (UTC)	151517		
Latitude	39.80450		
Longitude	-66.21460		
Depth (m)	2603.9		
Temp. (°C)	2.902		
Field ID(s)	Corbitellinae pink		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D09_01B_A01	Polychaeta A	16
	EX1905L2_D09_01B_A02	Polynoidae	1
	EX1905L2_D09_01B_A03	Amphipoda A	1
	EX1905L2_D09_01B_A04	Amphipoda B	1
	EX1905L2_D09_01B_A05	Amphipoda C	3
	EX1905L2_D09_01B_A06	Demospongiae	1



Sample ID	EX1905L2_D09_02B		
Date (UTC)	20190910		
Time (UTC)	155032		
Latitude	39.80450		
Longitude	-66.21510		
Depth (m)	2590.4		
Temp. (°C)	3.008		
Field ID(s)	Hexactinellida		
Commensals	No commensals		



Sample ID	EX1905L2_D09_03B		
Date (UTC)	20190910		
Time (UTC)	173922		
Latitude	39.80460		
Longitude	-66.21590		
Depth (m)	2539.6		
Temp. (°C)	3.255		
Field ID(s)	Nidaliidae		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D09_03B_A01	Euretidae	1
	EX1905L2_D09_03B_A02	Polychaeta	1
	EX1905L2_D09_03B_A03	Munidopsis sp.	1



Sample ID	EX1905L2_D09_04B		
Date (UTC)	20190910		
Time (UTC)	181750		
Latitude	39.80470		
Longitude	-66.21590		
Depth (m)	2528.3		
Temp. (°C)	3.279		
Field ID(s)	Hexactinellida		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D09_04B_A01	Zoantharia	1
	EX1905L2_D09_04B_A02	Isopoda	1
	EX1905L2_D09_04B_A03	Nidaliidae	1
	EX1905L2_D09_04B_A04	Amphipoda	1
	EX1905L2_D09_04B_A05	Scalpellidae	1
	EX1905L2_D09_04B_A06	Balanoidea	2
	EX1905L2_D09_04B_A07	Hydroidolina	1
	EX1905L2_D09_04B_A08	Corallium dead	1



Sample ID	EX1905L2_D09_05B		
Date (UTC)	20190910		
Time (UTC)	185819		
Latitude	39.80450		
Longitude	-66.21600		
Depth (m)	2503.9		
Temp. (°C)	3.302		
Field ID(s)	Geodiidae		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D09_05B_A01	Ophiurida	1
	EX1905L2_D09_05B_A02	Zoantharia	2
	EX1905L2_D09_05B_A03	Corallium dead	1
Comments			

## Dive 10

<p>General Location Map</p>	
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Bear Seamount Midwater</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE10</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	N/A		
ROV Dive Summary Data (from Processed ROV)	In Water: 2019-09-11T12:23:49.623524 39°, 59.551' N ; 67°, 21.218' W On Bottom: 2019-09-11T14:15:38.559732 39°, 59.544' N ; 67°, 21.027' W Off Bottom: 2019-09-11T15:07:27.626938 39°, 59.553' N ; 67°, 21.033' W Out Water: 2019-09-11T19:20:47.595953 40°, 0.39' N ; 67°, 20.161' W Dive duration: 6:56:57 Bottom Time: 0:51:49 Max. depth: 2181.0 m		
Special Notes	The ROV had to be recovered approximately 2.5 hour early due to strong currents that approached 3 knots and prevented holding station of the ship in dynamic positioning.		

## Scientists Involved

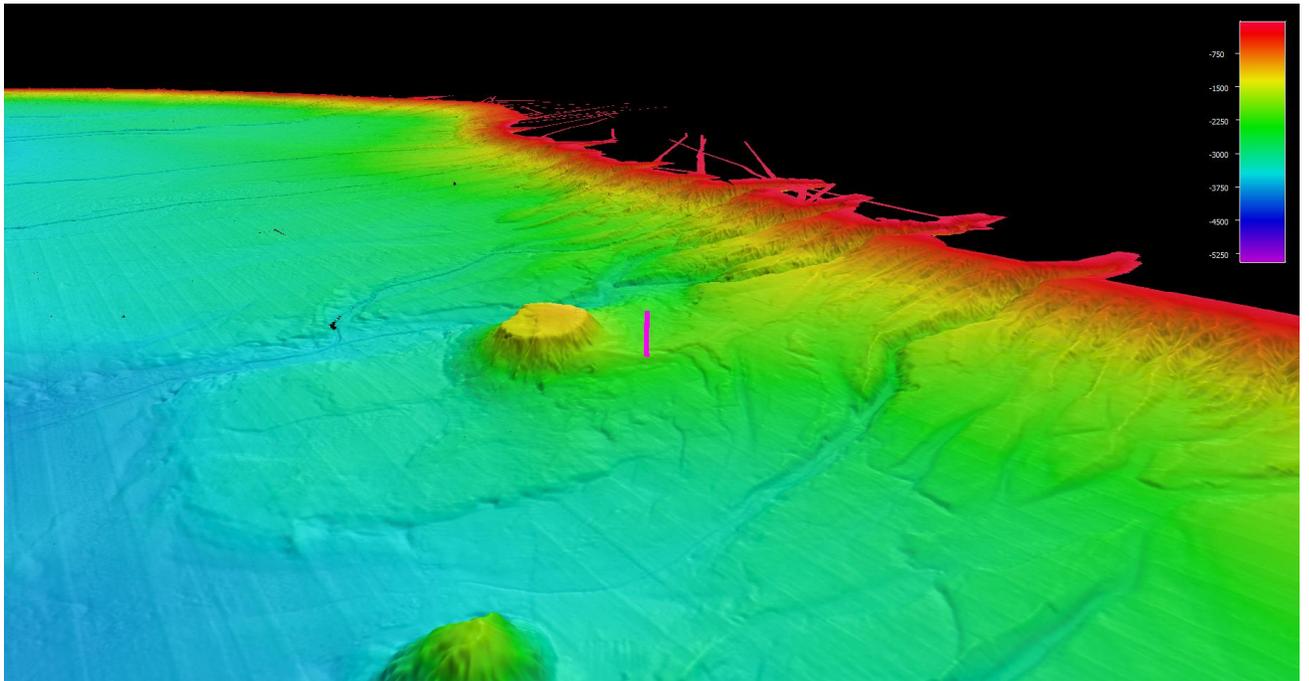
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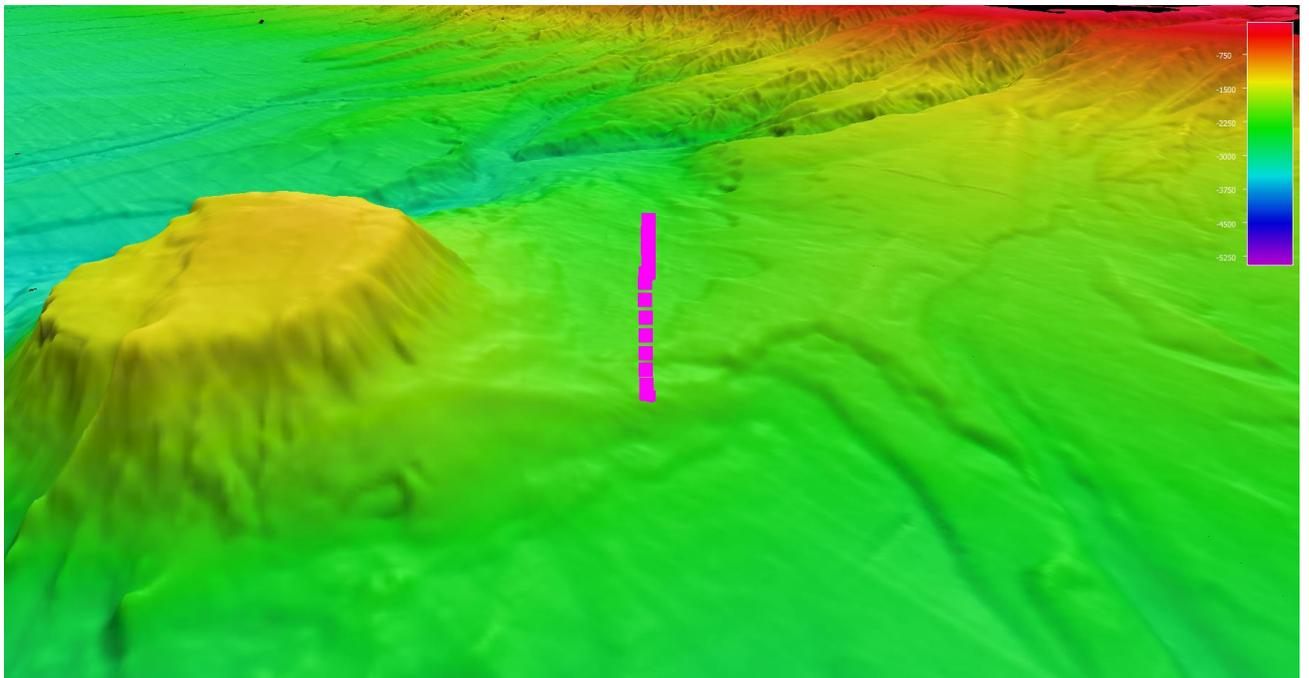
## Dive Purpose and Description

