Ocean Exploration and Research

EX-18-11 Expedition Report

Océano Profundo 2018:
Exploring Deep-Sea Habitats off Puerto Rico and the U.S. Virgin Islands

EX-18-11: Puerto Rico and U.S. Virgin Islands (ROV & Mapping)

October 30 - November 20, 2018

San Juan, Puerto Rico to San Juan, Puerto Rico

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Abstract

Between October 30 and November 20, 2018, the Office of Ocean Exploration and Research (OER) of the National Oceanic and Atmospheric Administration (NOAA) and partners conducted a 22-day telepresence-enabled expedition on NOAA Ship *Okeanos Explorer* to collect critical baseline information about unknown and poorly understood deep-water areas surrounding Puerto Rico and the U.S. Virgin Islands. The goal of the expedition was to use remotely operated vehicle (ROV) dives in combination with mapping operations to increase our understanding of deep-sea ecosystems of this poorly studied 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 19 successful dives ranging in depth from 250 to 5,000 meters that explored a wide diversity of habitats and geological features, including deep-sea fish habitats, deep-sea coral and sponge communities, midwater habitats, submarine canyons, submarine landslides, and more. Midwater explorations at depths ranging from 300 to 2,000 meters were also conducted during two ROV dives 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, 82 biological samples were collected (39 primary and 43 associated taxa), 19 of which 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. Commercially important deep-water fish species were documented on six dives, including a sighting of the queen snapper (*Etelis oculatus*) at a record depth of 539 meters. Other noteworthy ROV observations included a translucent egg case with a catshark embryo actively swimming inside, first-time documentation of several species of deep-sea urchins feeding, and documentation of three species of sea stars that are likely new to science. Additionally, the expedition investigated diverse geological features, including two large submarine landslides, one of which is believed to have caused the large tsunami of 1918. Eight rock samples were collected for geochemical composition analyses and age-dating to increase our understanding of the geological context of this region. In addition to ROV dives, the expedition also included mapping operations using four different sonar systems (multibeam, split-beam, sub-bottom profiler and ADCP). Over 14,959 square kilometers of seafloor were mapped over the course of the expedition, including areas around Mona Island, Saba Valley, and Engaño Canyon that had never before been mapped using high-resolution sonars.

All 14.2 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 publically available through national archives. Highlight images, videos, educational materials, and descriptions of the accomplishments of the expedition are available via the expedition website (https://oceanexplorer.noaa.gov/okeanos/explorations/ex1811/welcome.html). A total of 63 scientists, managers, and students from 37 institutions in seven countries participated in the expedition as members of the science team through telepresence technology.

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1. Introduction

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

NOAA Ship *Okeanos Explorer* is the only U.S. federal vessel dedicated to exploring our largely unknown ocean for the purpose of discovery and the advancement of knowledge. America's future depends on understanding the ocean. We explore the ocean to make valuable scientific, economic, and cultural discoveries, 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 October 30 through November 20, 2018, 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 surrounding Puerto Rico and the U.S. Virgin Islands. The deep waters of Puerto Rico and the U.S. Virgin Islands contain a wide diversity of habitats and geological features, including seamounts, submarine canyons, valleys, troughs, and trenches, the vast majority of which have never been explored in detail.

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 the *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

Océano Profundo 2018 (deep ocean in Spanish) 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, including the Caribbean Sea, 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. The deep waters surrounding Puerto Rico and the U.S. Virgin Islands are some of the least explored in the entire U.S. exclusive economic zone (EEZ) of the Atlantic Ocean, and information collected during the *Océano Profundo 2018* expedition aimed to fill important knowledge gaps.

In addition to being largely unexplored, the deep waters of Puerto Rico and the U.S. Virgin Islands also include various areas where more information is needed to support management efforts. Specifically, deep-sea environments inhabited by commercial fishery species, particularly deep-water grouper and snapper, as well as deeper extensions of marine managed areas, remain mostly unexplored in this region. The *Océano Profundo 2018* expedition involved mapping and ROV operations in several of these areas and thereby provided critical baseline information to support the science and management needs of the region. Furthermore, the Caribbean Sea is an area of active tectonic activity, which is subject to earthquakes, tsunamis, landslides, and other geohazards. During the *Océano Profundo 2018* expedition, several such geological areas of interest were explored, thereby providing important insights into past, present, and future geohazards of the region.

1.3 Expedition Objectives

The *Océano Profundo 2018* 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-caribbean.html) that was disseminated in July through August of 2018. 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. These objectives included:

- Acquire data on deep-water habitats to support science and management needs in Caribbean waters off Puerto Rico and the U.S. Virgin Islands, as well as in support of the ASPIRE campaign
- Explore deep-water areas relevant to resource managers, such as essential fish habitat (EFH), habitat areas of particular concern (HAPCs), 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, deep-water snapper and grouper habitats, and other vulnerable marine habitats
- Investigate biogeographic patterns and connectivity of deep-sea organisms for use in broader comparisons of 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-resolution) 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 assist in better understanding the characteristics of the water column and the pelagic fauna
- 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 *Océano Profundo 2018* expedition included the participation of 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 22 members representing six institutions, including NOAA's OER, NOAA's National Centers for Environmental Information (NCEI), the Global Foundation for Ocean Exploration (GFOE), the University Corporation for Atmospheric Research (UCAR), the Institute for Socio-Ecological Research (ISER), and Temple University (TU). A list of the 22 onboard mission personnel members of the *Océano Profundo 2018* expedition is provided in Table 1.

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Table 1. List of onboard mission personnel participants of the *Océano Profundo 2018* expedition.

Name	Role	Affiliation	Email
Daniel Wagner	Expedition Coordinator	NOAA/OER	daniel.wagner@noaa.gov
Stacey Williams	Science Co-Lead	ISER/UCAR	stcmwilliams@gmail.com
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Jeff Laning	ROV Team	GFOE	jlaning66@gmail.com
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Emily Narrow	Videographer	GFOE	enarrow@gmail.com
Caitlin Bailey	Videographer	GFOE	cbailey2290@gmail.com
Art Howard	Videographer	GFOE	art@art-work.global
Roland Brian	Video Engineer	GFOE	roland.brian@gmail.com
Bob Knott	Video Engineer	GFOE	k1rwk@cox.net

Shore-based science team members participated in this expedition via telepresence technology from various exploration command centers (ECCs) around the country, including an ECC that was established specifically for this mission at the EcoExploratorio Science Museum of Puerto Rico, as well as from science team members' offices and homes. A total of 63 resource managers, scientists and students from 37 institutions participated in the expedition on a regular basis, including participants from 15 U.S. states and seven different countries. A list of the 63 shore-side science team members of the *Océano Profundo 2018* expedition is provided in Table 2.

Table 2. List of shore-side science team members that participated in the *Océano Profundo 2018* expedition remotely via telepresence technology.

Name	Affiliation	Location	Email
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2. Methods

2.1 Operations Overview

The *Océano Profundo 2018* expedition was a 22-day expedition that started in San Juan, Puerto Rico on October 30, 2018, and ended in San Juan, Puerto Rico on November 20, 2018. The expedition included 24-hour operations, with daytime ROV dives to depths ranging between 250-5,000 meters, and overnight mapping operations to depths of 6,000 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, trenches, submarine landslides, and other poorly known deep-sea habitats. Mapping operations concentrated on seafloor and water column areas with little or no high-resolution sonar data, as well as to support 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 *Océano Profundo 2018* 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 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 depth 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 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 both 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 and Dive 17, which included midwater transects during the second half of the dive, all other dives focused exclusively 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 and Dive 17 also included horizontal midwater transects during the second half of the dive. During Dive 10, midwater transects were conducted at depths of 2,000, 900, 700, 500, and 300 meters. Each midwater transect lasted 25 minutes and was followed by a brief ascent to the next shallower transect depth. During Dive 17, midwater transects, approximately 45 minutes in duration each, were conducted at depths of 900, 700, 500, and 300 meters. Organisms encountered during midwater transects were identified to the lowest possible taxon, and recorded using the science chatroom and SeaTubeV2 software as described above.

2.3.2 Specimen Collections

D2 is equipped with two manipulator arms (*Schillings Orion* and *Kraft Predator*) and a sampling scoop 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 *Océano Profundo 2018* expedition. Biological

specimen collections (typically no more than four primary specimens per dive) targeted animals suspected of being a new species, new records or new depth ranges for the region, the dominant morphotype in a habitat, specimens that may contribute to connectivity studies, or other specimens with significant discovery potential. Similarly, geologic specimen collections (typically no more than two specimens per dive) targeted samples that had the potential to contribute to significant scientific discoveries, such as providing new insights in to the geologic history 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 processed in duplicates, with one set being processed using a DNA extraction kit provided by the Ocean Genome Legacy Center, and the other set being preserved in 95% ethanol for subsequent curation at the Biorepository at the National Museum of Natural History, Smithsonian Institution. All geological samples were weighed, rinsed in freshwater, 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. One set of each duplicate DNA sample was shipped to the Biorepository at the National Museum of Natural History, Smithsonian Institution, whereas the other DNA set was shipped to the Ocean Genome Legacy Center. Geological samples were all shipped to the Marine and Geology Repository at Oregon State University. Details for all repositories that will curate specimens collected during the *Océano Profundo 2018*, as well 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
  Website: https://invertebrates.si.edu/LoanPolicy.html

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- Biorepository, National Museum of Natural History, Smithsonian Institution, Museum Support Center, 4210 Silver Hill Road, Suitland, MD 20746
  Contact: Chris Huddleston, huddlestonc@si.edu
  Website: https://naturalhistory.si.edu/research/biorepository

- Ocean Genome Legacy Center, Northeastern University, 430 Nahant Road, Nahant, MA 01908
  Contact: Hannah Appiah-Madson, h.appiah-madson@northeastern.edu
  Website: https://www.northeastern.edu/ogl/

- Marine and Geology Repository, Oregon State University
  Burt 346, Corvallis, OR 97331-5503
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  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 *Océano Profundo 2018* expedition in order to map seafloor and water column features. These sonars include a Kongsberg EM302 multibeam, a suite of five Kongsberg EK60 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 concurrent with ROV dive operations were limited to collecting data with the ADCP and the EK60 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 split-beam fisheries sonars were used to characterize water column biological scattering layers at ROV dive sites, and to help guide exploration transects during ROV dives that included midwater transects (Dives 10 and 17). Mapping operations using the four different types of sonars conducted during the *Océano Profundo 2018* 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.

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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 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.

2.4.3 Split-beam Sonars (Kongsberg EK60)

NOAA Ship *Okeanos Explorer* is equipped with five EK60 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 cruise 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 sonars were used during midwater transects of ROV dives 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 Sun Photometer Measurements

OER gathers limited at-sea measurements aboard NOAA Ship *Okeanos Explorer* in order to support a NASA-led, long-term research effort that assesses marine aerosols. Onboard personnel collected georeferenced sun photometer measurements on sunny days during the expedition in order to collect data to support the Maritime Aerosol Network (MAN) component of the Aerosol Robotic Network (AERONET). AERONET is a network of sun

photometers which measure atmospheric aerosol properties around the world. MAN compliments AERONET by conducting sun photometer measurements on ships of opportunity in order to monitor aerosol properties over the oceans. Sun photometer measurements were conducted as time allowed on cloud-free days.

2.6 Permits and Clearances

The operating area of the *Océano Profundo 2018* expedition focused mostly on the U.S. EEZ of the Caribbean Sea, but also included limited operations in U.S. territorial waters of Puerto Rico (up to 9 nautical miles offshore), U.S. territorial waters of the U.S. Virgin Islands (up to 3 nautical miles from shore), as well as adjacent waters in the EEZ of the Dominican Republic.

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 biological evaluation determining that our operations 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 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, including the Caribbean Sea. They concurred that our operations would not adversely affect EFH, provided adherence to our standard operating procedures and their guidance stated in the letter. Additionally, a request for a letter of acknowledgement (LOA) from the NOAA Southeast Regional Office (SERO) covering all activities to be conducted as part of this expedition was submitted on September 11, 2018. A signed LOA from the SERO Regional Administrator stating that expedition activities are all in accordance with NMFS

regulations was received on September 18, 2018.

Operations in the EEZ of the Dominican Republic were conducted under a marine scientific research permit approved by the Ministry of Foreign Relations of the Dominican Republic (DCEP 031004). Operations in U.S. territorial waters of Puerto Rico were conducted under a permit approved by the Department of Natural and Environmental Resources of the Government of Puerto Rico (2018-IC-073). Operations in U.S. territorial waters of the U.S. Virgin Islands were conducted under a permit approved by the Department of Fish and Wildlife of the Government of the U.S. Virgin Islands (DFW18094X), as well as a permit approved by the National Parks Service (BUIS-2018-SCI-0006) for activities within the Buck Island Reef National Marine Monument. Copies of all permits and environmental clearance documents that were secured for the expedition are presented in Appendices B though I.

2.7 Expedition Schedule

The *Océano Profundo 2018* expedition started in San Juan, Puerto Rico on October 30, 2018 and ended in that same port city on November 20, 2018 (Table 3). Daily mapping operations were conducted throughout the expedition from October 30 to November 20, 2018. Daily ROV dives were conducted between October 31 and November 19, 2018, with the exception of November 3, where no dive operations were conducted due to weather conditions. Sun photometer measurements were taken on November 7 and 8, 2018. A summary of the expedition's main operations is presented table 3 below.

Table 3. Schedule of the *Océano Profundo 2018* expedition. The locality is where most operations were undertaken each day, which in most cases is the location of ROV dives.

Date	Locality	Operations
Oct-30	San Juan, Puerto Rico	Departed San Juan, all day mapping operations while in transit
Oct-31	East of Vieques Island	USBL navigation system calibration, Dive 1, overnight mapping operations
Nov-1	East of Vieques Island	Dive 2, overnight mapping operations
Nov-2	Buck Island	Dive 3, overnight mapping operations
Nov-3	Saba Valley	Dive operations cancelled due to weather, all day mapping operations
Nov-4	South of St. Croix	Dive 4, overnight mapping operations
Nov-5	Virgin Islands Trough	Dive 5, overnight mapping operations
Nov-6	Punta Yeguas, Puerto Rico	Dive 6, overnight mapping operations
Nov-7	Caja de Muertos Island	Dive 7, sun photometer measurements, overnight mapping operations
Nov-8	South of La Parguera	Dive 8, sun photometer measurements, overnight mapping operations
Nov-9	Jaguey Spur	Dive 9, overnight mapping operations
Nov-10	Mona Canyon	Dive 10, overnight mapping operations

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Date (cont.)	Locality	Operations
Nov-11	North of Vega Baja	Dive 11, overnight mapping operations
Nov-12	Mona Canyon	Dive 12, overnight mapping operations
Nov-13	Northeast of Mona Island	Dive 13, overnight mapping operations
Nov-14	South of Desecheo Island	Dive 14, overnight mapping operations
Nov-15	West of Desecheo Island	Dive 15, overnight mapping operations
Nov-16	Northwest of Desecheo Island	Dive 16, overnight mapping operations
Nov-17	South of Mona Island	Dive 17, overnight mapping operations
Nov-18	West of Desecheo Island	Dive 18, overnight mapping operations
Nov-19	Mona Seamount	Dive 19, overnight mapping operations
Nov-20	San Juan, Puerto Rico	Arrived in San Juan