Dive Purpose	This dive site was located just north of Bear Seamount, within the Northeast Canyons and Seamounts Marine National Monument. There have been extensive nekton trawling surveys in the vicinity of this site, as well as several ROV dives that explored benthic habitats on Bear Seamount. However, to date there have been no midwater ROV dives on the seamount. This dive therefore sought to collect valuable midwater video data that can be compared to historic midwater trawl data.
Dive Description	<p>The midwater dive site was located 7 km north of Bear Seamount within the boundary of the Northeast Canyons and Seamounts Marine National Monument. Throughout the dive, on shore experts completed detailed and accurate video annotation on SeaScribe in order to produce an inventory as one of the products from this dive.</p> <p>Unlike previous midwater exploration dives, this dive began by descending to the bottom at a depth of 2182 m and performing two near bottom 24 minute transects at 1.5 m and 10 m altitude above the seafloor. Particulates in the water column was dense during these transects and numerous larvacean houses were observed along with ctenophores (<i>Cidippa</i>), arrow worms (<i>Chaetognatha</i>), krill (<i>Euphausiacea</i>), hydromedusae, and copepods. A large Chimera, <i>Hydrolagus</i> sp., and juvenile rattail fish, <i>Coryphaenoides</i> sp. were also observed just above the seafloor. Between transects a possible new species of red cidippid ctenophore was collected using the suction sampler just above the seafloor at 2173 m.</p> <p>After a brief ascent, transects were performed at 1100 m, 900 m and 700 m water depth. Animals observed included bristlemouth fish (<i>Cyclothone pallida</i>), Haliocreatid hydromedusae, krill, copepods, nemertea, jellyfish (<i>Poralia</i> sp.), physonect siphonophores, sawtooth eel (<i>Serrivomer beani</i>), lobate ctenophore (<i>Bathocyroe fosteri</i>), goiter blacksmelt (<i>Bathylagus europs</i>), and pyrosomes. Midway through the 700 m transect, surface currents picked up and approached 3 knots, too strong to continue with ROV surveys. As a result, the transect was ended prematurely at roughly 12 minutes, and the vehicles were recovered.</p>
Notable Observations	<ul style="list-style-type: none"> <li>- Several potential undescribed species observed</li> <li>- Collected a potentially new species of ctenophore</li> </ul>
Community Presence/Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li><input type="checkbox"/> Corals and Sponges</li> <li><input type="checkbox"/> Chemosynthetic Community</li> <li><input type="checkbox"/> High-biodiversity Community</li> <li><input type="checkbox"/> Active Seep or Vent</li> <li><input type="checkbox"/> Extinct Seep or Vent</li> <li><input type="checkbox"/> Hydrates</li> </ul>

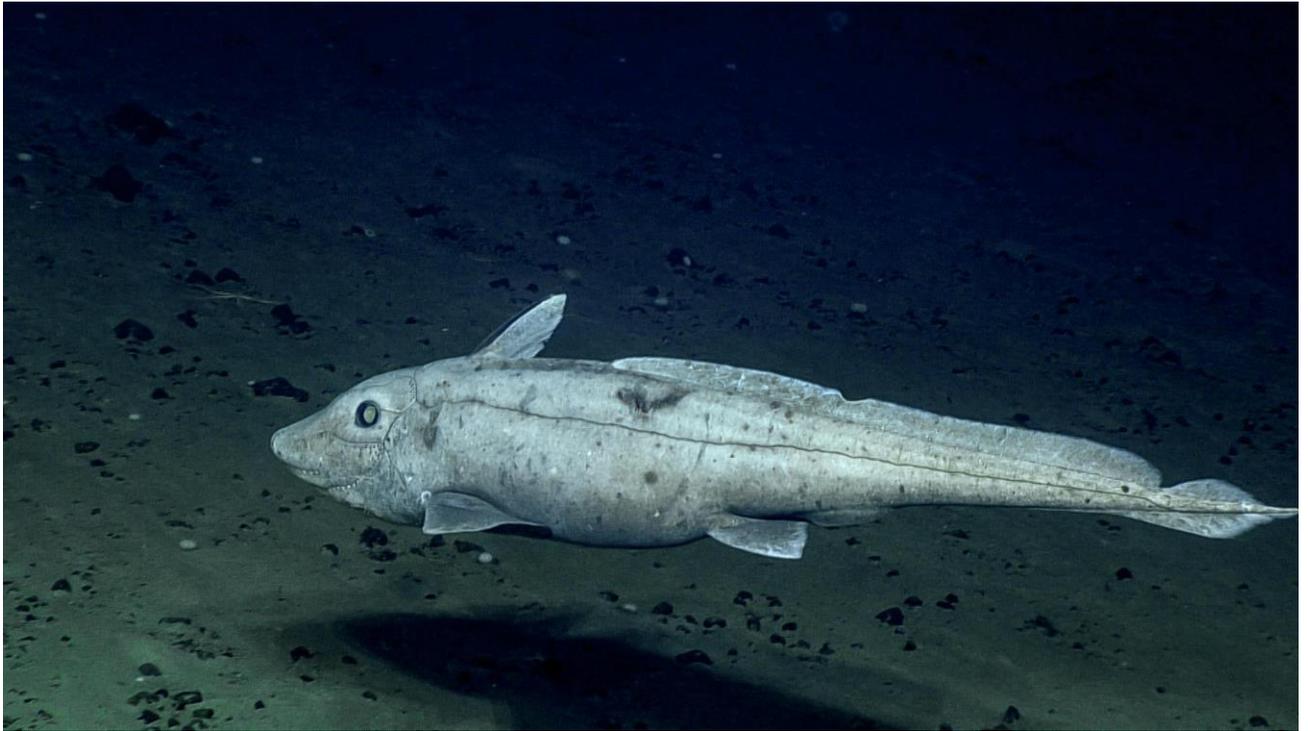
## Overall Map of the ROV Dive Area



## Close-up Map of Main Dive Site



## Representative Photos of the Dive



Chimera, *Hydrolagus* sp., swimming near the seafloor during the first midwater transect.