2.8 Expedition Map

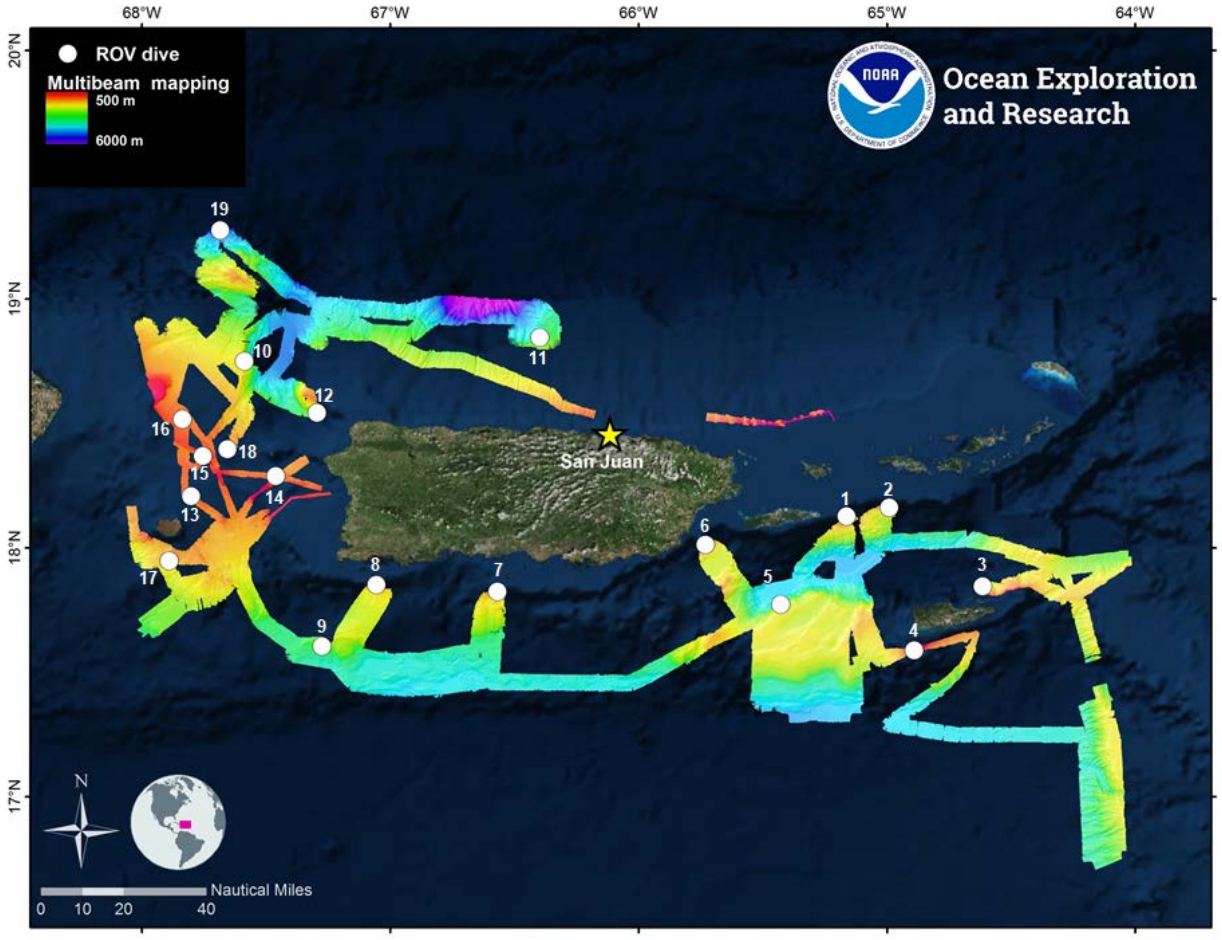

Figure 1. Map showing the location of ROV and mapping operations conducted during the *Océano Profundo 2018* expedition that explored deep-sea habitats off Puerto Rico, the U.S. Virgin Islands, and the Dominican Republic. Labels correspond to ROV dive numbers.

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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 cruise code (EX1811) at this data 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 data portal: https://www.ncddc.noaa.gov/website/google_maps/OE/mapsOE.htm. ROV dive annotations from expedition are available by looking up the cruise code (EX1811) at https://data.oceannetworks.ca/SeaTubeV2.

Objective 1: Acquire data on deep-water habitats to support science and management needs in Caribbean waters off Puerto Rico and the U.S. Virgin Islands, as well as in support of the ASPIRE campaign.

- Conducted a total of 19 ROV dives around Puerto Rico and the U.S. Virgin Islands for a total dive time of 145:27 hours and total on-bottom time of 96:16 hours. Collectively, these dives explored seafloor habitats at depths between 250-5,000 meters over a linear distance of 9.56 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:
    - Translucent egg case with a catshark embryo actively swimming inside seen at a depth of 250 meters during Dive 15 of the expedition.
    - Commercially valuable queen snapper (*Etelis oculatus*), silk snapper (*Lutjanus vivanus*), and misty grouper (*Hyporthodus mystacinus*) seen at depths between 250-539 meters on six different ROV dives. This included the sighting of the queen snapper at a record depth of 539 meters on Dive 7, thereby surpassing the previous known depth record of this species (450 meters) by a substantial margin.
    - First-time documentation of several species of deep-sea urchins feeding, including urchins feeding on crinoids, carnivorous sponges, black corals, and bamboo corals.
    - Documentation of five particularly rare sea star species, including three that are likely new species to science.
- Collected 82 biological samples (39 primary and 43 associated taxa). Nineteen 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 (HAPCs), marine protected areas (MPAs), and other priority management areas.

- Conducted five ROV dives in four different marine managed areas, including the deepest dives ever conducted inside the Buck Island Reef National Monument (1,812 meters), Mona Island Nature Reserve (1,212 meters), La Parguera Nature Reserve (1,101 meters), and Inés María Mendoza Nature Reserve (877 meters).
- Conducted mapping operations in seven different marine managed areas, including mapping areas in the deeper extensions of Buck Island Reef National Monument, Mona Island Nature Reserve, La Parguera Nature Reserve, Inés María Mendoza Nature Reserve, Cabezas de San Juan Nature Reserve, Río Espíritu Santo Nature Reserve, and Bosque Natural de Boquerón Nature Reserve. Deep-water portions of many of these areas had not been previously mapped with high-resolution sonars.

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, deep-water snapper and grouper habitats, and other vulnerable marine habitats.

- Deep-sea corals and sponges were recorded on all 19 dives of the expedition and at depths between 250-4,998 meters. High-density communities of deep-sea corals and sponges were documented during six different dives of the expedition (Dives 4, 5, 13, 14, 15, 18), and high-diversity communities were documented during eight different dives (Dives 4, 5, 9, 13, 14, 15, 17, 18). These coral and sponge communities were found at depths ranging between 300-2,000 meters, including one of which is currently among the deepest high-density and high-diversity communities (2,000 meters; Dive 5) known from the U.S. Caribbean region.
- Conducted nine ROV dives focused on exploring areas of interest to commercially important fishery species, including areas prioritized for exploration by the Caribbean Fishery Management Council, fishery biologists, and fishers (Dives 1, 2, 4, 7, 13, 14, 15, 16, 18). The commercially valuable queen snapper (*Etelis oculatus*), silk snapper (*Lutjanus vivanus*) and misty grouper (*Hyporthodus mystacinus*) were documented during six different ROV dives (Dives 4, 7, 13, 14, 15, 16) and at depths ranging between 250-539 meters. Additionally, individuals of the queen snapper were recorded at a record depth of 539 meters, thus surpassing the previous depth record of this species (450 meters) by a substantial margin.

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

- The 19 ROV dives completed during the expedition will likely represent the southwestern-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, information collected during these dives will provide very valuable information to interpret biogeographic patterns across the entire Atlantic range.
- Twenty 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 19 ROV dives explored a wide variety of different geological features including submarine canyons, escarpments, seamounts, trenches, terraces, troughs, and submarine landslides. Additionally, the expedition included three ROV dives which focused entirely on geological exploration of seafloor habitats (Dives 11, 12, 19).
- Conducted two ROV dives on large submarine landslides (Dives 11, 12), including one which is believed to have caused the large tsunami of 1918 (Dive 11). Data collected during these dives will increase our understanding of past, present, and future geohazards of the region.
- Collected eight 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 Caribbean 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 14,959 square kilometers of seafloor, including 14,429 square kilometers in the U.S. EEZ and 530 square kilometers in the EEZ of the Dominican Republic. Mapping operations included several areas that had never before been mapped with high-resolution multibeam sonars, including deep-sea areas around Mona Island, Saba Valley, Engaño Canyon and Engaño Bank.
- High-resolution multibeam data were collected over all 19 ROV dives and used to refine dive plans and safely conduct all dive operations.
- While no maritime heritage sites were identified in the field during seafloor mapping operations, the expedition included mapping in large areas around Mona

Island 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 for a total of 5:16 hours and at depths between 300-2,000 meters during two separate ROV dives (Dives 10, 17). Additional data on midwater habitats were collected during all ascents and descents of the 19 ROV dives of the expedition, for a total of 49:11 hours.

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 63 scientists, managers, and students from seven different countries and 15 U.S. states participated in the expedition regularly via telepresence technology as members of the shore-side science team. Additionally, 226 scientists, managers and students signed up for the expedition science listserv, and participated intermittently via telepresence technology.
- All 14.2 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 publically available through national archives. Highlight images, videos and description of the accomplishments of the expedition, as well as educational materials, are already available via the expedition website (https://OceanExplorer.NOAA.gov/okeanos/explorations/ex1811/welcome.html).
- Live video feeds from the expedition received more than 166,900 views. Expedition content on the OER website received over 18,900 views during the expedition.
- One new exploration command center was established at the EcoExploratorio Science Museum of Puerto Rico, which facilitated participation by local scientists and the general public. Over 6,100 people visited the EcoExploratorio during the expedition, and social media posts and Facebook live events hosted by the museum received over 967,500 views.
- Conducted eight live telepresence interactions with over 675 individuals with various venues around the country, including partners at the EcoExploratorio Science Museum of Puerto Rico, St. Croix National Park Service, Gulf and Caribbean Fisheries Institute Conference, National Ocean Exploration Forum, New England Aquarium, South Carolina Aquarium, University of Hawaii, and the Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE) Workshop.
- Conducted seven ship tours of NOAA Ship *Okeanos Explorer* for a total of 49 resource managers and scientists representing federal and territorial management agencies, non-governmental institutions, academic institutions, and the private sector.

- Throughout the expedition, science and outreach communications were conducted in both English and Spanish language, including bilingual coverage of the live video narrations, expedition website, live interactions, and ship tours.
- Received news and media coverage by numerous international, national, and local media sources, including features stories by the Associated Press, CNN, NBC, ABC, USA Today, Ciencia Puerto Rico, El Nuevo Dia, Virgin Island Consortium, St. Croix Source, Irish Examiner, Miami Herald, Post & Courier, and others.

3.2 ROV Dive Operations

A total of 19 ROV dives were conducted during the *Océano Profundo 2018* expedition to maximum depths ranging between 250-5,000 meters (Table 4). The primary focus was on seafloor biology on 16 dives and geology on three dives. Furthermore, dedicated midwater transects were conducted during the second portion of two ROV dives (Dives 10 and 17), for 2:08 hours and 3:08 hours of midwater exploration time, respectively. Total dive times of individual ROV dives ranged between 2:52-10:22 hours, for a total dive time of 145:27 hours. On-bottom dive times of individual ROV dives ranged between 2:11-7:10 hours, for a total on-bottom time of 96:16 hours over the course of the expedition. Linear distances covered on individual ROV dives ranged between 230-901 meters, for a total on-bottom distance covered throughout the expedition of 9,556 meters. Summary information for the 19 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.

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Table 4. Summary information for the 19 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)	Midwater transects (h:min)
Oct-31	1	East of Vieques	Biology	276-283	18.1273	-65.1630	230	2:11	2:52	N/A
Nov-1	2	East of Vieques	Biology	458-780	18.1632	-64.9907	901	6:55	8:09	N/A
Nov-2	3	Buck Island Reef	Biology	1607-1812	17.8456	-64.6142	695	5:52	8:06	N/A
Nov-4	4	South of St. Croix	Biology	450-564	17.5892	-64.8891	341	4:51	5:43	N/A
Nov-5	5	Virgin Islands Trough	Biology	1890-2153	17.7729	-65.4279	338	5:43	8:32	N/A
Nov-6	6	Punta Yeguas	Biology	636-877	18.0139	-65.7310	900	7:10	8:18	N/A
Nov-7	7	Caja de Muertos	Biology	401-535	17.8244	-66.5675	557	4:35	6:02	N/A
Nov-8	8	South of La Parguera	Biology	804-1101	17.8520	-67.0553	933	6:57	8:22	N/A
Nov-9	9	Jaguey Spur	Biology	2610-2789	17.6057	-67.2749	340	4:47	8:02	N/A
Nov-10	10	Mona Canyon	Biology	2536-2766	18.7512	-67.5870	350	3:36	10:06	2:08
Nov-11	11	North of Vega Baja	Geology	3024-3342	18.8469	-66.3974	382	4:35	8:20	N/A
Nov-12	12	Mona Canyon	Geology	1966-2415	18.5435	-67.2951	586	6:02	8:39	N/A
Nov-13	13	Northeast of Mona	Biology	409-566	18.2089	-67.8016	592	6:55	8:02	N/A
Nov-14	14	South of Desecheo	Biology	319-398	18.2896	-67.4598	455	3:01	5:57	N/A
Nov-15	15	West of Desecheo	Biology	250-366	18.3701	-67.7549	412	5:33	8:12	N/A
Nov-16	16	Northwest of Desecheo	Biology	431-521	18.5180	-67.8364	716	6:59	8:04	N/A
Nov-17	17	South of Mona	Biology	1129-1212	17.9478	-67.8898	255	4:08	10:22	3:08
Nov-18	18	West of Desecheo	Biology	307-367	18.3970	-67.6550	423	3:45	5:08	N/A
Nov-19	19	Mona Seamount	Geology	4927-5000	19.2781	-67.6840	150	2:32	8:22	N/A

3.3 Specimen Collections

A total of 90 samples were collected using the manipulator arms of the ROV including eight geological samples (Table 5) and 82 biological samples (Table 6). Among the collected biological samples, 39 were purposely collected as primary specimens, whereas 43 were incidentally 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, duplicate DNA samples of most biological samples were collected and one set of these was shipped to the Ocean Genome Legacy Center and the other to the Biorepository at the National Museum of Natural History, Smithsonian Institution.

Table 5. Summary information for the eight 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)
EX1811_D05_02G	Nov-5	16:41	Rock	17.7731	-65.4270	2043	3.83	34.97	7.79
EX1811_D09_02G	Nov-9	18:30	Rock	17.6068	-67.2729	2639	4.14	34.97	6.44
EX1811_D10_01G	Nov-10	14:12	Rock	18.7514	-67.5871	2764	2.86	34.94	7.96
EX1811_D11_01G	Nov-11	17:49	Rock	18.8454	-66.3944	3034	2.72	34.92	7.74
EX1811_D12_01G	Nov-12	16:39	Rock	18.5442	-67.2943	2348	3.05	34.92	7.89
EX1811_D12_04G	Nov-12	20:40	Rock	18.5447	-67.2908	1990	3.62	34.95	7.74
EX1811_D19_01G	Nov-19	15:40	Rock	19.2783	-67.6840	4993	2.19	34.93	7.52
EX1811_D19_03G	Nov-19	16:52	Rock	19.2788	-67.6839	4960	2.23	34.93	7.52

Table 6. Summary information for the 82 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 both the Ocean Genome Legacy Center and 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
EX1811_D02_01B	Nov-1	16:06	*Crypthelia sp.*	18.1656	-64.9911	603	10.78	35.35	3.88	Yes
EX1811_D02_02B	Nov-1	17:52	*Pennatula sp.*	18.1665	-64.9932	559	12.25	35.56	4.06	Yes
EX1811_D02_03B	Nov-1	18:10	*Callogorgia sp.*	18.1666	-64.9934	554	12.29	35.58	4.06	Yes
EX1811_D02_03B_A01	Nov-1	18:10	Ophiuroidea	18.1666	-64.9934	554	12.29	35.58	4.06	Yes
EX1811_D04_01B	Nov-4	18:40	Plexauridae	17.5899	-64.8876	457	13.53	35.75	4.12	Yes
EX1811_D04_02B	Nov-4	19:31	Antipatharia	17.5897	-64.8874	447	13.5	35.74	4.11	Yes
EX1811_D04_02B_A01	Nov-4	19:31	Chirostylidae	17.5897	-64.8874	447	13.5	35.74	4.11	Yes
EX1811_D04_02B_A02	Nov-4	19:31	Shrimp	17.5897	-64.8874	447	13.5	35.74	4.11	No
EX1811_D05_01B	Nov-5	16:02	Tunicata	17.7731	-65.4273	2071	3.84	34.97	7.79	Yes
EX1811_D05_02G_A01	Nov-5	16:41	Crinoidea	17.7731	-65.4270	2043	3.83	34.97	7.79	No
EX1811_D05_02G_A02	Nov-5	16:41	*Crypthelia sp.*	17.7731	-65.4270	2043	3.83	34.97	7.79	No
EX1811_D05_02G_A03	Nov-5	16:41	Bryozoa	17.7731	-65.4270	2043	3.83	34.97	7.79	No
EX1811_D05_02G_A04	Nov-5	16:41	Polychaeta	17.7731	-65.4270	2043	3.83	34.97	7.79	No
EX1811_D05_03B	Nov-5	17:11	Asteroidea	17.7732	-65.4269	2038	3.83	34.97	7.79	No
EX1811_D05_03B_A01	Nov-5	17:11	Isididae	17.7732	-65.4269	2038	3.83	34.97	7.79	No