Potentially undescribed ctenophore floating gracefully in the water column. A similar individual was collected on this dive.



Sawtooth eel, *Serrivomer beari*, spotted floating vertically in the water column. This fish is unique in having teeth that are fused into a single band down the center of the roof of its mouth like a saw.



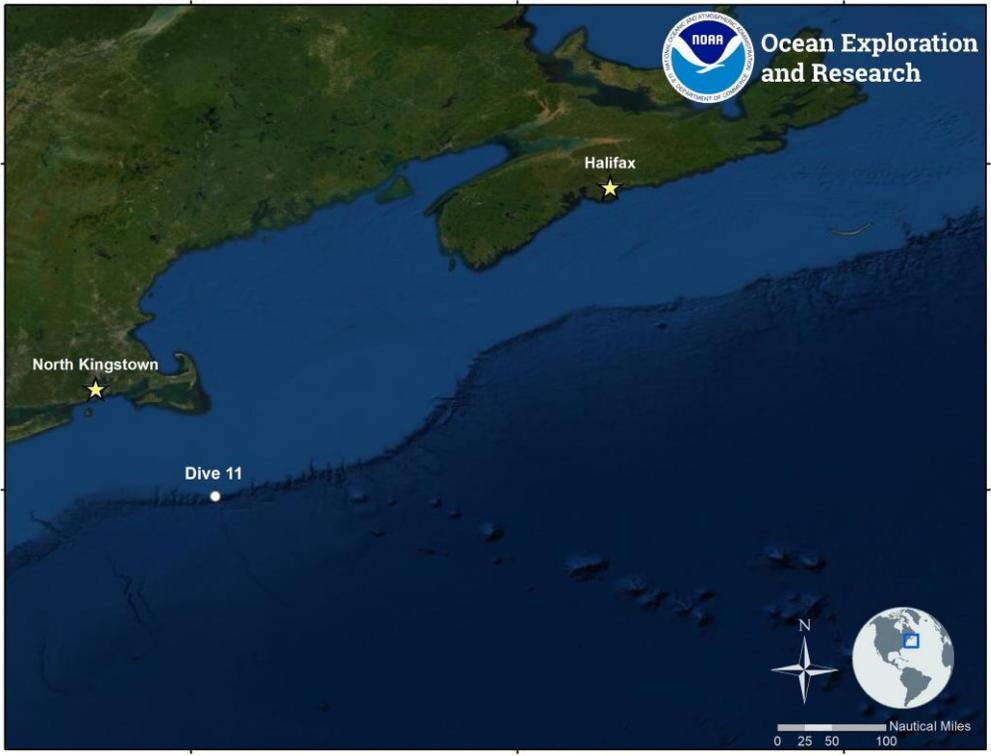
This dusky red jelly, *Poralia* sp., is a common sight during midwater transects.

## Samples Collected



Sample ID	EX1905L2_D10_01B
Date (UTC)	20190911
Time (UTC)	145614
Latitude	39.99260
Longitude	-67.35060
Depth (m)	2172.7
Temp. (°C)	3.289
Field ID(s)	<i>Agmayeria</i> sp.?
Commensals	No commensals
Comments	N/A

## Dive 11

<p>General Location Map</p>	
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Veatch Canyon</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE11</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	N/A		
ROV Dive Summary Data (from Processed ROV)	In Water:	2019-09-12T12:33:18.653628 39°, 51.279' N ; 69°, 32.972' W	
	On Bottom:	2019-09-12T14:08:05.776046 39°, 50.919' N ; 69°, 33.216' W	
	Off Bottom:	2019-09-12T19:55:01.672908 39°, 51.004' N ; 69°, 33.016' W	
	Out Water:	2019-09-12T20:41:47.642864 39°, 51.12' N ; 69°, 33.321' W	
	Dive duration:	8:8:28	
	Bottom Time:	5:46:55	
	Max. depth:	1342.0 m	
Special Notes	A squall came through that caused the vehicles to lift off bottom for approximately 30 minutes while the ship worked to maintain position.		

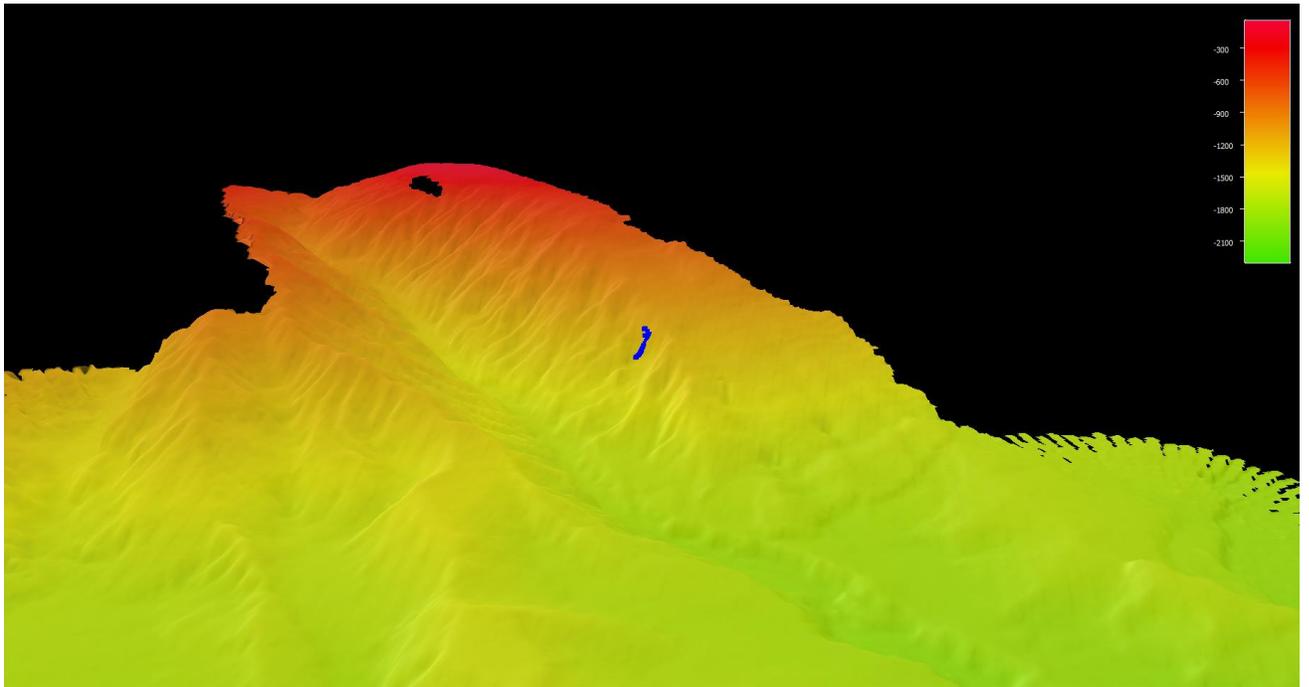
## Scientists Involved

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Scott France	University of Louisiana at Lafayette	france@louisiana.edu
Tara Luke	Stockton University	luket@stockton.edu

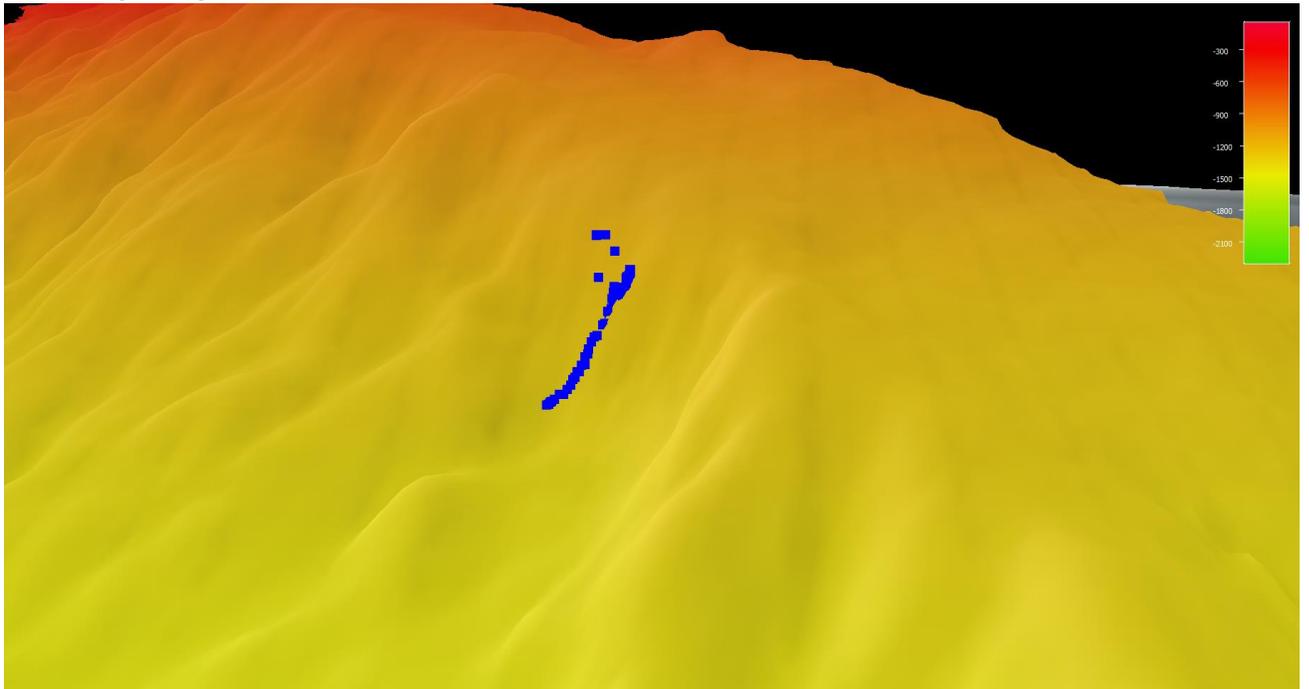
## Dive Purpose and Description

Dive Purpose	The purpose of this dive was to explore the eastern wall of Veatch Canyon in a region that has not yet been surveyed by deep-sea submersibles. Habitat suitability models predicted that this area contained suitable habitat for deep-sea corals.
Dive Description	The ROV reached the seafloor at 1430 UTC in soft sediments characteristic of most canyon axes at this relatively deep depth (1300 m). Bottom fauna were typical for substrate, including hake (Moridae), halosaurs (Halosauridae), cut throat eels (Synaphobranchidae), xenophyophores, deep-sea red crabs ( <i>Chaceon</i> sp.), and pancake urchin ( <i>Phorosoma placenta</i> ) with an associated juvenile cusk eel ( <i>Baratherites</i> sp.). Clasts and boulders of carbonate rocks with encrusting organisms were also observed on the canyon floor, with increasing density as the foot of the slope was reached. Slopes dramatically increased a short distance up the canyon wall, and interbedded (1-2 m) packages of sandstones and carbonates were observed with one thin mudstone layer. This lithology transitioned into one single massive carbonate sequence of > 100 m thickness that was sparsely encrusted with primnoid corals ( <i>Calyptrophora antilla</i> and <i>Thouarella grasshoffi</i> ), cup corals ( <i>Desmophyllum</i> sp.), and encrusting demosponges. The dive was halted for ~30 minutes due to surface weather conditions, during which the ROVs were suspended > 100 m above the seafloor. Once the ROVs were set back down on the seafloor, two samples were collected, a bamboo coral (Keratoisidinae) and a plexaurid coral ( <i>Switfia</i> sp.). As the dive concluded, a very dense assemblage of black corals ( <i>Parantipathes larix</i> ), cup corals ( <i>Desmophyllum</i> sp.), hard corals ( <i>Lophelia pertusa</i> ) and purple stoloniferous corals ( <i>Clavularia</i> sp.) was observed.
Notable Observations	<ul style="list-style-type: none"> <li>- Vertical uniform carbonate walls &gt; 100 m tall</li> <li>- Deep-sea corals and sponges</li> <li>- Dense coral and sponge community observed during the dive</li> </ul>
Community Presence/Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>☹ Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>☹ Active Seep or Vent</li> <li>☹ Extinct Seep or Vent</li> <li>☹ Hydrates</li> </ul>