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Specimen Code (cont.)	Date (UTC)	Time (UTC)	Field ID	Latitude	Longitude	Depth (m)	Temp. (°C)	Salinity (PSU)	Dissolved oxygen (mg/L)	DNA sub-sample
EX1811_D05_04B	Nov-5	19:22	Chondrocladia	17.7717	-65.4250	1895	3.86	34.97	7.71	Yes
EX1811_D05_04B_A01	Nov-5	19:22	Polychaeta	17.7717	-65.4250	1895	3.86	34.97	7.71	No
EX1811_D06_01B	Nov-6	16:36	*Geodia sp.*	18.0168	-65.7292	693	8.27	34.99	3.88	Yes
EX1811_D06_02B	Nov-6	18:18	Hyalonematidae	18.0194	-65.7303	649	9.14	35.1	3.77	No
EX1811_D06_02B_A01	Nov-6	18:18	Zoantharia	18.0194	-65.7303	649	9.14	35.1	3.77	No
EX1811_D06_02B_A02	Nov-6	18:18	Squat lobster	18.0194	-65.7303	649	9.14	35.1	3.77	No
EX1811_D06_03B	Nov-6	18:35	Scleractinia	18.0195	-65.7305	649	9.21	35.11	3.77	Yes
EX1811_D06_04B	Nov-6	19:36	Zoantharia	18.0201	-65.7318	638	9.92	35.21	3.75	Yes
EX1811_D07_01B	Nov-7	18:51	*Pennatula sp.*	17.825	-66.5664	489	13.35	35.73	4.19	Yes
EX1811_D07_02B	Nov-7	19:55	Plexauridae	17.8254	-66.5659	438	14.41	35.93	4.47	Yes
EX1811_D07_02B_A01	Nov-7	19:55	Ophiuroidea	17.8254	-66.5659	438	14.41	35.93	4.47	Yes
EX1811_D07_02B_A02	Nov-7	19:55	Shrimp	17.8254	-66.5659	438	14.41	35.93	4.47	No
EX1811_D07_03B	Nov-7	21:54	Octocoral whip	17.8277	-66.5649	407	15.36	36.08	4.71	Yes
EX1811_D08_01B	Nov-8	16:37	Wood fall	17.855	-67.0524	907	6.29	34.88	4.58	No
EX1811_D08_01B_A01	Nov-8	16:37	Crinoidea	17.855	-67.0524	907	6.29	34.88	4.58	No
EX1811_D08_01B_A02	Nov-8	16:37	Crinoidea	17.855	-67.0524	907	6.29	34.88	4.58	No
EX1811_D08_01B_A03	Nov-8	16:37	Gastropoda	17.855	-67.0524	907	6.29	34.88	4.58	No
EX1811_D08_01B_A04	Nov-8	16:37	Polyplacophora	17.855	-67.0524	907	6.29	34.88	4.58	No
EX1811_D08_01B_A05	Nov-8	16:37	Polychaeta	17.855	-67.0524	907	6.29	34.88	4.58	No
EX1811_D08_02B	Nov-8	17:00	*Pennatula sp.*	17.8553	-67.0523	899	6.34	34.87	4.54	Yes
EX1811_D08_03B	Nov-8	17:46	*Madrepora oculata*	17.8558	-67.052	891	6.37	34.88	4.52	Yes
EX1811_D08_03B_A01	Nov-8	17:46	Porifera	17.8558	-67.052	891	6.37	34.88	4.52	Yes
EX1811_D08_03B_A02	Nov-8	17:46	Polychaeta	17.8558	-67.052	891	6.37	34.88	4.52	No
EX1811_D09_01B	Nov-9	16:40	Isididae	17.6062	-67.2738	2707	4.14	34.97	6.48	Yes
EX1811_D09_02G_A01	Nov-9	18:30	Porifera	17.6068	-67.2729	2639	4.14	34.97	6.44	No
EX1811_D09_02G_A02	Nov-9	18:30	Hexactenellida	17.6068	-67.2729	2639	4.14	34.97	6.44	No
EX1811_D09_02G_A03	Nov-9	18:30	Bryozoan	17.6068	-67.2729	2639	4.14	34.97	6.44	No
EX1811_D11_01G_A01	Nov-11	17:49	Bryozoa	18.8454	-66.3944	3034	2.72	34.92	7.74	No
EX1811_D11_01G_A02	Nov-11	17:49	Hexactenellida	18.8454	-66.3944	3034	2.72	34.92	7.74	No
EX1811_D11_01G_A03	Nov-11	17:49	Hexactenellida	18.8454	-66.3944	3034	2.72	34.92	7.74	No
EX1811_D11_02B	Nov-11	17:56	Porifera	18.8456	-66.3943	3034	2.72	34.92	7.74	Yes
EX1811_D11_03B	Nov-11	18:11	Pedicellasteridae	18.8456	-66.3943	3033	2.74	34.92	7.72	No
EX1811_D12_02B	Nov-12	17:34	*Candidella sp.*	18.5442	-67.2938	2265	3.2	34.95	7.8	Yes

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Specimen Code (cont.)	Date (UTC)	Time (UTC)	Field ID	Latitude	Longitude	Depth (m)	Temp. (°C)	Salinity (PSU)	Dissolved oxygen (mg/L)	DNA sub-sample
EX1811_D12_03B	Nov-12	17:47	Branching bryozoa	18.5441	-67.2937	2263	3.26	34.95	7.81	No
EX1811_D12_04G_A01	Nov-12	20:40	Polychaeta	18.5447	-67.2908	1990	3.62	34.97	7.74	No
EX1811_D13_01B	Nov-13	14:32	Plexauridae	18.2082	-67.8018	504	12.47	35.87	4.36	Yes
EX1811_D13_01B_A01	Nov-13	14:32	Ophiuroidea	18.2082	-67.8018	504	12.47	35.87	4.36	Yes
EX1811_D13_01B_A02	Nov-13	14:32	Squat lobster	18.2082	-67.8018	504	12.47	35.87	4.36	No
EX1811_D13_02B	Nov-13	16:00	Raspailiidae	18.2072	-67.802	427	14.5	35.97	4.61	Yes
EX1811_D13_03B	Nov-13	17:05	Octocorallia	18.2070	-67.8028	412	14.06	35.94	4.54	Yes
EX1811_D13_03B_A01	Nov-13	17:05	Ophiuroidea	18.2070	-67.8028	412	14.06	35.94	4.54	Yes
EX1811_D13_03B_A02	Nov-13	17:05	Shrimp	18.2070	-67.8028	412	14.06	35.94	4.54	No
EX1811_D15_01B	Nov-15	15:15	Porifera	18.3708	-67.755	320	16.81	36.39	5.08	Yes
EX1811_D15_02B	Nov-15	16:31	Scleractinia	18.3713	-67.7551	274	17.99	36.57	5.35	Yes
EX1811_D15_02B_A01	Nov-15	16:31	Stylasteridae	18.3713	-67.7551	274	17.99	36.57	5.35	No
EX1811_D16_01B	Nov-16	13:47	Tunicata	18.5179	-67.8361	498	12.82	35.73	4.45	Yes
EX1811_D16_01B_A01	Nov-16	13:47	Crustacea	18.5179	-67.8361	498	12.82	35.73	4.45	No
EX1811_D16_01B_A02	Nov-16	13:47	Porifera	18.5179	-67.8361	498	12.82	35.73	4.45	No
EX1811_D16_02B	Nov-16	14:45	Euplectillidae	18.5176	-67.8357	474	12.84	35.75	4.46	Yes
EX1811_D16_02B_A01	Nov-16	14:45	Ophiuroidea	18.5176	-67.8357	474	12.84	35.75	4.46	No
EX1811_D16_02B_A02	Nov-16	14:45	Hydroid	18.5176	-67.8357	474	12.84	35.75	4.46	No
EX1811_D16_03B	Nov-16	16:47	Porifera	18.5180	-67.8336	434	14.46	35.99	4.73	Yes
EX1811_D16_04B	Nov-16	17:13	*Endoxocrinus sp.*	18.5179	-67.8335	433	14.08	35.93	4.66	Yes
EX1811_D17_01B	Nov-17	14:00	Antipatharia	17.9472	-67.8893	1193	4.9	34.97	5.96	Yes
EX1811_D17_02B	Nov-17	15:22	*Acanella sp.*	17.9470	-67.8881	1149	5.01	34.97	5.86	Yes
EX1811_D17_02B_A01	Nov-17	15:22	Polychaeta	17.9470	-67.8881	1149	5.01	34.97	5.86	No
EX1811_D18_01B	Nov-18	19:03	Porifera	18.3955	-67.6539	352	16.23	36.23	5.06	Yes
EX1811_D18_02B	Nov-18	19:11	Primnoidae	18.3955	-67.6540	352	15.9	36.18	5.00	Yes
EX1811_D18_02B_A01	Nov-18	19:11	Squat lobster	18.3955	-67.6540	352	15.9	36.18	5.00	No
EX1811_D18_02B_A02	Nov-18	19:11	Crinoidea	18.3955	-67.6540	352	15.9	36.18	5.00	No
EX1811_D18_02B_A03	Nov-18	19:11	Squat lobster	18.3955	-67.6540	352	15.9	36.18	5.00	No
EX1811_D18_03B	Nov-18	20:03	*Crinometra sp.*	18.3950	-67.6540	349	15.57	36.14	4.95	Yes
EX1811_D18_03B_A01	Nov-18	20:03	Ophiuroidea	18.3950	-67.6540	349	15.57	36.14	4.95	No
EX1811_D19_01G_A01	Nov-19	15:40	Serpulidae	19.2783	-67.6840	4993	2.19	34.93	7.52	No
EX1811_D19_01G_A02	Nov-19	15:40	Foramnifera	19.2783	-67.6840	4993	2.19	34.93	7.52	No
EX1811_D19_02B	Nov-19	16:41	*Abyssopathes lyra*	19.2786	-67.6839	4966	2.23	34.93	7.54	Yes
EX1811_D19_04B	Nov-19	17:39	Cladorhizidae	19.2792	-67.6843	4932	2.23	34.92	7.49	Yes

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3.4 Mapping Operations

Access to all mapping data products from this expedition can be obtained by looking up the cruise code (EX1811) at this data 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 14,959 square kilometers of seafloor over a linear ship track distance of approximately 4,180 kilometers (2,600 miles). Mapped seafloor areas included 14,429 square kilometers in the U.S. exclusive economic zone (EEZ) and 530 square kilometers in the EEZ of the Dominican Republic.

Mapping operations included several areas that had never before been mapped with high-resolution multibeam sonars, including deep-sea areas around Mona Island, Saba Valley, Engaño Canyon, and Engaño Bank. 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 shallow banks, steep canyons, seamounts, ridges, abyssal hills, deep-sea troughs, and extensive submerged channels.

The multibeam dataset for the expedition is archived at NOAA's NCEI, and easily 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 4,180 kilometers (2,600 miles) was mapped using the sub-bottom profiler during the expedition. 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 4,180 kilometers (2,600 miles) was mapped using the EK60 during the expedition. EK60 water column data for the

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expedition can be accessed from the following online data portal: 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.

3.5 Sun Photometers Measurements

Sun photometer measurements were taken on the expedition as time and a clear sky allowed. More information about AERONET can be found here: https://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.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 encourage 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) seminar presentations by mission personnel prior to, and after, the expedition, (2) ship tours for resource managers, scientists and students prior to the expedition in San Juan, Puerto Rico, (3) live interactions with various groups throughout the expedition, (4) public displays of live video feeds from the expedition at various venues, (5) school group presentations by shore-side science team members at several different schools, (6) continuous updates of the expedition web page with up to date information, (7) 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. Whenever possible, content was presented in both English and Spanish languages in order to reach local audiences throughout Puerto Rico, as well as other places where these two languages are spoken throughout the world. Collectively, this resulted in reaching over 7,700 individuals in person, and over 1.1 million online views. 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 in ocean exploration.

Date	Venue	Location	Language	People on site	Online views
Seminars					
Oct. 1	Science Introduction Webinar	Online	English	N/A	83
Oct. 9	Exploring by Seat of your Pants Webinar	Online	English	130	75
Oct. 25	Webinar for Educators	Online	English	N/A	40
Oct. 27	EcoExploratorio Science Museum	San Juan, PR	Spanish	60	1,500
Nov. 29	Science Wrap-up Webinar	Online	English	N/A	34
Ship Tours					
Oct. 27 & 29	NOAA Ship *Okeanos Explorer*	San Juan, PR	English & Spanish	49	N/A
Live Interactions					
Nov. 2	St. Croix National Park Service	Christiansted, VI	English	40	2,470
Nov. 3	EcoExploratorio Science Museum	San Juan, PR	Spanish	60	295
Nov. 5	Gulf & Caribbean Fisheries Institute Conference	San Andres, Colombia	English & Spanish	300	N/A
Nov. 9	National Ocean Exploration Forum	Boston, MA	English	40	N/A
Nov. 10	New England Aquarium IMAX Theater	Boston, MA	English	100	N/A
Nov. 14	University of Hawaii at Manoa	Honolulu, HI	English	35	N/A
Nov. 15	ASPIRE Workshop	Silver Spring, MD	English	50	N/A
Nov. 17	South Carolina Aquarium	Charleston, SC	English	50	N/A
Public Video Displays					
Oct. 31-Nov. 19	YouTube Channel Live Video Feed Views	Online	English & Spanish	N/A	166,900
Oct. 31-Nov. 19	EcoExploratorio Science Museum	San Juan, PR	English & Spanish	6,100	967,524
Nov. 3, 10, 17	South Carolina Aquarium	Charleston, SC	English & Spanish	300	N/A
Nov. 5-9	Gulf & Caribbean Fisheries Institute Conference	San Andres, Colombia	English & Spanish	300	N/A
School Group Presentations					
Nov. 9	Pierpoint Elementary, Kindergarten	Ventura, CA	English	40	N/A
Nov. 9	Academia del Perpetuo Socorro, 7th grade	San Juan, PR	Spanish	75	N/A
Nov. 12	Academia del Perpetuo Socorro, 3rd grade	San Juan, PR	Spanish	50	N/A
Expedition Website					
Oct. 24-Nov. 20	Expedition Website Views	Online	English & Spanish	N/A	18,900
Articles					
Oct. 30-Nov. 8	NOAA.gov feature story	Online	English	N/A	6,900
Oct. 30	NOAA in the Caribbean newsletter, Winter 2018	Online	English & Spanish	N/A	600
Dec. 20	*Deep-Sea Life* newsletter	Online	English	N/A	2,000
Mar. 20	NOAA in the Caribbean newsletter, Spring 2019	Online	English & Spanish	N/A	600

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5. Acknowledgements

The planning and successful execution of the *Océano Profundo 2018* 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 (Chris Ritter, Karl McLetchie, Jeff Lanning, Dan Rogers, Sean Kennison, Levi Unema, Andy Lister, Fernando Aragon, Lee Arnold and Lars Murphy) and video engineers (Roland Brian, Bob Knott, Arthur Howard, Emily Narrow and Caitlin Bailey). We are also grateful for all the hard work by the rest of the onboard mapping team (Watch Lead Neah Baechler and Senior Survey Technician 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 (Eric Johnson, Fionna Matheson, Rosemary Abbitt, Faith Knighton, Anna Hallingstad, Brianna Pacheco and Brian Caldwell) and crew (Randy Collins, Vincent Palazzolo, Jerrod Hazendorf, Rick Gabona, Warren Taylor, Pedro Lebron, William Rogeaux, Pedro Lebron, Christian Lebron, Mike Sapien, William Johnson, Mike Collins, Eli Pacheco, Sidney Dunn, Peter Brill, Gregorio Oliveras, James Scott, Frank Forbell and Celeste Morris) 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, Kelley Elliott, Kasey Cantwell, Nick Pawlenko, Mashkoor Malik, Caitlin Adams, David McKinnie, Emily Crum, Katie Wagner, Adrienne Copeland, Susan Haynes, Matt King, Stephen Hammond, James Murphy, Amanda Netburn, Susan Gottfried, Catalina Martinez, Colleen Peters, James Rawsthorne, and Andrew O'Brien.

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 *Océano Profundo 2018* expedition, which included Abigail Pratt, Allen Collins, Amanda Demopoulos, Andrea Quattrini, Andrew Shuler, Asako Matsumoto, Ashley Perez, Aurea Rodriguez, Brian Kennedy, Bruce Mundy, Charles Messing, Cheryl Morrison, Chris Kelley, Chris Taylor, Christian Jones, Christopher Mah, Clayton Pollock, Colleen Peters, Dhugal Lindsay, Donald Kobayashi, Elizabeth Gugliotti, Enrique Salgado, Frank Tamara, Graciela Garcia-Moliner, Iris Costa, Jason Chaytor, Jaymes Awbrey, Jessica Robinson, Jim Masterson, Joana Xavier, John Ogden, Kate Overly, Kate Rose, Kenneth Sulak, Kevin Rademacher, Kimberly Galvez, Lauren Walling, Les Watling, Luisa Dueñas, Marcela Cañon, Mary Wicksten, Matthew Kupchik, Megan McCuller, Michael Vecchione, Michelle Schärer, Mike Ford, Nelson Crespo, Nolan Barrett, Rachel

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6. Appendices

6.1 Appendix A: EX1811 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 (EX1811): Puerto Rico and U.S. Virgin Islands (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) of the Caribbean Sea, as well as in territorial waters surrounding surrounding Puerto Rico and the U.S. Virgin Islands.

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: 10/30/2018 to 11/20/2018

1.6 Planned coverage of the data

Latitude boundaries:	16.82	to	20.36
Longitude boundaries:	-68.30	to	-64.09

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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
Phone:	808-256-5014

3. Point of contact for managing the data

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

4. Resources
4.1 Have resources for management of these data been identified? True
4.2 Approximate percentage of the budget devoted to data management. Unknown

5. Data lineage and quality
5.1 What is the processing workflow from collection to public release?
SCS data shall be delivered in its native format as well as an archive-ready, documented, and compressed NetCDF3 format to NCEI-MD; multibeam data and metadata will be compressed and delivered in a bagit format to NCEI-CO

5.2 What quality control procedures will be employed?
Quality control procedures for the data from the Kongsberg EM302 is handled at UNH CCOM/JHC. Raw (level-0) bathymetry files are cleaned/edited into new data files (level-1) and converted to a variety of products (level-2). Data from sensors monitored through the SCS are archived in their native format and are not quality controlled. Data from CTD casts

and XBT firings are archived in their native format. CTDs are post-processed by the data management team as a quality control measure and customized CTD profiles are generated for display on the Okeanos Atlas (explore.noaa.gov/okeanosatlas).

6. Data documentation

6.1 Does the metadata comply with the data documentation directive? True

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

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? True

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: no

Authority: not applicable

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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

Form Version: September 2017

Categorical Exclusion (CE) Determination Worksheet

Project Title: EX1811

Date Review Completed: 9/12/2018

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

OAR Functional Role: OER

Worksheet File Name: 2018-09-OER-CE-EX1811

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 the NOAA vessel *Okeanos Explorer*. ROV operations will include collection of detailed high-resolution imagery, limited biological and geological specimens, and digital environmental sensor data. The expedition EX1811 will conduct operations in the U.S. exclusive economic zone (EEZ) of the Caribbean Sea, as well as in territorial waters surrounding Puerto Rico (up to 9 nautical miles from shore) and the U.S. Virgin Islands (up to 3 nautical miles from shore). The expedition is currently scheduled to start in San Juan, Puerto Rico on October 30, 2018, and end in San Juan, Puerto Rico on November 20, 2018. See EX1811 project instructions for more details.

3. Which class of CE in Appendix E of the NAO 216-6A Companion Manual is applicable to this action and why?
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 EX1811 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 surrounding Puerto Rico and the U.S. Virgin Islands.

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 in deep-sea (>250 m) areas off Puerto Rico and the U.S. Virgin Islands during EX1811, an expedition which seeks to address research and management priorities of several federal and territorial management agencies, as well as the scientific community. See Table 1 of the EX1811 project instructions for bounding coordinates of the expedition's operating area. This action does not involve any procedures or outcomes known to result in impacts on human health and safety more than would be negligible.

5. Would the action result in adverse effects on an area with unique environmental characteristics that are not negligible?
This expedition will include limited operations within the Buck Islands Reef Marine National Monument managed by the National Parks 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 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, Buck Islands Reef Marine National Monument, Caribbean Fishery Management Council, U.S. Virgin Islands Department of Planning and Environmental Resources, and Puerto Rico Department of Natural and Environmental Resources. OER will use input from these management authorities that are familiar with these areas to ensure no more than negligible effects on these areas with potentially unique environmental characteristics.

6. Would the action result in adverse effects on species or habitats protected by the ESA, MMPA, MSA, NMSA, or MBTA that are not negligible?
OER and NCCOS have taken measures to ensure that any effects on species or habitats protected by the ESA, MMPA, MSA or NMSA meet the definition of negligible. In June 2017, a request from NCCOS was submitted to the NMFS SERO Protected Species Division to initiate consultation under section 7 of the ESA for all expeditions of the Southeast Deep Coral Initiative (SEDCI) in 2017-2019, including expeditions to the U.S. Caribbean aboard NOAA Ship *Okeanos Explorer*. Accompanying this request was a biological assessment that described the planned operations proposed for 2017-2019 expeditions to the U.S. Caribbean aboard NOAA Ship *Okeanos Explorer* that identified all ESA-listed species, including corals, in the operating areas. On August 17, 2017, NCCOS received a letter that concurred with the determination that these operations are not likely to adversely affect ESA-listed species. The ESA section 7 letter is provided as an appendix in the EX1811 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, however, 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 EX1811 project instructions.

OER also initiated a request for an abbreviated essential fish habitat (EFH) consultation for expeditions by NOAA Ship *Okeanos Explorer* in 2018-2020 to the Greater Atlantic Region, including the U.S. Caribbean. 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 supplemented a previously completed EFH consultation between NCCOS and SERO for activities by SEDCI in 2017-2019 in waters of the U.S. Caribbean, Gulf of Mexico and South Atlantic Bight. That previously conducted EFH consultation also concluded that SEDCI activities would have no adverse impacts on EFH.

7. Would the action result in the potential to generate, use, store, transport, or dispose of hazardous or toxic substances, in a manner that may have a significant effect on the environment?
No. The cruise operations will be in compliance with FEC 07 Hazardous Materials and Hazardous Waste Management Requirements for Visiting Scientific Parties (or the OMAO procedure that supersedes it) to ensure generation, use, storage, transport, and disposal of such substances will not result in significant impacts.

8. Would the action result in adverse effects on properties listed or eligible for listing on the National Register of Historic Places authorized by the National Historic Preservation Act of 1966, National Historic Landmarks designated by the Secretary of the Interior, or National Monuments designated through the Antiquities Act of 1906; Federally recognized Tribal and Native Alaskan lands, cultural or natural resources, or religious or cultural sites that cannot be resolved through applicable regulatory processes?
During EX1811 we will be conducting 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 exploration, they can potentially be eligible for listing on the Natural Register of Historic Places. OER conducts non-invasive surveys on archaeology targets and has specific protocols for protecting sensitive location information of such UCH. These protocols and procedures are outlined in detail in the appendices of the EX1811 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, the NOAA Ship *Okeanos Explorer* will be operating in remote areas of the U.S. Caribbean (see Table 1 in EX1811 project instructions for bounding coordinates). There are no communities within or near the geographic scope of the cruise and the cruise does not involve actions known or likely to result in adverse impacts on human health.

10. Would the action contribute to the introduction, continued existence, or spread of noxious weeds or nonnative invasive species known to occur in the area or actions that may promote the introduction, growth, or expansion of the range of the species?
No. During EX1811 the ship will not make landfall in areas other than commercial ports in San Juan, Puerto Rico. 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 fresh water and completely dried to prevent spreading organisms from one site to another. Also the Engineering Department aboard the NOAA Ship *Okeanos Explorer* attends yearly Ballast Management Training in accordance with NOAA Form 57-07-13 NPDES VGP Annual Inspection and Report to prevent the introduction of invasive species.

11. Would the action result in a potential violation of Federal, State, or local law or requirements imposed for protection of the environment?
The proposed action will not result in a potential violation of Federal, State, or local law or requirements imposed for protection of the environment. The expedition coordinator obtained authorizations for this expedition via several consultations on ESA section-7 and EFH outlined in sections 4-7 above. Additionally, the expedition coordinator submitted permit applications for activities within the (1) Buck Island Marine National Monument to the National Park Service on August 27, 2018, (2) territorial waters of the U.S. Virgin Islands (up to 3 nautical miles from shore) to the Department of Planning and Natural Resources of the U.S. Virgin Islands on September 6, 2018, and (3) territorial waters of Puerto Rico (up to 9 nautical miles from shore) to the Puerto Rico Department of Natural Resources on September 10, 2018. All of these permit applications are currently pending approval.

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.

Categorical Exclusion 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 on an environmental assessment or environmental impact statement.

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

Signature: 

Signed by: Craig W. Russell

Date Signed: 9/12/2018

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 0 8 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.

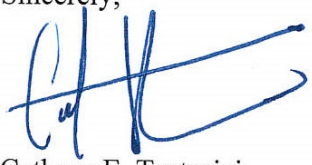
We reviewed the consultation request document and related materials submitted by your office. We requested that your office update the acoustic thresholds submitted in the biological evaluation to match NMFS's 2018 acoustic technical guidance (NMFS 2018a). This assisted NMFS's ESA Interagency Cooperation 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.totorici@noaa.gov or Jonathan Molineaux at (301) 427-8440 or by email at jonathan.molineaux@noaa.gov.

Sincerely,



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

Literature Cited

NMFS. (2017). *Concurrence letter for activities to be conducted for National Centers for Coastal Ocean Science-led activities as part of the Southeast Deep Coral Initiative in 2017 through 2019*. Silver Spring, Maryland: National Marine Fisheries Service, Office of Protected Resources.

NMFS. (2018a). *2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0) . NOAA Technical Memorandum*. U.S. Department of Commerce.

NMFS. (2018b). *ESA Section 7 Consultation regarding to the proposed issuance of an Incidental Harassment Authorization to Garden State Offshore Energy for upcoming surveys*. Gloucester, Massachusetts: National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office.

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: Southeast Regional Office (SERO) Letter of Acknowledgement (LOA)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

F/SER28:SS

Dr. Daniel Wagner
NOAA National Centers for Coastal Ocean Science
331 Fort Johnson Road
Charleston, SC 29412

SEP 1 4 2018

Dear Dr. Wagner:

This letter of acknowledgement (LOA) recognizes the activities outlined in your September 11, 2018, request as scientific research conducted by a scientific research vessel in accordance with the definitions and guidance at 50 CRF 600.10 and 600.745(a). As such, the proposed activities are not subject to fishing regulations at 50 CFR Part 622 or other fishing regulations promulgated in accordance with the Magnuson-Stevens Fishery Conservation and Management Act.

NOAA Fisheries understands that the purpose of these collection activities is to conduct deep-sea research and exploration activities in U.S. federal waters surrounding Puerto Rico and the U.S. Virgin Islands (USVI) during an upcoming expedition aboard NOAA Ship *Okeanos Explorer* (EX1811). Activities are currently scheduled to start in San Juan, Puerto Rico, on October 30, 2018, and end in San Juan, Puerto Rico, on November 20, 2018. The geographic areas to be targeted during the expedition include deep-water (>250 m) areas surrounding Puerto Rico and the USVI and include various deep-water submarine canyons, seamounts, slope habitats, and other deep-water areas. All operations would be conducted in water depths of 250 m and deeper, with the majority of activities conducted in water depths of 500 m and greater.

Specifically, these efforts would use the following technologies to explore and characterize deep-water areas around Puerto Rico and the USVI: (1) deep-water mapping systems, (2) remotely operated vehicles (ROV), (3) conductivity, temperature, and depth (CTD) water sampling, and (4) high-bandwidth satellite connection for real-time ship to shore communications.

All of the mapping sonars used on the *Okeanos Explorer* have hull-mounted transducers that are downward facing directly underneath the ship. Mapping activities would supplement previous work where possible, and would occur continuously throughout the day and night except when the ROV is deployed. If cetacean species are present within 400 m of the ship, the vessel would stop until the animals depart the area, but the mapping sonars would continue transmitting to avoid startle responses.

The *Okeanos Explorer* is equipped with a fully integrated, two-body ROV system. The first body, the ROV *Deep Discoverer*, is a 3.17 m long, 1.95 m wide, and 2.59 m high vehicle capable of diving to 6,000 m depth. The second body, the ROV *Seirios*, is a 3.51 m long, 1.12 m wide, and 1.23 m high vehicle that provides additional lighting and an aerial viewpoint. During ROV operations, the two ROVs are connected to each other by a 30 m long tether and the *Seirios* ROV is attached to the ship by an 8,200 m armored fiber-optic cable providing power and telemetry to the two vehicles. ROV operations would be conducted only during daylight hours, while the *Okeanos Explorer* is stopped and holding station using dynamic positioning (no anchoring). ROV operations would typically take place within several meters of the seafloor, and would be conducted in a manner that minimizes seafloor disturbance. Up to 20 ROV

deployments may occur during the proposed project, resulting in approximately 160 hours total dive time (~8 hours for each dive).

The ROV *Deep Discoverer* would also be used for collecting up to six samples (four biological and two geological) per dive. When possible, only a subsample would be taken of biological specimens (e.g., only a piece of sponge or branch of coral would be collected) in the most minimally destructive manner possible. Sample collections would be made using the cutting tool on the ROV, and whenever possible, only portions of organisms (<50 cm) would be collected to avoid mortality. Additionally, geological samples would be selected in a way to minimize the amount of attached organisms impacted. It is understood that collection may include coral species for which harvest is prohibited in U.S. Caribbean federal waters, potentially including members of the Orders Alcyonacea (soft corals), Scleractinia (hard corals), and Antipatharia (black corals). 50 CFR 622.472; *id.* 622.2 (defining Caribbean prohibited coral). See Table 1 of Appendix A to Part 622 for a complete list of coral reef resources in the U.S. Caribbean.

The *Okeanos Explorer* is outfitted with a SeaBird CTD that is attached to an open cylindrical steel frame (1.16 meters [m] in diameter and 1.6 m high) containing 12, 10-liter (L) bottles for collecting water samples at specific depths. The CTD can be lowered to a maximum depth of 6,800 m while the vessel is stopped and holding station using dynamic positioning. The average time to conduct CTD sampling varies from one to several hours and would be conducted simultaneously during ROV dives. An integrated real-time altimeter adds assurance that the CTD would not impact the seafloor.

This LOA is separate and distinct from any permits, authorizations, and/or consultations required by the Marine Mammal Protection Act, the Endangered Species Act, or any other applicable law, and from any authorizations that may be necessary to sample in protected waters such as national parks and monuments. Under 50 C.F.R. § 600.745(a), we are required to inform you that such permits may be required and should be obtained from the appropriate agency prior to embarking on the activity.

Copies of this LOA and the scientific research plan for the project should be onboard the vessel during all sampling activities.

Please send a copy of any cruise report or other publications resulting from the scientific research activity to the Director, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33149-1003.

Sincerely,

Roy E. Crabtree, Ph.D.
for Regional Administrator

Enclosure

cc: F/SEFSC, F/EN3

6.6 Appendix F: National Parks Service (NPS) Permit for Activities in the Buck Island Reef National Monument

SCIENTIFIC RESEARCH AND COLLECTING PERMIT

Grants permission in accordance with the attached general and special conditions

United States Department of the Interior
National Park Service
Buck Island Reef

Study#: BUIS-00083
Permit#: BUIS-2018-SCI-0006
Start Date: Oct 28, 2018
Expiration Date: Nov 18, 2018
Coop Agreement#:
Optional Park Code:

Name of principal investigator:
Name: Dr Daniel Wagner **Phone:**8082565014 **Email:**daniel.wagner@noaa.gov

Name of institution represented:
NOAA Office of Ocean Exploration and Research

Additional investigators or key field assistants:

Name: Derek Sowers	**Phone:** (603) 862-0369	**Email:** derek.sowers@noaa.gov
Name: Steven Auscavitch	**Phone:** 203-520-9024	**Email:** Steven.Auscavitch@temple.edu
Name: Stacey Williams	**Phone:** 787-702-5818	**Email:** stcmwilliams@gmail.com

Study Title:
EX1811: Puerto Rico/US Virgin Islands ROV and Mapping

Purpose of study:
NOAA's Office of Ocean Exploration and Research (OER) is the only federal organization dedicated to exploring the global ocean. OER works with partners to identify priority areas for exploration, supports innovations in exploration tools and capabilities, and encourages the next generation of ocean explorers, scientists, and engineers to pursue careers in ocean exploration and related fields. Data and information collected during OER expeditions and funded research activities give resource managers, the academic community, and the private sector the information they need to identify, understand, and manage ocean resources for current and future generations of Americans.