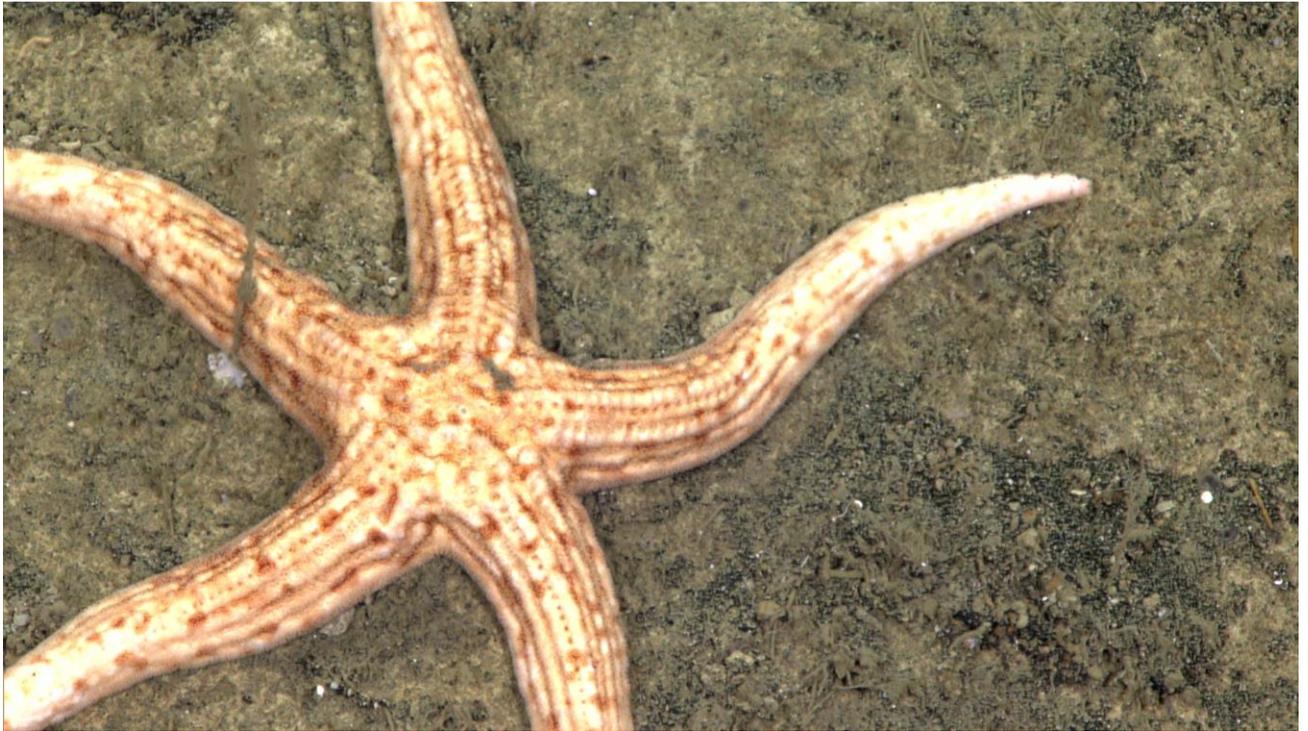
### Overall Map of the ROV Dive Area



### Close-up Map of Main Dive Site



## Representative Photos of the Dive



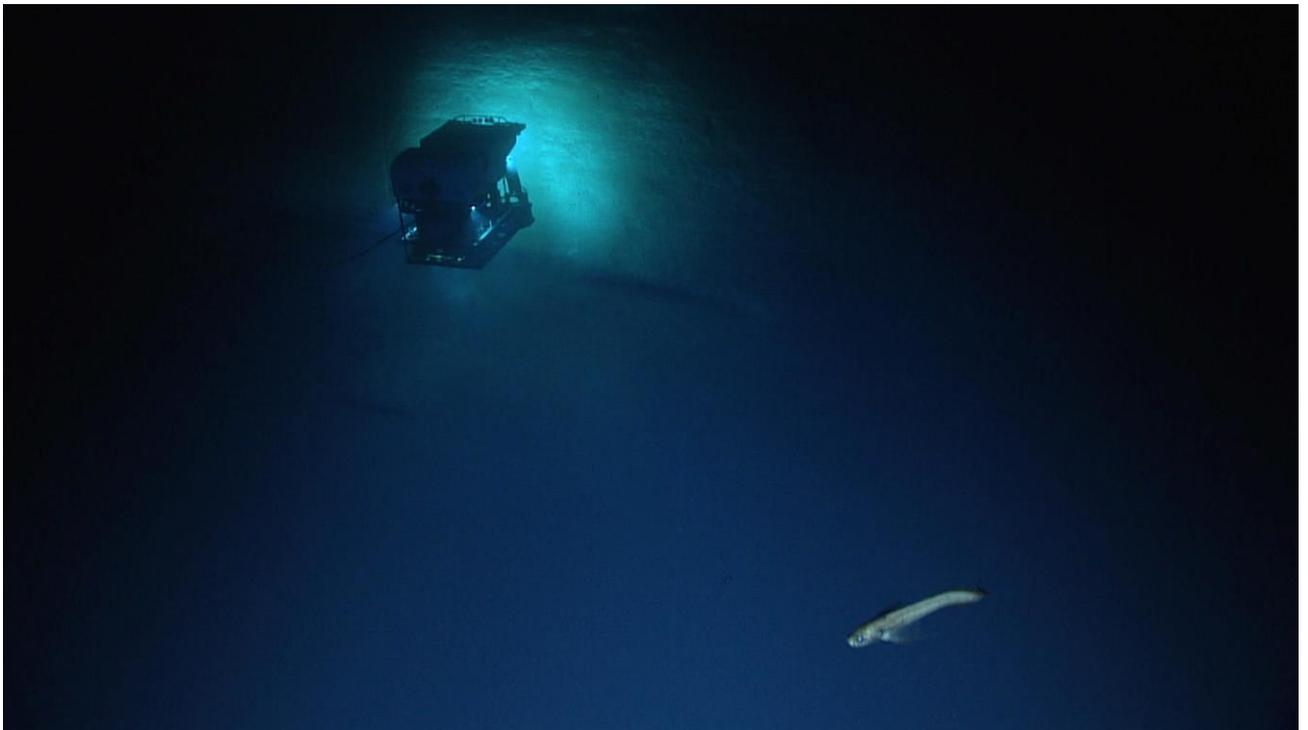
This sea star, *Neomorphaster foricpatus*, was a common sight during the dive and its ancestors are also well known in the fossil record.



*Calyptrophora antilla*, a lyrate branching primnoid coral growing on the vertical wall of Veatch Canyon.

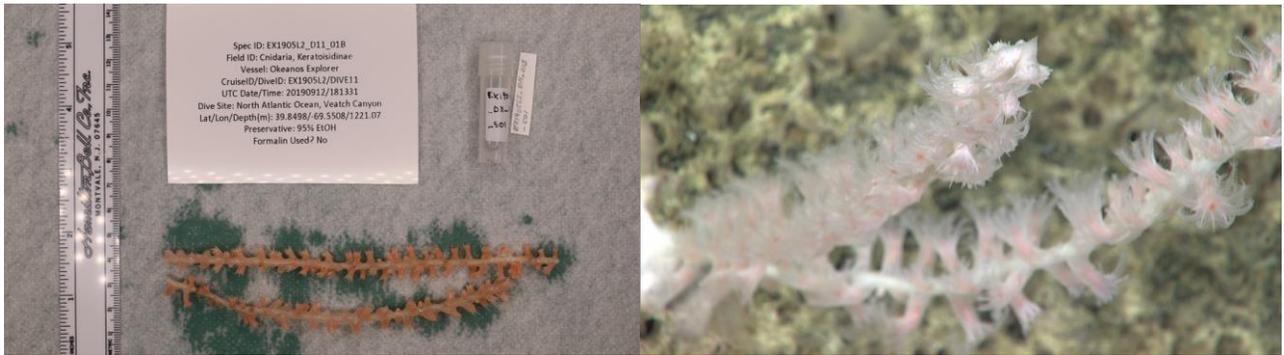


Community of corals and sponges on the final wall of the dive at Veatch Canyon featuring cupcorals, *Acanthogorgia* sp. yellow coral, and *Lophelia pertusa* hard coral.

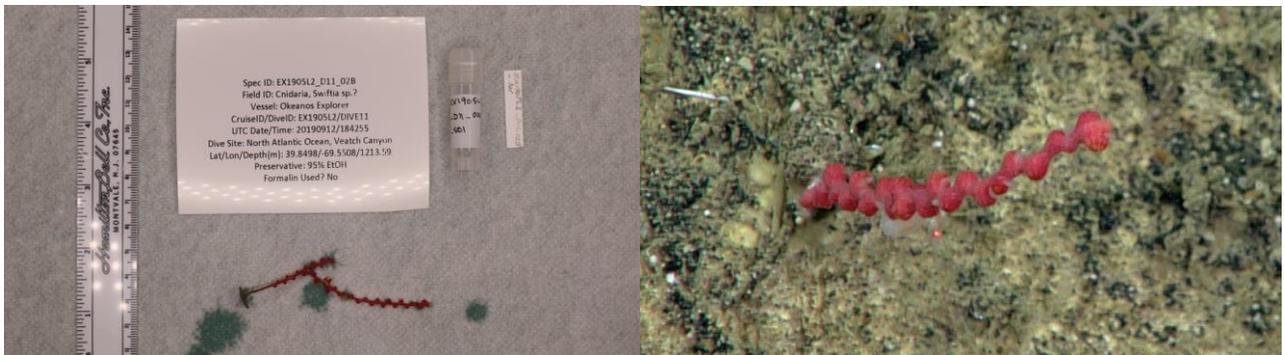


*Deep Discover* surveying the stunning near vertical > 100 m thick unbroken sequence of carbonate rock wall of Veatch Canyon.