NOAA Ship Okeanos Explorer is the only U.S. federal vessel dedicated to exploring our largely unknown ocean for the purpose of discovery and the advancement of knowledge. America's future depends on understanding the ocean. We explore the ocean to make valuable scientific, economic, and cultural discoveries, 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 high-quality scientific information about the deep ocean to anyone who needs it.

In close collaboration with government agencies, academic institutions, and other partners, NOAA's OER conducts deep-ocean 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 helps to establish a foundation of information and to fill data gaps. Data collected on the ship follow federal open-access data standards and are publicly available shortly after an expedition ends, usually within 30-90 days of cruise completion. This ensures the delivery of reliable scientific data needed to identify, understand, and manage key elements of the ocean environment.

In October-December 2018, NOAA will work with the scientific and management community to characterize unknown and poorly-known areas of the Caribbean, including the waters in around the Buck Island Reef National Marine Monument, through telepresence-based exploration. Baseline information collected during this cruise will support and catalyze further exploration, research and management activities.

Like all previous expeditions of NOAA Ship Okeanos Explorer, NOAA will work with the management and scientific community to characterize unknown and poorly-known areas through telepresence-based exploration. To achieve its objectives, this project will use the following technologies to explore and characterize deep-water areas in the Caribbean:
1. bathymetry and water column mapping data acquisition using the Okeanos Explorer's scientific sonars;
2. high-definition video and limited physical sampling with a remotely operated vehicle (ROV);
3. standard oceanographic measurements using a conductivity, temperature, and depth (CTD)/rosette system, and
4. standard meteorological data collection using shipboard sensors. While the focus will be on digital data and information, permission is requested to collect a small number of biological and geological samples per ROV dive (4-6 total samples per dive), as well as standard water samples using the CTD/rosette.

Subject/Discipline:
Animal Communities / Wildlife

Permit: BUIS-2018-SCI-0006 - Page 1 of 8

Coastal / Marine Systems
Ecology (Aquatic, Marine, Terrestrial)
Maps / Cartography / GIS
Threatened / Endangered / Rare Species
Water Resources

Locations authorized:
The proposed research and exploration activities will take place in deep waters (>250 m) of the Buck Island Reef National Marine Monument. The exact locations for activities have not yet been finalized, but will be chosen in direct consultation with Monument staff in order to ensure that collected data addresses Monument priorities and needs.

Transportation method to research site(s):
All operations for this project will be conducted onboard NOAA Ship Okeanos Explorer, a 224' long, 43' wide federal government vessel with a 20' draft and a transit cruising speed of 10 knots. NOAA Ship Okeanos Explorer is outfitted with a suite of hull-mounted sonars (described below) and the dedicated two-body ROV system (Deep Discoverer and Seirios).

Collection of the following specimens or materials, quantities, and any limitations on collecting:

Name of repository for specimens or sample materials if applicable:

Repository type: Permanently retained in National Park Service collection, maintained in one or more non-NPS repositories identified in attached Appendix A (complete and submit an Appendix A for each proposed repository) (Smithsonian Institution, National Museum of Natural History)
Objects collected:
Sampling operations will be conducted during ROV expeditions to collect a limited number of biological specimens using the ROV manipulator arms (limited to 4 biological samples per dive). Specimen collections will be limited to samples that have the potential to contribute to significant scientific discoveries. Biological specimen collections will target animals suspected of being a new species or new records for the area, the dominant morphotype in a habitat, specimens that may contribute to connectivity studies, or other specimens with significant discovery potential. When possible, only a subsample will be taken of biological specimens (e.g., only a piece or branch of corals and sponges will be collected, not the entire organism) in as minimally destructive manner as possible.

Repository type: Permanently retained in National Park Service collection, maintained in one or more non-NPS repositories identified in attached Appendix A (complete and submit an Appendix A for each proposed repository) (Oregon State University)
Objects collected:
Sampling operations will be conducted during ROV expeditions to collect a limited number of geological specimens using the ROV manipulator arms (limited to two geological samples per dive). Specimen collections will be limited to geologic specimens that may contribute to significant scientific discoveries. When possible, rock samples will be selected in a way to minimize the amount of attached organisms.

NPS General Conditions for Scientific Research and Collecting Permit (available at the RPRS HELP page) apply to this permit. The following specific conditions or restrictions, and any attached conditions, also apply to this permit:
SPECIFIC CONDITIONS FOR PERMIT

If you have a non-life threatening emergency while working/staying in the Park, call BUIS/CHRI/SARI Chief of Law Enforcement: 340-277-6794. In addition to contacting Park Law Enforcement, call St. Croix EMS 340-772-9111 for all life-threatening emergencies. This number is staffed 24/7.

The permittee shall notify the Biologist, Clayton Pollock (clayton_pollock@nps.gov or 340-773-1460 x 238) or alternatively designated point of contact at least one day prior to initiating field activities in the park. Ideally this contact should occur at least two weeks prior to the initial visit to the park. Anticipated dates of field work, information about any vehicles (make, model, color) and license plate# must be provided.

The permittee is requested to provide Buck Island Reef National Monument (BUIS) with one hardcopy and one electronic copy of all associated reports, reprints, and theses /dissertations at the completion of the study.

The permittee shall display a copy of the first page of this permit in the windshield of their vehicle and shall carry a complete copy of this permit while conducting field activities within the park or utilizing the park parking lot.

Vehicle access - The research vehicle is restricted to designated parking spaces at the study points identified in the permit application, or at any other public parking area used.

All watercraft operators and passengers must follow established USCG boat safety requirements.

All boat/canoe/kayak operators and crew shall wear USCG approved PFDs while conducting research within BUIS.

The Permittee authorizes the National Park Service to take necessary measures to protect information from being released to the public concerning the nature and specific location of resources at BUIS that are endangered, threatened, rare or commercially valuable, or are objects of significant cultural importance.

The Permittee must take reasonable efforts to follow "Leave No Trace" outdoor ethics principles to minimize impacts on park resources or experiences of other park visitors.

The Permittee agrees to adhere to safety protocols for the appropriate handling, storage, labeling, use and disposal of any chemicals used in this study.

The Investigator's Annual Report (see General Condition 7 below) shall reference this research permit number, and shall include a map depicting the areas from which samples were collected in the park. This report may be submitted via the NPS Research Permit and Reporting System web site (http: //rprs.nps.gov/research/ac/Researchindex), or by hard copy to:

National Park Service
2100 Church St. #100
Christiansted, VI 00820

BUCK ISLAND REEF NATIONAL MONUMENT CONDITIONS

The permittee shall exercise this privilege subject to the supervision of the Superintendent, and shall comply with all applicable laws and regulations of the area.
Damages - The permittee shall pay the United States for any damage resulting from this use which would not reasonably be inherent in the use which the permittee is authorized to make of the land described in the permit.
The permit does not authorize any entry upon, nor activities within, any lands not under the jurisdiction of the National Park Service. Such activities must be coordinated and authorized, through the respective agency or owner.
It is the responsibility of the permittee to identify and attain all required permits and permissions from all relevant local, state and federal agencies. This research permit is not valid without all other required permits and permissions. Documentation of these permits may be requested by NPS at any time.
The permit does not authorize any ground disturbing activities. Any ground disturbing activities require initiation of archaeological clearances (Section 106), please contact the park's research coordinator immediately to initiate appropriate procedures should the project require ground disturbing activities.

GENERAL CONDITIONS FOR SCIENTIFIC RESEARCH AND COLLECTING

PERMIT: United States Department of the Interior, National Park Service
1. Authority - The permittee is granted privileges covered under this permit subject to the supervision of the superintendent or a designee, and shall comply with all applicable laws and regulations of the National Park System area and other federal and state laws. A National Park Service (NPS) representative may accompany the permittee in the field to ensure compliance with regulations.
2.Responsibility - The permittee is responsible for ensuring that all persons working on the project adhere to permit conditions and applicable NPS regulations.
3.False information - The permittee is prohibited from giving false information that is used to issue this permit. To do so will be considered a breach of conditions and be grounds for revocation of this permit and other applicable penalties.
4.Assignment - This permit may not be transferred or assigned. Additional investigators and field assistants are to be coordinated by the person(s) named in the permit and should carry a copy of the permit while they are working in the park. The principal investigator shall notify the park's Research and Collecting Permit Office when there are desired changes in the approved study protocols or methods, changes in the affiliation or status of the principal investigator, or modification of the name of any project member.
5.Revocation - This permit may be terminated for breach of any condition. The permittee may consult with the appropriate NPS Regional Science Advisor to clarify issues resulting in a revoked permit and the potential for reinstatement by the park superintendent or a designee.
6.Collection of specimens (including materials) - No specimens (including materials) may be collected unless authorized on the Scientific Research and Collecting permit.
The general conditions for specimen collections are:
-Collection of archaeological materials without a valid Federal Archaeology Permit is prohibited.
-Collection of federally listed threatened or endangered species without a valid U.S. Fish and Wildlife Service endangered species permit is prohibited.
-Collection methods shall not attract undue attention or cause unapproved damage, depletion, or disturbance to the environment and other park resources, such as historic sites.

-New specimens must be reported to the NPS annually or more frequently if required by the park issuing the permit. Minimum information for annual reporting includes specimen classification, number of specimens collected , location collected , specimen status (e.g., herbarium sheet, preserved in alcohol/formalin, tanned and mounted , dried and boxed, etc.), and current location.
-Collected specimens that are not consumed in analysis or discarded after scientific analysis remain federal property. The NPS reserves the right to designate the repositories of all specimens removed from the park and to approve or restrict reassignment of specimens from one repository to another. Because specimens are Federal property, they shall not be destroyed or discarded without prior NPS authorization.
-Each specimen (or groups of specimens labeled as a group) that is retained permanently must bear NPS labels and must be accessioned and cataloged in the NPS National Catalog. Unless exempted by additional park-specific stipulations, the permittee will complete the labels and catalog records and will provide accession information. It is the permittee's responsibility to contact the park for cataloging instructions and specimen labels as well as instructions on repository designation for the specimens.
-Collected specimens may be used for scientific or educational purposes only, and shall be dedicated to public benefit and be accessible to the public in accordance with NPS policies and procedures.
-Any specimens collected under this permit, any components of any specimens (including but not limited to natural organisms , enzymes or other bioactive molecules, genetic materials, or seeds), and research results derived from collected specimens are to be used for scientific or educational purposes only, and may not be used for commercial or other revenue-generating purposes unless the permittee has entered into a Cooperative Research And Development Agreement (CRADA) or other approved benefit-sharing agreement with the NPS. The sale of collected research specimens or other unauthorized transfers to third parties is prohibited. Furthermore, if the permittee sells or otherwise transfers collected specimens, any components thereof, or any products or research results developed from such specimens or their components without a CRADA or other approved benefit-sharing agreement with NPS, permittee will pay the NPS a royalty rate of twenty percent (20%) of gross revenue from such sales or other revenues. In addition to such royalty, the NPS may seek other damages to which the NPS may be entitled including but not limited to injunctive relief against the permittee.
7.Reports - The permittee is required to submit an Investigator's Annual Report and copies of final reports, publications, and other materials resulting from the study. Instructions for how and when to submit an annual report will be provided by NPS staff. Park research coordinators will analyze study proposals to determine whether copies of field notes, databases, maps, photos, and/or other materials may also be requested. The permittee is responsible for the content of reports and data provided to the National Park Service.
8.Confidentiality - The permittee agrees to keep the specific location of sensitive park resources confidential. Sensitive resources include threatened species, endangered species, and rare species, archeological sites, caves, fossil sites, minerals, commercially valuable resources, and sacred ceremonial sites.
9.Methods of travel - Travel within the park is restricted to only those methods that are available to the general public unless otherwise specified in additional stipulations associated with this permit.
10. Other permits - The permittee must obtain all other required permit(s) to conduct the specified project.
11.Insurance - If liability insurance is required by the NPS for this project, then documentation must be provided that it has been obtained and is current in all respects before this permit is considered valid.
12.Mechanized equipment - No use of mechanized equipment in designated, proposed, or potential wilderness areas is allowed unless authorized by the superintendent or a designee in additional specific conditions associated with this permit.
13.NPS participation -The permittee should not anticipate assistance from the NPS unless specific arrangements are made and documented in either an additional stipulation attached to this permit or in other separate written agreements.
14.Permanent markers and field equipment - The permittee is required to remove all markers or equipment from the field after the completion of the study or prior to the expiration date of this permit. The superintendent or a designee may modify this requirement through additional park specific conditions that may be attached to this permit. Additional conditions regarding the positioning and identification of markers and field equipment may be issued by staff at individual parks.
15.Access to park and restricted areas - Approval for any activity is contingent on the park being open and staffed for required operations. No entry into restricted areas is allowed unless authorized in additional park specific stipulations attached to this permit.
16.Notification - The permittee is required to contact the park's Research and Collecting Permit Office (or other offices if indicated in the stipulations associated with this permit) prior to initiating any fieldwork authorized by this permit. Ideally this contact should occur at least one week prior to the initial visit to the park.
17.Expiration date - Permits expire on the date listed. Nothing in this permit shall be construed as granting any exclusive research privileges or automatic right to continue , extend, or renew this or any other line of research under new permit(s) .
18. Other stipulations - This permit includes by reference all stipulations listed in the application materials or in additional attachments to this permit provided by the superintendent or a designee. Breach of any of the terms of this permit will be grounds for revocation of this permit and denial of future permits.

Recommended by park staff(name and title):

CLAYTON POLLOCK; BIOLOGIST

Approved by park official:

Reviewed by Collections Manager:

Yes ✓ No ____

Date Approved:

10/2/2018

Title:

Superintendent, CHRI/BUIS/SARI

I Agree To All Conditions And Restrictions Of this Permit As Specified
(Not valid unless signed and dated by the principal investigator)

10/5/2018

(Principal investigator's signature) (Date)

THIS PERMIT AND ATTACHED CONDITIONS AND RESTRICTIONS MUST BE CARRIED AT ALL TIMES WHILE CONDUCTING RESEARCH ACTIVITIES IN THE DESIGNATED PARK(S)

GENERAL CONDITIONS
For
SCIENTIFIC RESEARCH AND COLLECTING PERMIT

United States Department of the Interior
National Park Service

1. **Authority** - The permittee is granted privileges covered under this permit subject to the supervision of the superintendent or a designee, and shall comply with all applicable laws and regulations of the National Park System area and other federal and state laws. A National Park Service (NPS) representative may accompany the permittee in the field to ensure compliance with regulations.

2. **Responsibility** - The permittee is responsible for ensuring that all persons working on the project adhere to permit conditions and applicable NPS regulations.

3. **False information** - The permittee is prohibited from giving false information that is used to issue this permit. To do so will be considered a breach of conditions and be grounds for revocation of this permit and other applicable penalties.

4. **Assignment** - This permit may not be transferred or assigned. Additional investigators and field assistants are to be coordinated by the person(s) named in the permit and should carry a copy of the permit while they are working in the park. The principal investigator shall notify the park's Research and Collecting Permit Office when there are desired changes in the approved study protocols or methods, changes in the affiliation or status of the principal investigator, or modification of the name of any project member.

5. **Revocation** - This permit may be terminated for breach of any condition. The permittee may consult with the appropriate NPS Regional Science Advisor to clarify issues resulting in a revoked permit and the potential for reinstatement by the park superintendent or a designee.

6. **Collection of specimens (including materials)** - No specimens (including materials) may be collected unless authorized on the Scientific Research and Collecting permit.

The general conditions for specimen collections are:

- Collection of archeological materials without a valid Federal Archeology Permit is prohibited.

- Collection of federally listed threatened or endangered species without a valid U.S. Fish and Wildlife Service endangered species permit is prohibited.

- Collection methods shall not attract undue attention or cause unapproved damage, depletion, or disturbance to the environment and other park resources, such as historic sites.

- New specimens must be reported to the NPS annually or more frequently if required by the park issuing the permit.Minimum information for annual reporting includes specimen classification, number of specimens collected, location collected, specimen status(e.g., herbarium sheet, preserved in alcohol / formalin, tanned and mounted, dried and boxed, etc.), and current location.

- Collected specimens that are not consumed in analysis or discarded after scientific analysis remain federal property.The NPS reserves the right to designate the repositories of all specimens removed from the park and to approve or restrict reassignment of specimens from one repository to another. Because specimens are Federal property, they shall not be destroyed or discarded without prior NPS authorization.
- Each specimen (or groups of specimens labeled as a group) that is retained permanently must bear NPS labels and must be accessioned and cataloged in the NPS National Catalog.Unless exempted by additional park - specific stipulations, the permittee will complete the labels and catalog records and will provide accession information.It is the permittee's responsibility to contact the park for cataloging instructions and specimen labels as well as instructions on repository designation for the specimens.

- Collected specimens may be used for scientific or educational purposes only, and shall be dedicated to public benefit and be accessible to the public in accordance with NPS policies and procedures.

- Any specimens collected under this permit, any components of any specimens (including but not limited to natural organisms, enzymes or other bioactive molecules, genetic materials, or seeds), and research results derived from collected specimens are to be used for

scientific or educational purposes only, and may not be used for commercial or other revenue - generating purposes unless the permittee has entered into a Cooperative Research And Development Agreement(CRADA) or other approved benefit - sharing agreement with the NPS.The sale of collected research specimens or other unauthorized transfers to third parties is prohibited.Furthermore, if the permittee sells or otherwise transfers collected specimens, any components thereof, or any products or research results developed from such specimens or their components without a CRADA or other approved benefit-sharing agreement with NPS, permittee will pay the NPS a royalty rate of twenty percent(20 %) of gross revenue from such sales or other revenues. In addition to such royalty, the NPS may seek other damages to which the NPS may be entitled including but not limited to injunctive relief against the permittee.

7. **Reports** - - The permittee is required to submit an Investigator's Annual Report and copies of final reports, publications, and other materials resulting from the study. Instructions for how and when to submit an annual report will be provided by NPS staff.Park research coordinators will analyze study proposals to determine whether copies of field notes, databases, maps, photos, and / or other materials may also be requested.The permittee is responsible for the content of reports and data provided to the National Park Service

8. **Confidentiality** - - The permittee agrees to keep the specific location of sensitive park resources confidential. Sensitive resources include threatened species, endangered species, and rare species, archeological sites, caves, fossil sites, minerals, commercially valuable resources, and sacred ceremonial sites.

9. **Methods of travel** - Travel within the park is restricted to only those methods that are available to the general public unless otherwise specified in additional stipulations associated with this permit.

10. **Other permits** - The permittee must obtain all other required permit(s) to conduct the specified project.

11. **Insurance** - If liability insurance is required by the NPS for this project, then documentation must be provided that it has been obtained and is current in all respects before this permit is considered valid.

12. **Mechanized equipment** - No use of mechanized equipment in designated, proposed, or potential wilderness areas is allowed unless authorized by the superintendent or a designee in additional specific conditions associated with this permit.

13. **NPS participation** - The permittee should not anticipate assistance from the NPS unless specific arrangements are made and documented in either an additional stipulation attached to this permit or in other separate written agreements.

14. **Permanent markers and field equipment** - The permittee is required to remove all markers or equipment from the field after the completion of the study or prior to the expiration date of this permit. The superintendent or a designee may modify this requirement through additional park specific conditions that may be attached to this permit. Additional conditions regarding the positioning and identification of markers and field equipment may be issued by staff at individual parks.

15. **Access to park and restricted areas** - Approval for any activity is contingent on the park being open and staffed for required operations. No entry into restricted areas is allowed unless authorized in additional park specific stipulations attached to this permit.

16. **Notification** - The permittee is required to contact the park's Research and Collecting Permit Office (or other offices if indicated in the stipulations associated with this permit) prior to initiating any fieldwork authorized by this permit.Ideally this contact should occur at least one week prior to the initial visit to the park.

17. **Expiration date** - Permits expire on the date listed. Nothing in this permit shall be construed as granting any exclusive research privileges or automatic right to continue, extend, or renew this or any other line of research under new permit(s).

18. **Other stipulations** - This permit includes by reference all stipulations listed in the application materials or in additional attachments to this permit provided by the superintendent or a designee. Breach of any of the terms of this permit will be grounds for revocation of this

permit and denial of future permits.

6.7 Appendix G: Government of U.S. Virgin Islands Permit for Activities within U.S. Territorial Waters of the U.S. Virgin Islands

GOVERNMENT OF THE VIRGIN ISLANDS OF THE UNITED STATES

DEPARTMENT OF PLANNING AND NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
45 MARS HILL
FREDERIKSTED, VI 00840
PHONE: (340) 772-1955, FAX: (340) 772-3227

INDIGENOUS SPECIES RESEARCH/COLLECTION/EXPORT PERMIT DFW18094X

Permittee:	Daniel Wagner, Ph.D.
Mailing Address:	331 Fort Johnson Rd. Charleston, SC, 29412
Physical Address	331 Fort Johnson Rd. Charleston, SC, 29412
Phone:	(808) 256-5014
Email:	daniel.wagner@noaa.gov

BACKGROUND:

The territory of the Virgin Islands of the United States (USVI) has the obligation to "protect, conserve, and manage indigenous fish, wildlife and plants, and endangered or threatened species for the ultimate benefit of all Virgin Islanders, now and in the future." Authority for this is vestedin the Department of Planning and Natural Resources by Title 12, Chapter 2 of the Virgin Islands Code. This act provides that the responsibility for all plant and animal species indigenous to the Territory and within the geopolitical boundaries of the Territory, including all waters from the shoreline to the 3-mile Territorial Limit, is the purview of the Territory.

By this permit, the Division of Fish and Wildlife of the Department of Planning and Natural Resources (DFW) grants the Permittee authorization to conduct seafloor mapping, specimen collection, and meteorological data collection in U.S. Virgin Islands waters off the north-east and east end of St. Croix, subject to the limits specified in the following permit Conditions.

CONDITIONS:

1. The names and qualifications of all persons performing the described activities, including volunteers and staff, must be submitted to the Division of Fish and Wildlife (DFW) prior to the beginning of work. Only those individuals specifically authorized by this permit are allowed to engage in any activity described by this document.
2. A copy of this permit must be present at the site authorized activities.
3. All activities related to this permit are subject to on-site assessment by DFW staff.
4. No invasive techniques or methods may be used, except as specified in this permit.
5. Techniques that may destroy, injure or harm non-target organisms is not permitted.
6. Seafloor and water column mapping may be conducted by the NOAA Ship *Okeanos Explorer* using ship-based, hull-mounted mapping sonars within USVI waters.
7. Oceanographic data may be collected using a CTD and rossette system to collect water samples to measure seawater conductivity, temperature, and depth within USVI waters
8. Meteorological and atmospheric measurements may be recorded using shipboard sensors within USVI waters.
9. Biological and geological samples collected may be retained on the NOAA *Ship Okeanos Explorer* during the research expedition and may be exported for processing and analysis. A copy of the approved permit must accompany all samples while in transit.
10. Minimize turning all sonar sources on and off as a precautionary measure to avoid startling animals.
11. If a sea turtle is present within 400-meters of the ship, the survey department will respond by stopping the pinging of the sub-bottom sonar and remain off until the sea turtle has departed the 400-meter safety zone.
12. If marine mammals are within 400 meters of the ship (460m for North Atlantic Right Whales), the vessel will stop if the animal is in danger of colliding with the ship, while the mapping sonars continue to transmit to avoid startling response. If observed animal does not depart area, sonars will be secured, and the ship will slowly move away from area.
13. Marine mammal that are within 400-meters and not in danger of collision, speed will be reduced, and animal will be avoided as much as possible. The survey department will stop the pinging of the sub-bottom sonar and switch the multibeam sonar to mammal protection mode (reducing pinging by 20 decibels). No changes will occur to the EK 60s.
14. When the systems have been shut down for any reason, the multibeam mammal protection mode will be used to return the multibeam back on first. Only after the multibeam has been brought from mammal protection mode to full power will the sub-bottom profiler and EK 60 sonars be turned back on.

15. If the multibeam sonar is not being used, but other sonar systems are being turned on, they will be started in lower power settings and over a fifteen-minute period, be adjusted to higher power settings as appropriate for the water depths to mimic the approach of the mammal protection mode of the multibeam.
16. All living animals must be handled so as to minimize the risk of injury and damage to health or wellbeing. All animals that are incidentally injured or stranded (an "Incident"), but living, such as sea turtles or marine mammals, must be reported to DFW immediately. To report an Incident, DFW staff may be reached by calling 1-340-773-1082, 1-340-775-6762, or 911. An Incident is not considered to be reported until information is provided directly to a DFW staff member.
17. The loss, death, or destruction of any wildlife shall be reported in writing to DFW the next working day. This is in addition to the reporting carried out under Condition 15, above. Deceased subjects shall be preserved and kept for scientific research whenever possible; separate permits are required for retention of any native species, dead or alive, and may be applied for following an Incident.
18. All other applicable state and federal permits must be obtained to carry out this work. This may include, and is not limited to, National Park Service, U.S. Army Corps of Engineers permits and associated biological and cultural evaluations. The applicant must obtain a valid permit from the National Park Service to conduct sampling within Buck Island Reef National Monument.
19. A final report shall be submitted to director of Div. Fish and Wildlife to ruth.gomez@dpnr.vi.gov, within 120 days of the end of the project or the expiration of this permit, whichever occurs first. Published articles, a dissertation, or a thesis may be submitted, and are preferred, in lieu of a final report.
20. An inventory of samples and specimens must be kept by the applicant, regularly updated, and provided to DFW upon request.
21. This permit is not valid until signed by all parties designated below.
22. This permit expires on 31 December 2019, at 11:59 p.m. AST, unless revoked prior to the expiration.
23. This permit may be renewed. To be considered for renewal, a letter of request must be received by DFW by mail or email no later than 30 days before the expiration date.

10/9/18
Dawn L. Henry, Esq. Date
Commissioner, Department of Planning and Natural Resources

10/9/2018
Jean-Pierre Oriol Date
Director, Division of Coastal Zone Management

10/3/18
Ruth Gomez Date
Director, Division of Fish and Wildlife

October 3, 2018
Daniel Wagner, Ph.D. Date
Permittee

cc: Howard Forbes, Director Division of Environmental Enforcement (DEE)

AUTHORIZED PERSONNEL:

Daniel Wagner, Ph.D., Expedition Coordinator
Stacey Williams, Ph.D., Science Co-Lead
Steven Auscavitch. Science Co-Lead
Derek Sowers, Mapping Lead
Neah Baechler, Mapping Watch Lead
Megan Cromwell, Sample Data Manager
Karl McLetchis, ROV Dive Supervisor
Jeff Laning, ROV Team

Andy O'Brien, ROV Team
Levi Unema, ROV Team
Sean Kennison, ROV Team
Andy Lister, ROV Team
Josh Carlson, ROV Team
Dan Rogers, ROV Team
Lars Murphy, ROV Team
Emily Narrow, Video Engineer
Caitlin Bailey, Video Engineer
Art Howard, Video Engineer
Roland Brian, Video Engineer
Bob Knott, Video Engineer

LOCATION OF ACTIVITY:

6.8 Appendix H: Government of Puerto Rico Permit for Activities within U.S. Territorial Waters of Puerto Rico

GOBIERNO DE PUERTO RICO
Departamento de Recursos Naturales y Ambientales

PERMISO PARA PROPÓSITOS CIENTÍFICOS

Autorizado: Dr. Daniel Wagner y Personal autorizado NOAA Office of Ocean Exploration and Research 1315 East-West Highway Silver Spring Maryland, USA 20910 Tel. (808) 256-5014	**Número DRNA: 2018-IC-073** **(O-VS-PVS15-SJ-01015-14092018)** **Expira:** 30 de septiembre de 2019 **Lugar donde se autoriza a llevar a cabo la actividad objeto de este Permiso:** Aguas territoriales de Puerto Rico

La Parte Peticionaria de epígrafe, solicita al Departamento de Recursos Naturales y Ambientales (DRNA) un Permiso para Propósitos Científicos.

Evaluada la Solicitud presentada, al amparo de la Ley Núm. 23 de 20 de junio de 1972, según enmendada, mejor conocida como *Ley Orgánica del Departamento de Recursos Naturales y Ambientales*, por la Ley Núm. 278 de 29 de noviembre de 1998, según enmendada, mejor conocida como *Ley de Pesquerías de Puerto Rico* y el Reglamento 7949 de 24 de noviembre de 2010, mejor conocido como *Reglamento de Pesca de Puerto Rico-2010,* se emite el presente Permiso, sujeto a que se cumplan con las siguientes:

1. Condiciones y autorización:

1.1. La validez de este Permiso depende de que las actividades aquí autorizadas se lleven a cabo de acuerdo a las leyes y reglamentos estatales y federales aplicables y de que se cumpla con las condiciones aquí estipuladas.

1.2. Este Permiso es intransferible y sujeto a revisión o cancelación si las circunstancias, a juicio del DRNA, así lo ameritan.

1.3. Este Permiso no será válido sin los permisos federales y locales correspondientes de éstos ser requeridos.

1.4. Este Permiso deberá ser portado por su tenedor en todo momento durante su uso.

1.5. **Se autoriza al Dr. Daniel Wagner y personal autorizado de la "National Oceanographic and Atmospheric Administration" (NOAA), a realizar investigaciones exploratorias sobre la diversidad y distribución de los hábitats de aguas profundas alrededor de Puerto Rico y las Islas Vírgenes estadounidenses a bordo de la embarcación "Okeanos Explorer" de la NOAA. El objetivo es efectuar cartografías en aguas profundas y operaciones en vehículos operados por control remoto (ROV) dentro de las aguas territoriales de Puerto Rico para atender los intereses de los manejadores regionales, de las partes con interés ("stakeholders") y científicos.**

1.6. Este Permiso se concede sujeto a las siguientes condiciones:

1.6.1. No podrá colectar ninguna especie designada como vulnerable o en peligro de extinción.

1.6.2. Podrá realizar la adquisición de datos de batimetría y mapas de la columna de agua usando los sonares del "Okeanos Explorer"

1.6.3. Podrá realizar un muestreo con video de alta definición y muestreo físico limitado con un ROV (vehículo operado por control remoto).

Carr. 8838 Km 6.3 Sector El Cinco, Río Piedras, PR 00926 • PO Box 366147, San Juan, PR 00936
787.999.2200 787.999.2303 www.drna.pr.gov

1.6.4. Podrá realizar mediciones oceanográficas estándar utilizando un sistema de roseta de conductividad, temperatura y profundidad (CTD).

1.6.5. Se autoriza coleccionar datos meteorológicos estándar utilizando los sensores de a bordo del barco.

1.6.6. Podrá colectar un número pequeño de muestras biológicas y geológicas por cada buceo del ROV (4 muestras biológicas y 2 muestras geológicas, para un total de 6 muestras por buceo) y muestras estándar de agua usando el sistema de CTD.

1.6.7. Podrá colectar cantidades razonables de muestras de invertebrados (esponjas, corales, etc.), solamente si son de interés científico.

1.6.8. Deberá solicitar la renovación al menos noventa (90) días laborables, previo a la fecha de expiración del Permiso.

2. **Requisitos de Informe**: Deberá rendir **UN INFORME** detallado de las actividades realizadas al amparo de este Permiso, treinta (30) días antes de la fecha de expiración, disponiéndose que transcurrido el término sin haber presentado el informe, el DRNA podrá incautar y disponer de cualquier especie autorizada en el Permiso, no renovar el Permiso o tomar acciones legales y administrativas que en derecho procedan.

Expedido por:	**Fecha de efectividad:**
Armando G. Otero Pagán Subsecretario	09 OCT 2018

6.9 Appendix I: Dominican Republic Ministry of Foreign Relations Permit for Activities within the Exclusive Economic Zone of the Dominican Republic

MINISTERIO DE RELACIONES EXTERIORES
REPÚBLICA DOMINICANA

DCEP 0 3 1 0 0 4

El Ministerio de Relaciones Exteriores – Dirección de Ceremonial de Estado y Protocolo, saluda atentamente a la Honorable Embajada de los Estados Unidos de América, en ocasión de comunicarle que la solicitud de autorización para entrada y salida sin restricciones en aguas territoriales de la República Dominicana, a favor del barco **OKEANOS EXPLORER**, contenida en la Nota No. 825, de fecha 25 de septiembre de 2018, **ha sido aprobada**, mediante oficio No. 33251, de fecha 02 de octubre de 2018, del Ministerio de Defensa.