## Samples Collected

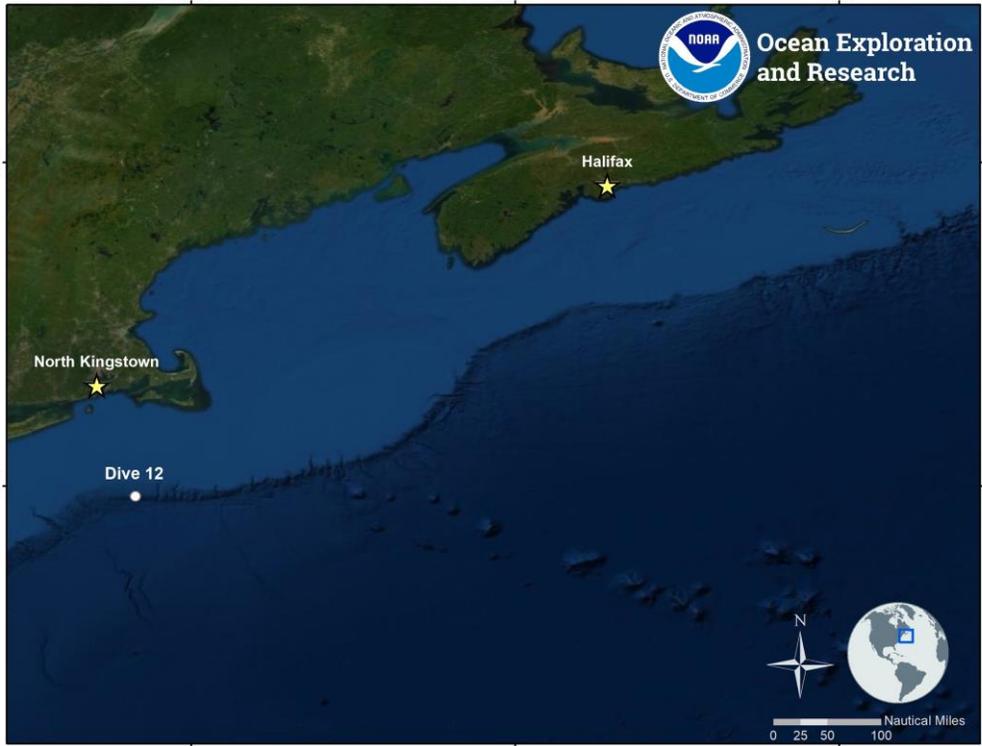


Sample ID	EX1905L2_D11_01B
Date (UTC)	20190912
Time (UTC)	181331
Latitude	39.84980
Longitude	-69.55080
Depth (m)	1221.1
Temp. (°C)	4.249
Field ID(s)	Keratoisidinae
Commensals	No commensals
Comments	N/A



Sample ID	EX1905L2_D11_02B
Date (UTC)	20190912
Time (UTC)	184255
Latitude	39.84980
Longitude	-69.55080
Depth (m)	1213.6
Temp. (°C)	8.188
Field ID(s)	<i>Swiftia</i> sp.?
Commensals	No commensals
Comments	N/A

## Dive 12

<p>General Location Map</p>	
<p>General Area Descriptor</p>	<p>U.S. and Canadian Atlantic Continental Margin</p>
<p>Site Name</p>	<p>Block-Alvin Intercanyon</p>
<p>Science Team Leads</p>	<p>Meagan Putts (UH) Jeff Obelcz (USNRL)</p>
<p>Expedition Coordinator</p>	<p>Daniel Wagner (NOAA-OER)</p>
<p>ROV Dive Supervisor</p>	<p>Sean Kennison (GFOE)</p>
<p>Mapping Lead</p>	<p>Michael White (NOAA-OER)</p>

## ROV Dive Name

<p>Cruise</p>	<p>EX1905L2</p>
<p>Dive Number</p>	<p>DIVE12</p>

## Equipment Deployed

ROV	<i>Deep Discoverer</i>		
Camera Platform	<i>Seirios</i>		
ROV Measurements	✓ CTD	✓ Depth	✓ Altitude
	✓ Scanning Sonar	✓ USBL Position	✓ Heading
	✓ Pitch	✓ Roll	✓ HD Camera 1
	✓ HD Camera 2	✓ Low Res Cam 1	✓ Low Res Cam 2
	✓ Low Res Cam 3	✓ Low Res Cam 4	✓ Low Res Cam 5
Equipment Malfunctions	N/A		
ROV Dive Summary Data (from Processed ROV)	<p>In Water: 2019-09-14T12:23:40.335549 39°, 49.62' N ; 70°, 51.058' W</p> <p>On Bottom: 2019-09-14T13:22:56.760239 39°, 49.245' N ; 70°, 51.008' W</p> <p>Off Bottom: 2019-09-14T19:41:52.358617 39°, 49.126' N ; 70°, 51.172' W</p> <p>Out Water: 2019-09-14T20:42:29.306971 39°, 49.026' N ; 70°, 50.826' W</p> <p>Dive duration: 8:18:48</p> <p>Bottom Time: 6:18:55</p> <p>Max. depth: 1277.0 m</p>		
Special Notes	N/A		