El Ministerio de Relaciones Exteriores – Dirección de Ceremonial de Estado y Protocolo hace provecho de la oportunidad para reiterar a la Honorable Embajada de los Estados Unidos de América, las seguridades de su más alta y distinguida consideración.

Santo Domingo, D. N.
03 de octubre de 2018.

Anexo: Copia de aprobación

PG/ag.-

REPÚBLICA DOMINICANA
MINISTERIO DE DEFENSA
DISTRITO NACIONAL
"TODO POR LA PATRIA"

"AÑO DEL FOMENTO DE LAS EXPORTACIONES"

33261

PRIMER ENDOSO :

Del : Ministro de Defensa.

Al : Comandante General de la Armada de República Dominicana, (ARD).

Asunto : Remisión de Nota No. 825, de fecha 25 de septiembre de 2018, de la Embajada de los Estados Unidos de América, donde solicitan la entrada y salida sin restricciones en aguas territoriales de la República Dominicana, para el barco **Okeanos Explorer, IMO8835114**, de la Administración Nacional Oceánica y Atmosférica (NOAA por sus siglas en Inglés), en misión de realizar investigaciones sobre la diversidad y distribución de hábitats de aguas profunda y la vida en el Atlántico Sur y el Caribe, el cual se llevará a cabo entre el 03 de octubre y el 16 de diciembre de 2018.

Anexo : Oficio No. 030216, de fecha 27-09-2018, de la Viceministra de Relaciones Exteriores para Asuntos Consulares y Migratorios, Encargada de la Cancillería y anexo.

REFERIDO cortésmente, con la aprobación de este Despacho.

RUBÉN D. PAULINO SEM,
Teniente General, ERD.

PE.-
AP/Olivero- (02)
02-10-2018.

Copia al:
Ministro de Relaciones Exteriores.
Viceministro de Defensa para Asuntos Navales y Costeros.
Viceministra de Relaciones Exteriores para Asuntos Consulares y Migratorios, Encargada de la Cancillería.
Asesor Militar, Terrestre, Naval y Aéreo del Poder Ejecutivo.
Inspector General de las Fuerzas Armadas.
J-3, Director de Planes y Operaciones del Estado Mayor Conjunto, MIDE.
J-2, Director de Inteligencia del Estado Mayor Conjunto, MIDE.
Honorable Embajada de los Estados Unidos de América en República Dominicana.
Director de Asuntos Internacionales de las Fuerzas Armadas, "DAIFFAA".
Archivo.-

MINISTERIO DE RELACIONES EXTERIORES
REPÚBLICA DOMINICANA

"AÑO DEL FOMENTO DE LAS EXPORTACIONES"

MUY URGENTE

Santo Domingo, D. N.
27 de septiembre de 2018.

DCEP

Al : Teniente General, E.R.D
RUBEN DARIO PAULINO SEM
Ministro de Defensa
Su Despacho. -

Asunto : Remisión de Nota No. 825, de fecha 25 de septiembre de 2018, de la Embajada de los Estados Unidos de América, donde solicitan la entrada y salida sin restricciones en aguas territoriales de la República Dominicana, para el barco **Okeanos Explorer, IMO8835114**, de la Administración Nacional Oceánica y Atmosférica (NOAA por sus siglas en Inglés), en misión de realizar investigaciones sobre la diversidad y distribución de hábitats de aguas profunda y la vida en el Atlántico Sur y el Caribe, el cual se llevara a cabo entre el 03 de octubre y el 16 de diciembre de 2018.

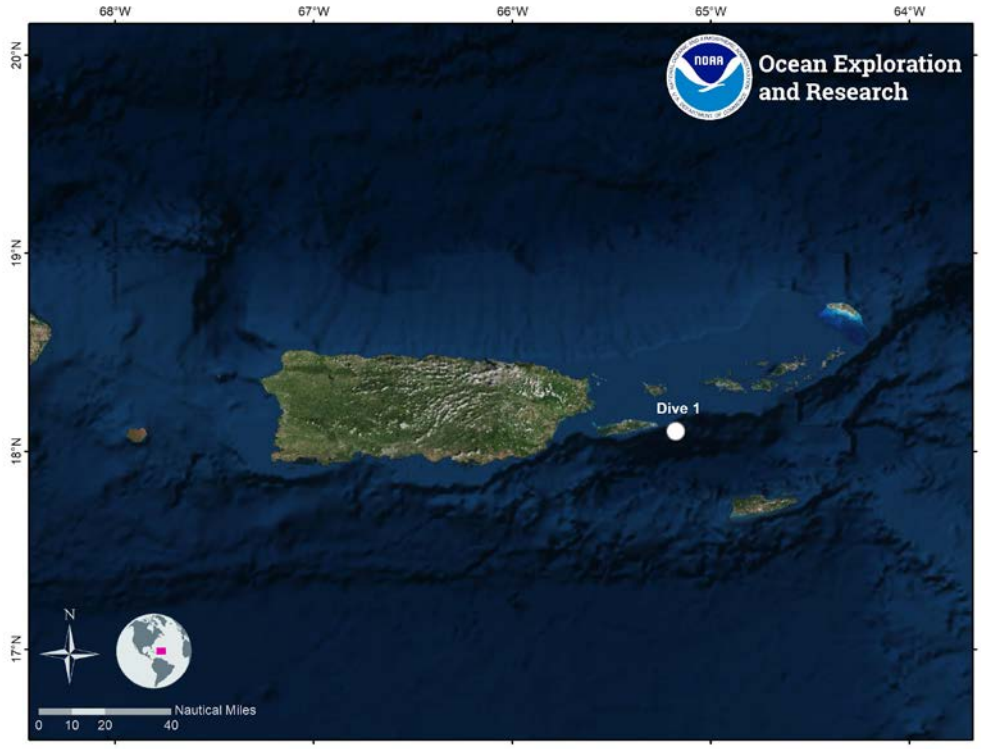
Muy cortésmente remitimos a usted, lo citado en el asunto, para su conocimiento y fines que estime procedentes.

Atentamente le saluda,

MARJORIE ESPINOSA
Viceministra de Relaciones Exteriores para
Asuntos Consulares y Migratorios
Encargada de la Cancillería.

ME/PG/ag.-

6.10 Appendix J: Dive Summary Forms for the 19 Completed ROV Dives

EX1811-Dive01 Information			
General Location Map			
General Area	U.S. Caribbean Sea		
Site Name	East of Vieques Island		
Science Leads	Stacey Williams (ISER) and Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE01		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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 science chatroom did not display ROV navigation and environmental data during the dive. This data also had to be manually imported into SeaTubeV2 after the dive.
	In Water: 2018-10-31T17:42:31.246011 18°, 7.597' N ; 65°, 9.789' W On Bottom: 2018-10-31T18:00:27.230319 18°, 7.637' N ; 65°, 9.777' W Off Bottom: 2018-10-31T20:12:10.744620 18°, 7.557' N ; 65°, 9.873' W Out Water: 2018-10-31T20:34:37.439001 18°, 7.761' N ; 65°, 9.683' W Dive duration: 2:52:6 Bottom Time: 2:11:43 Max. depth: 283.0 m
	Dive 01 was a short dive as a USBL calibration was performed in the morning prior to the dive.

Name	Affiliation	Email
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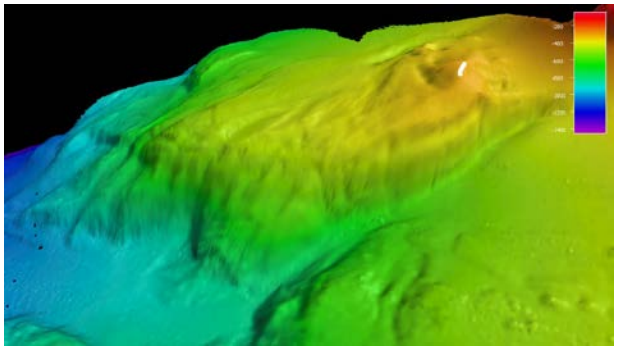
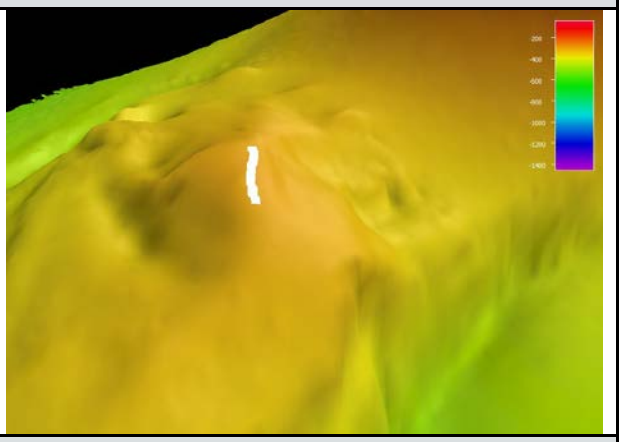
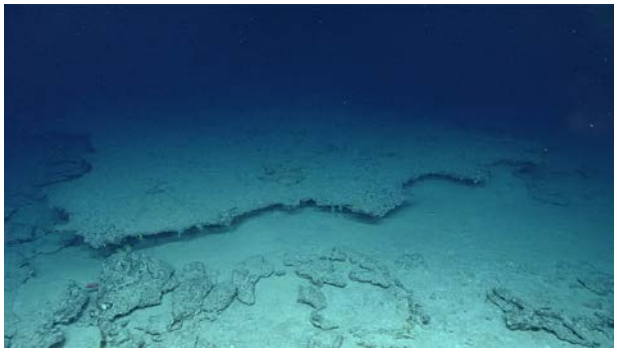
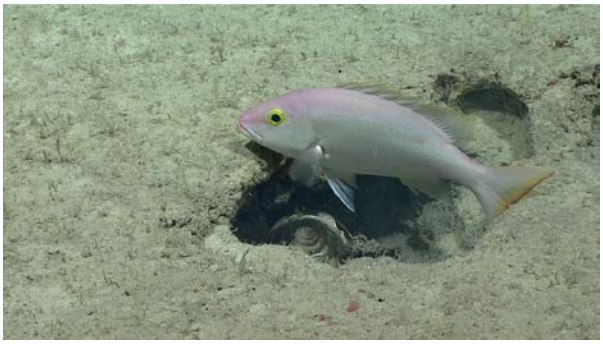
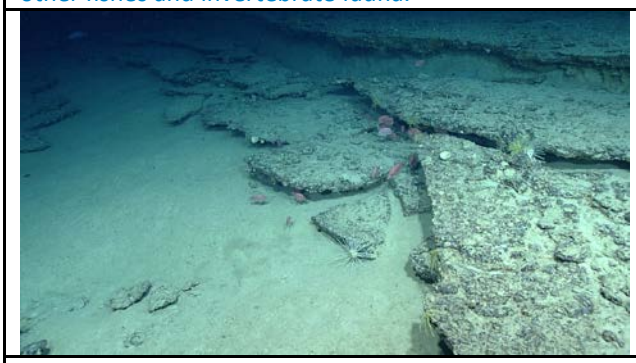
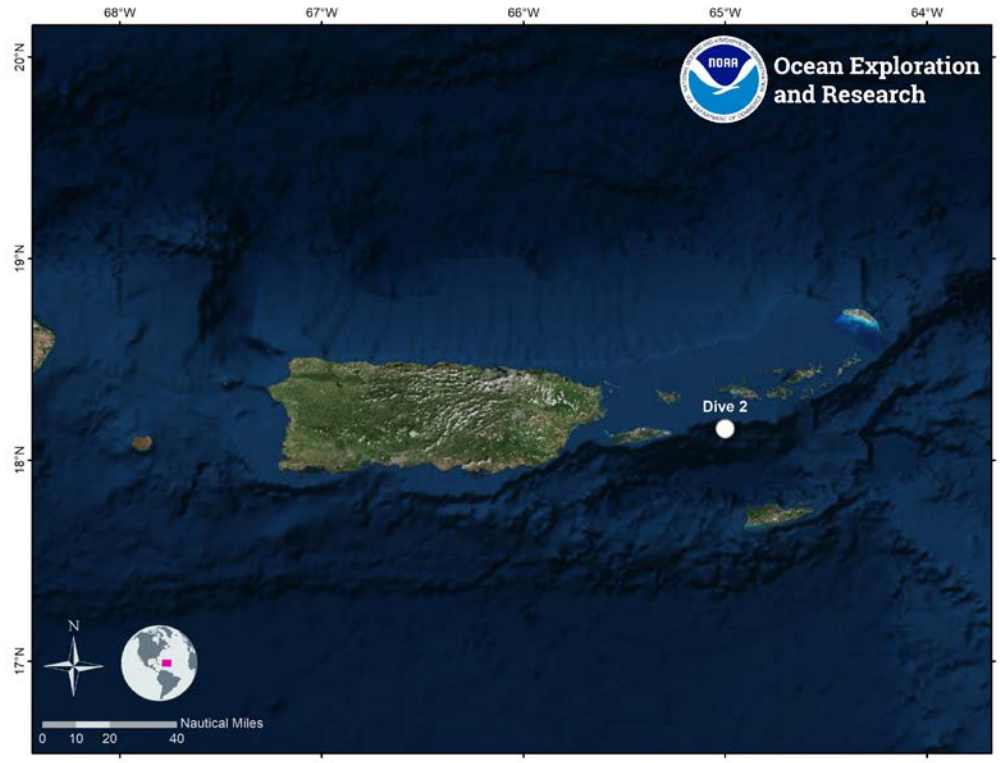
Steven Auscavitch	Temple University	steven.auscavitch@temple.edu
Tara Harmer Luke	Stockton University	luket@stockton.edu

Dive Purpose	The purpose of the dive was exploratory with an emphasis on identifying occurences of deep-water fish species, as well as their habitat preferences along the dive track. The dive survey was designed to traverse a variety of slopes, ultimately ending on a local topographic high. The targeted depth range lied within the known depth range for commercially important snapper species in the area. The dive also targeted deep-sea coral and sponge communities.

Dive Description	The first dive of EX1811 occurred on a local topographic high to the east of Vieques Island. Vehicles reached bottom at 18:01 UTC at a depth of 275 m. On descent, a couple of groupers were swimming above the seafloor, but quickly fled as the ROV approached. Substrate on landing was relatively hard and lightly sedimented. The substrate was largely unchanged through the dive with occasional isolated cobble-sized stones, carbonate outcroppings and ledges. The entirety of the dive was spent traversing the seafloor to the southwest since the on-bottom location was far to the northeast of the intended target. Around 18:45 UTC we came across one of the more substantial rocky outcroppings with deep-water snappers, corals and sponges. These formations were occasionally associated with schooling snappers, moray eels, and occasional misty groupers. The seafloor was scattered with many yellow comatulid crinoids and stalked species. There were many brittle stars (multiple species) and two species of sea urchins (pancake and cidarids with white long spines). There was a small sea star that wasn't well imaged attached to a black coral branch. Two large slitshell gastropods were observed with the larger of the two (~10 cm in shell diameter) occurring near the off-bottom location. Notable crustaceans included squat lobsters (Galatheidae), decorator crabs, and coral-associated shrimp. Two octopods were observed hiding in or near burrows in the sediment. Silk snappers (*Lutjanus vivanus*) were the most abundant fish. At one point a large school was observed at the edge of a rock outcrop. This was a multi-species school, mainly comprised of silk snappers and one large vermillion snapper. The dive also documented four misty groupers, many small schools of bigeye soldierfish, boarfish (*Antigonia* sp.), and very shy longtail jewelfish. Four green moray eels were also spotted along the dive. Most fish were observed next to rocky outcrops or in crevices in the seafloor. Fish were observed many times using these outcrops as shelter. Marine debris was not common, but one glass bottle on the seafloor was observed. *Sargassum* phytodetritus was also seen throughout the dive. Deep-sea corals and sponges were regularly observed, but were not abundant. The most common coral species were black coral whips (*Stichopathes* spp.) and solitary cup corals (Scleractinia). One species of colonial deep-water coral was seen, *Madracis* cf*. myriaster*, on an outcrop lip. This colony was small (<20 cm in total height), but at least one other colony was observed nearby. At least three genera of octocorals were observed, *Chrysogorgia* sp. , a white *Nicella* sp., and a yellow Plexaurid (?*Paramuricea* sp.). Several small (<5 cm) black coral colonies were observed on close zooms, but a firm identification could not be reached. One *Bathypathes*-like black coral was also seen on two occasions. Small stylasterids (<5 cm in height) were commonly observed during tight zooms of rocky hard-bottom, but were unidentifiable. Three morphologies of sponges were observed but not identified; one demosponge, one hexactinellid sponge and one unknown.
Notable Observations	Multi-species schools of snappers (including silk and vermillion), as well as large misty groupers (>80 cm) associated with rocky ledges and outcroppings.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Rocky carbonate crust with attached coral and sponge fauna along the edges. Rubble provided habitat for other fishes and invertebrate fauna.	Silk snapper using depressions in the seafloor for refuge. Such depressions in the rock were common.
	