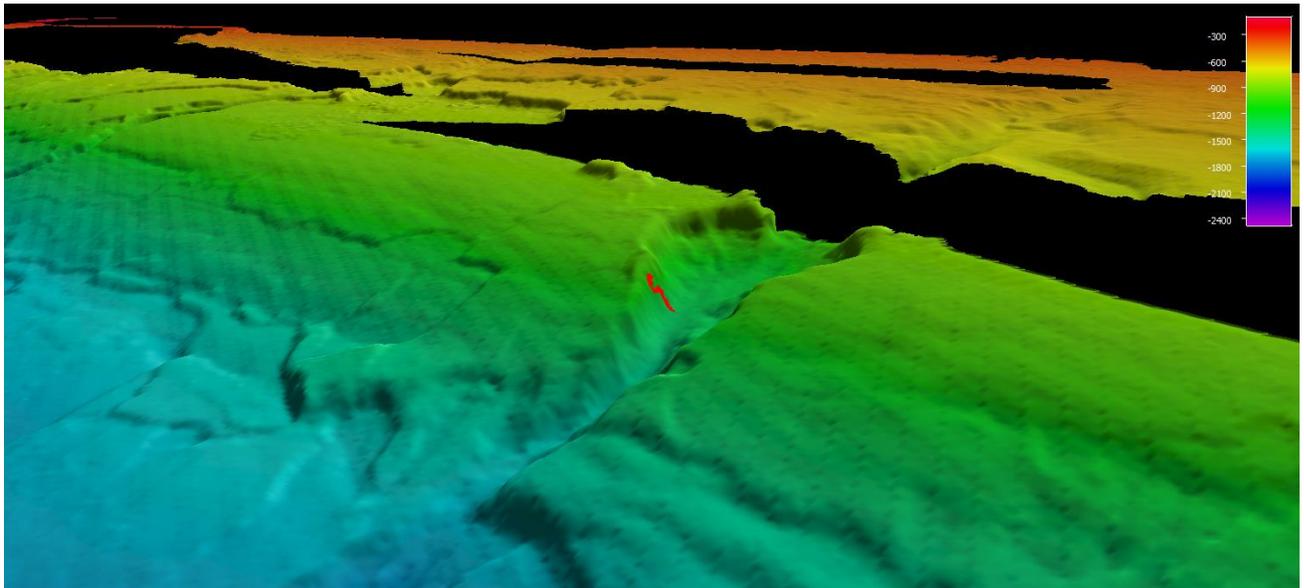
## Scientists Involved

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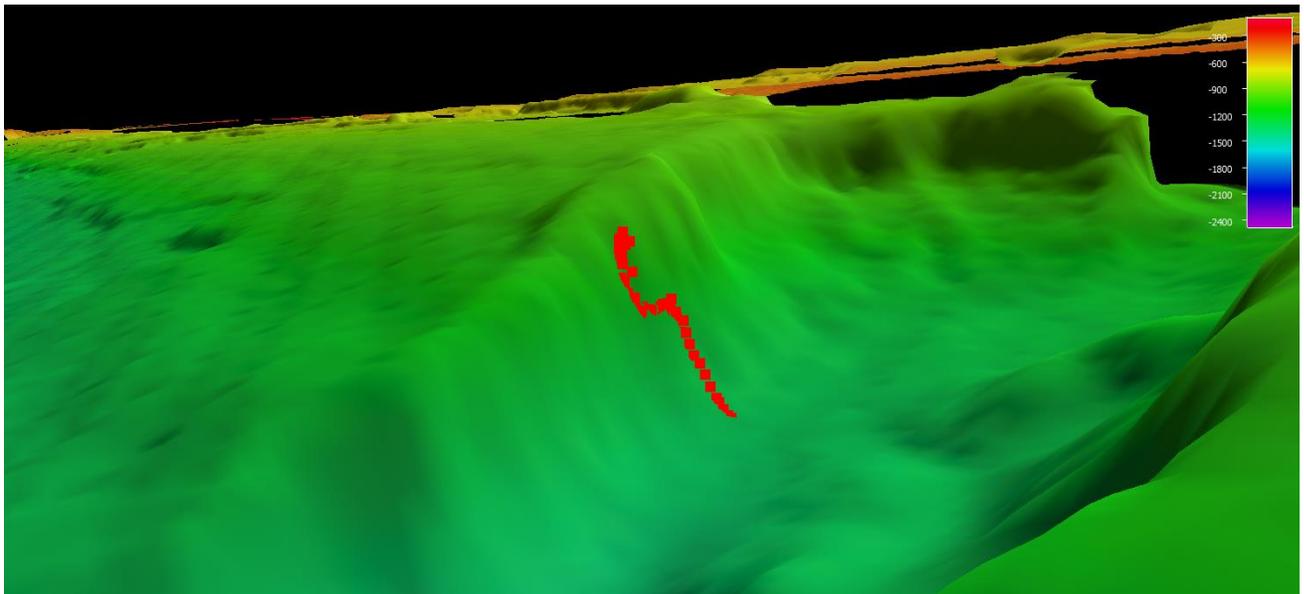
## Dive Purpose and Description

Dive Purpose	The purpose of the dive was to explore a minor box canyon located between Block and Alvin Canyons. The dive track was designed to traverse across steep terrain that was predicted to provide suitable habitat for deep-sea corals and sponges. This site was also close to the Ocean Observatories Initiative (OOI) Pioneer Array. Thus, benthic data collected during the dive would be linkable to long-term oceanographic datasets collected at the Pioneer Array.
Dive Description	The ROVs reached the seafloor at approximately 1315 UTC. The bottom community was characteristic of soft substrate observed throughout this expedition, and comprised of small swimming sea cucumbers (Elipiidae), hake ( <i>Antimora</i> sp.), cutthroat eels ( <i>Synaphobranchus gracilis</i> ), and octopods ( <i>Graneledone verrucosa</i> ). The canyon axis also had carbonate debris scattered throughout. Once the ROVs reached the canyon walls, the lower parts were comprised of highly consolidated but not cemented mudstone, which has been observed in numerous other canyons throughout this expedition. Despite being steep, the canyon walls were not colonized heavily with encrusting organisms besides small demosponges. As the ROVs ascended the canyon walls, the lithology transitioned into the sheer carbonate rocks also observed in Veatch Canyon. These walls were encrusted patchily with flame scallops ( <i>Acesta cryptadelphe</i> ), sea stars ( <i>Neomorphaser forcipatus</i> ), cup corals, yellow octocorals ( <i>Acanthogorgia</i> sp. and <i>Paramuricea</i> sp.), purple stoloniferous corals ( <i>Clavularia</i> sp.), bubblegum corals ( <i>Paragorgia arborea</i> ), and black corals ( <i>Bathypathes</i> sp., <i>Parantipathes larix</i> , and <i>Telopathes magna</i> ). Variations in lithology were also observed, with thin intervals (20-50 cm) of much harder carbonate rock more heavily encrusted than the softer interceding areas. Five samples were collected on this dive: a demosponge, a small primnoid coral, two specimens of <i>Acanthogorgia</i> sp. with many associates including aplacophorans, and <i>Parantipathes larix</i> with associated brittlestars (Ophiacanthidae) and squat lobsters ( <i>Uroptychus</i> sp.). The collected coral specimens are known species, but they will be important to support multiple genetic and evolutionary studies. Additionally, some of their associates may be new species.
Notable Observations	<ul style="list-style-type: none"> <li>- Sheer carbonate walls extending most of the height of the western canyon wall.</li> <li>- Heavily encrusting corals and sponges, particularly near the rim of the canyon.</li> </ul>
Community Presence/ Absence (community is defined as more than two species)	<ul style="list-style-type: none"> <li>✓ Corals and Sponges</li> <li>✗ Chemosynthetic Community</li> <li>✓ High-biodiversity Community</li> <li>✗ Active Seep or Vent</li> <li>✗ Extinct Seep or Vent</li> <li>✗ Hydrates</li> </ul>

## Overall Map of the ROV Dive Area



## Close-up Map of Main Dive Site



## Representative Photos of the Dive



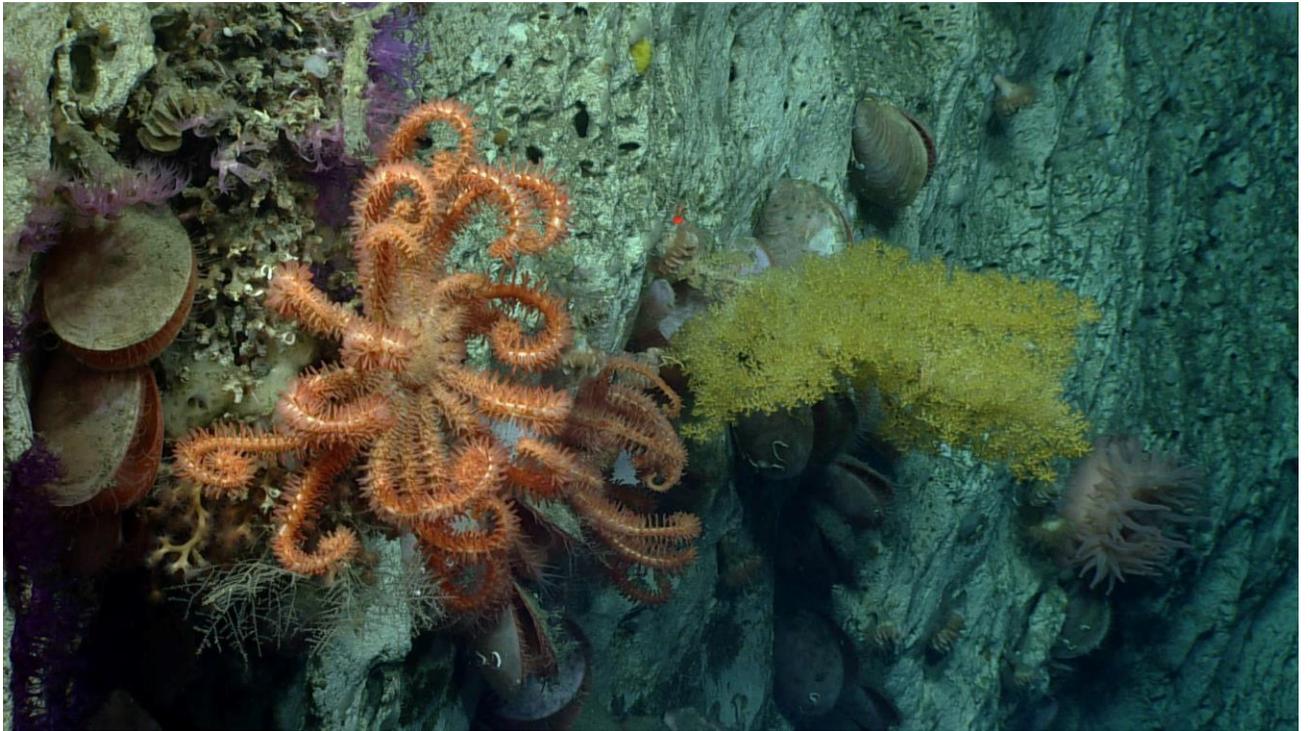
Warty octopus (*Graneledone verrucosa*) and shortfin squid (*Illex illecebrosus*) documented during the dive.



Cutthroat eel (*Synaphobranchus affinis*) feeding on a piece of fish.



Fault in rock observed during the dive. Much harder carbonate rock were more frequently overgrown by organisms compared to the softer interceding areas.

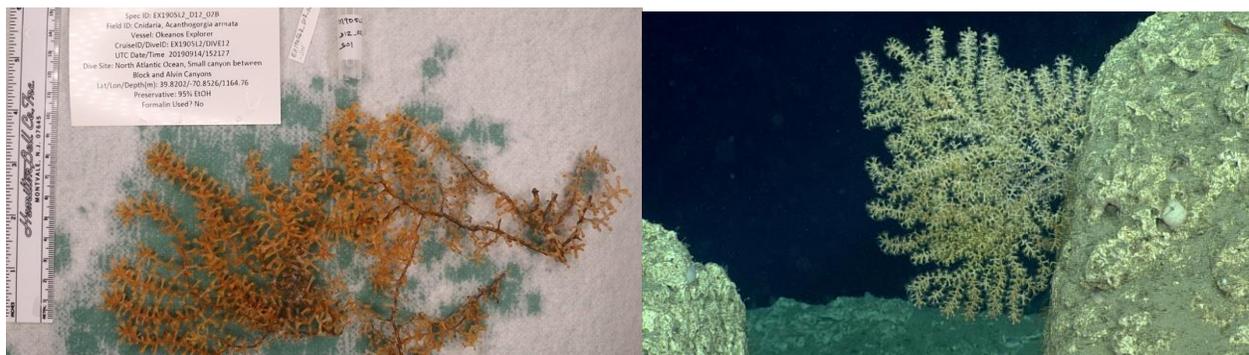


A diverse assemblage of invertebrates growing on the canyon wall, including a *Novodinia* sea star, a yellow octocoral (*Acanthogorgia* sp.), purple stoloniferous octocorals (*Clavularia* sp.), flame scallops (*Acesta cryptadelphe*), and an anemone.

## Samples Collected



Sample ID	EX1905L2_D12_01B		
Date (UTC)	20190914		
Time (UTC)	143812		
Latitude	39.82040		
Longitude	-70.85230		
Depth (m)	1176.9		
Temp. (°C)	4.260		
Field ID(s)	Demospongiae		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D12_01B_A01	Gastropoda	1
	EX1905L2_D12_01B_A02	Polychaeta	1
	EX1905L2_D12_01B_A03	Holothuroidea	1



Sample ID	EX1905L2_D12_02B		
Date (UTC)	20190914		
Time (UTC)	152127		
Latitude	39.82020		
Longitude	-70.85260		
Depth (m)	1164.8		
Temp. (°C)	4.295		
Field ID(s)	<i>Acanthogorgia armata</i>		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D12_02B_A01	Polychaeta	5

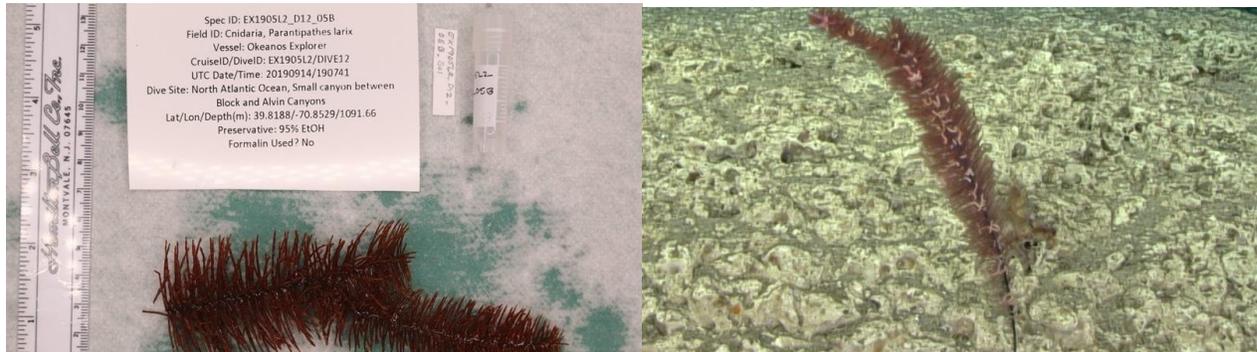


Sample ID	EX1905L2_D12_03B		
Date (UTC)	20190914		
Time (UTC)	163808		
Latitude	39.81910		
Longitude	-70.85240		
Depth (m)	1170.8		
Temp. (°C)	4.291		
Field ID(s)	Primnoidae		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D12_03B_A01	Gastropoda	1
	EX1905L2_D12_03B_A02	Sipunculida	1
	EX1905L2_D12_03B_A03	Caprellidae	1
	EX1905L2_D12_03B_A04	Amphipoda A	18
	EX1905L2_D12_03B_A05	Isopoda	1
Comments			



Sample ID	EX1905L2_D12_04B		
Date (UTC)	20190914		
Time (UTC)	173624		
Latitude	39.81870		
Longitude	-70.85270		
Depth (m)	1138.1		
Temp. (°C)	4.263		
Field ID(s)	<i>Acanthogorgia armata</i>		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D12_04B_A01	Aplacophora	2

	EX1905L2_D12_04B_A02	Actiniaria	2
	EX1905L2_D12_04B_A03	Ophiacanthidae	11
	EX1905L2_D12_04B_A04	Polynoidae	23
	EX1905L2_D12_04B_A05	Polychaeta	5
Comments			



Sample ID	EX1905L2_D12_05B		
Date (UTC)	20190914		
Time (UTC)	190741		
Latitude	39.81880		
Longitude	-70.85290		
Depth (m)	1091.7		
Temp. (°C)	4.285		
Field ID(s)	<i>Parantipathes larix</i>		
Commensals	Commensal Sample ID	Field Identification	Count
	EX1905L2_D12_05B_A01	Ophiacanthidae	5
	EX1905L2_D12_05B_A02	<i>Uroptycus</i> sp.	2
Comments			