Rocky ledge community including fishes, bigeye soldierfish and silk snappers.	Large mixed species school of snappers associated with rocky ledges.
Samples Collected	
No samples were collected on this dive	

EX1811-Dive02 Information			
General Location Map			
General Area	U.S. Caribbean Sea		
Site Name	East of Vieques Island 2		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE02		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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 science chatroom did not display ROV navigation and environmental data during the dive. This data had to be manually imported into SeaTubeV2 after the dive. The starboard vertical thruster on *D2* failed during ascent due to a blown fuse, but did not affect operations.
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-01T12:22:42.367912 18°, 9.815' N ; 64°, 59.44' W On Bottom: 2018-11-01T13:08:39.494240 18°, 9.79' N ; 64°, 59.439' W Off Bottom: 2018-11-01T20:03:44.096221 18°, 10.126' N ; 64°, 59.755' W Out Water: 2018-11-01T20:32:29.542309 18°, 9.958' N ; 64°, 59.505' W Dive duration: 8:9:47 Bottom Time: 6:55:4 Max. depth: 780.0 m
Special Notes	N/A

Scientists Involved (provide name, affiliation, email)

Name	Affiliation	Email
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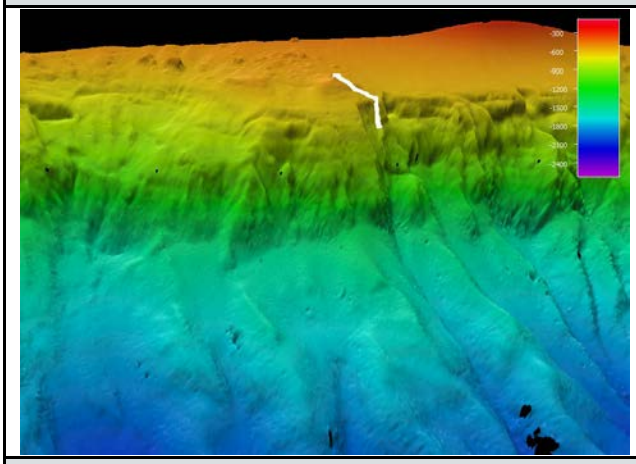
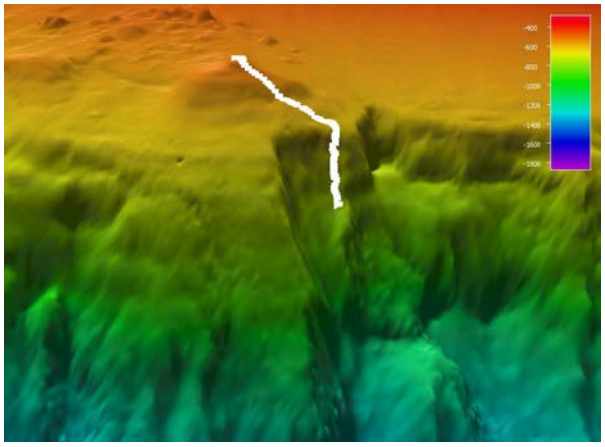
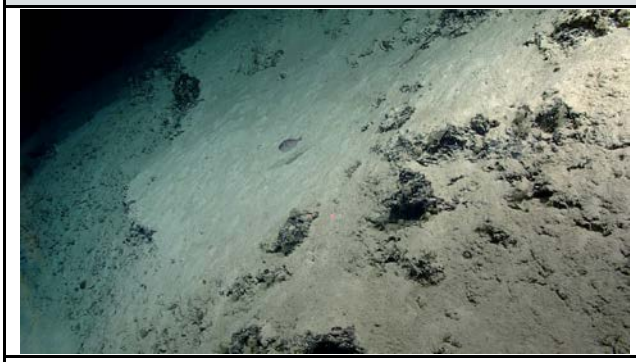
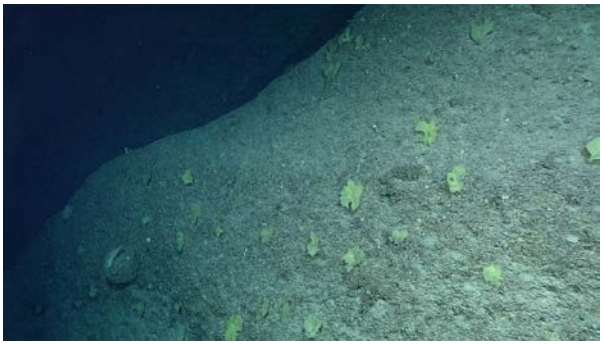
Steven Auscavitch	Temple University	steven.auscavitch@temple.edu
Tara Harmer Luke	Stockton University	luket@stockton.edu
Tina Molodtsova	P.P. Shirshov Institute of Oceanology	tina@ocean.ru

Dive Purpose	The purpose of the dive was exploratory with an emphasis on identifying occurences of deep-water fish species, as well as their habitat preferences. The dive survey was designed to traverse a variety of slopes and ultimately ending on a local topographic high. The targeted depth range lied within the known depth range for commercially-important snapper and grouper species. The dive also sought to survey and characterize deep-sea coral and sponge communities.
Dive Description	The second dive of this expedition took place on a relatively gentle sloped drop-off south of St. Thomas terminating on a 100 m tall mound. Substrate type for the majority of the dive was consolidated sediment with occasional outcrops of exposed hard rocky bottom. The mound feature was consolidated sediment with terrace-like features rising toward the summit. The diversity of demersal fish species was higher than on Dive 01, with more fish being observed at the beginning of the dive at deeper depths. Sixteen species of fish were observed during this dive. Most of the fish spotted were out in the open and not shy of the camera. The species observed at the beginning of the dive (UTC 13:17-15:13) in order as observed were cutthroat eel, cusk eel, halosaur, beardfish (*Polymixia* sp.), *Gephyroberyx* sp., grenadier, toadfish (*Chaunax* sp.), shortbelly eel (*Dysomma anguillare*), black mouth bass (*Synagrops bellus*), tripod fish (*Bathypterois* sp.), goosefish (*Lophiodes beroe*). An unknown fish was spotted at UTC 17:03, along with rosy dory (*Cyttopsis rosea*). The striped brotula (*Neobythites marginatus*) was seen swimming in a bottle at UTC 18:15-18:43, snailfish (Liparidae) at UTC 18:05, another unknown fish at UTC 18:57, catshark (maybe a first for the Caribbean) at UTC 19:29, and finally a possible sighting of *Erythrocles*. There was some trash found along the route, which included glass bottles, aluminum can and some old cable (might be from an old FAD). The echinoderms were by far the most abundant at the more flat areas with soft consolidated sediment. Crinoids, both stalked and unstalked, contributed the most to the echinoderm abundance. We saw a unique armored crinoid, of the genus *Holopus*. We spotted three species of sea cucumbers (purple floating, pink spiky, and clear white), three urchin species (mostly Cidarids) and an irregular sea urchin that looked like a dead sponge from a far. There were a lot of brittle stars hanging off the soft corals and inside crevices. A bumpy or ribbed brittle star (*Asteroschema* sp.) was collected along with a soft coral at UTC 18:06. There were four species of sea stars observed, including *Pteraster* sp., *Tamaria* sp., and *Linkia* sp. Yellow glass sponges were in high abundances along near-vertical structures. There were a few *Euplectella* glass vase sponges scattered along the seafloor around 13:43 UTC. Also, we observed two species of stalked glass sponges (*Sympagella* sp.), along with smaller glass sponges (Farreidae) that were in low abundance. A few species of demosponges were also observed during the dive. Deep-water corals were neither particularly abundant throughout the dive, nor would any particular portion of the dive be classified as high density. Nevertheless, at least 16 species of corals were observed across the following groups: Stylasteridae, Scleractinia (solitary only), Octocorallia, and Antipatharia. Early on in the dive, black coral whips in the genus *Stichopathes* were the most common coral often attaching to the sparse hard substrate. As the slope increased (around 14:00 UTC) other rigid corals including numerous small colonies of *Crypthelia* sp. (Stylasteridae) were common rocky outcrops. A sample of a particularly large colony was acquired at 15:59 UTC for identification confirmation (EX1811_D02_01B). *Crypthelia* sp. was commonly observed on hard substrate throughout the dive. Other octocorals present on this dive include *Thesea* sp., *Stylopathes* sp., *Acanthoprimnoa cf. goesi*, Chrysogorgiidae, *Antipathes* sp., *Callogorgia* sp., *Pennatula* sp. and multiple cup coral species. One Pennatulid sea pen (*Pennatula* sp.) was sampled (EX1811_D02_02B) because of its poor identification in this area. The third occurrence of unidentified *Callogorgia*-like colonies was sampled at 554 m for identity confirmation (EX1811_D02_03B). This genus is not well

	documented in the Caribbean and at least two species have been recently described in the literature from collections and museum specimens. On the summit of the mound closest to the final waypoint, *Parantipathes*-like black corals were found, as well as a different species of *Stichopathes* sp. with yellow-pale coloration. Bamboo coral fans (S1 Clade) were present on the rocky vertical fringes of the mound.
Notable Observations	Fish in a bottle. Well-camouflaged irregular sea urchin. Large *Callogorgia* sp. sea fans.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	

Representative Photos of the Dive	
	
Steep slopes early on the dive were heavily layered with sediment. Exposed hard substrate was usually colonized by stylasterids (*Crypthelia* sp.) and sponges.	Current scoured vertical surfaces were often covered with demosponges.

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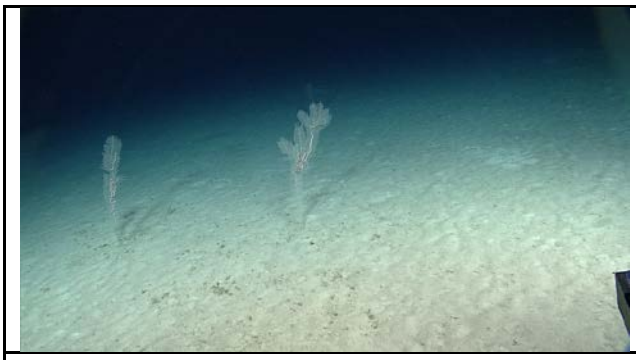
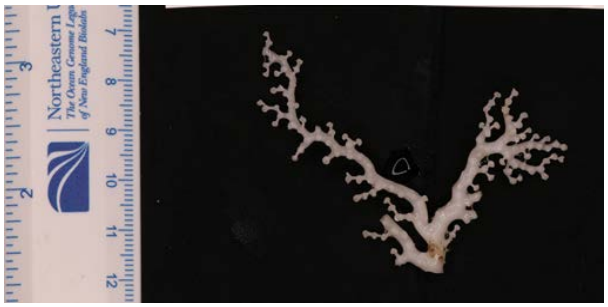
	
Moderate slopes with thin sediment veneer saw large colonies of *Callogorgia* sp. and many invertebrate associates.	The mound feature at the end of the dive track was composed of step-like carbonate rock with occasional attached fauna like Chrysogorgiid octocorals, black corals, and bamboo corals.

Samples Collected

Sample ID	EX1811_2D02_01B	
Date (UTC)	20181101	
Time (UTC)	160604	
Depth (m)	603.07	
Temp. (°C)	10.78	
Field ID(s)	*Crypthelia* sp.	
Commensals	No commensals	
Comments	N/A	

Sample ID	EX1811_D02_S02B	
Date (UTC)	20181101	
Time (UTC)	175228	
Depth (m)	559.1	
Temp. (°C)	12.25	
Field ID(s)	*Pennatula* sp.	
Commensals	No commensals	
Comments	N/A	

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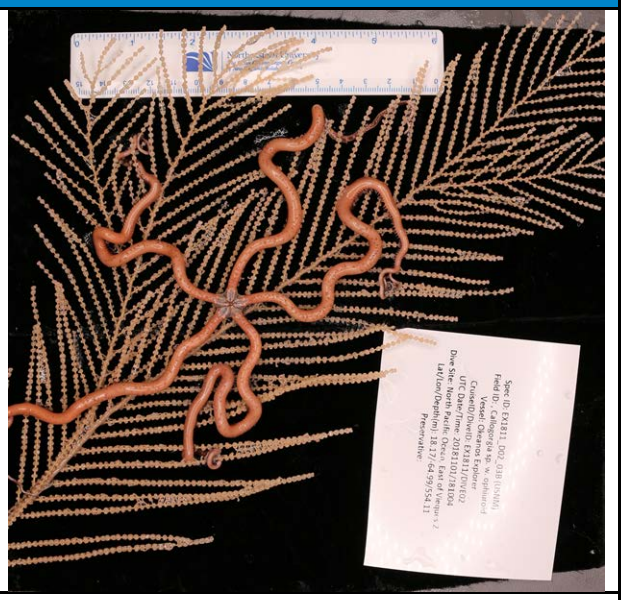
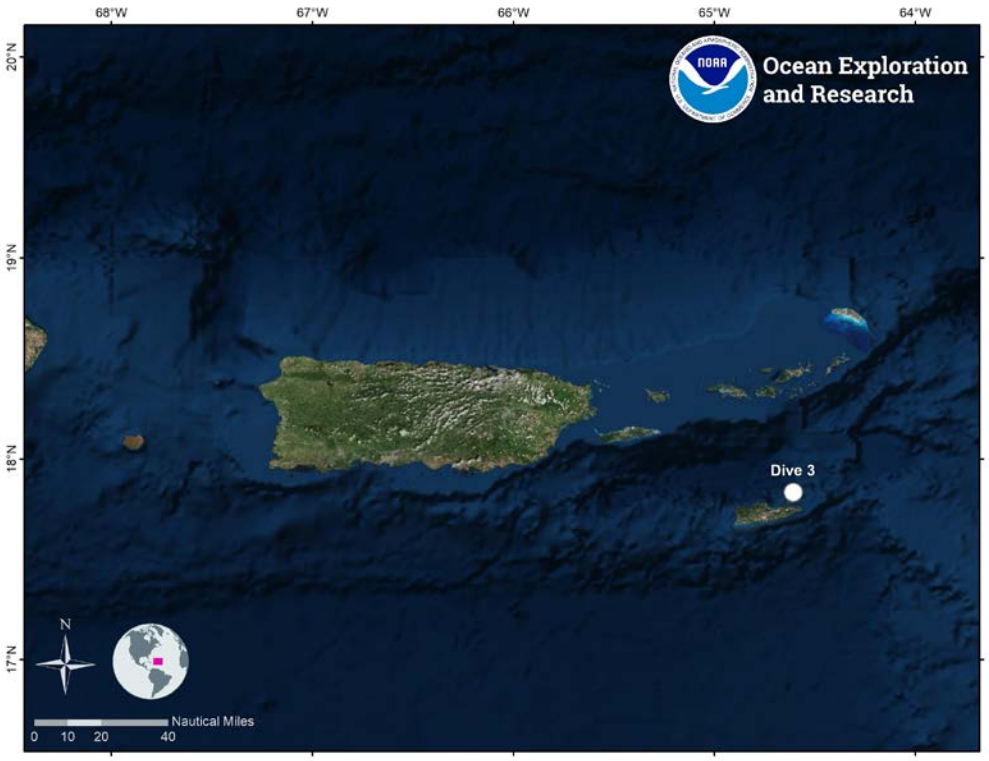
Sample ID	EX1811_D02_03B
Date (UTC)	20181101
Time (UTC)	181004
Depth (m)	554.11
Temp. (°C)	12.29
Field ID(s)	*Callogorgia* sp.



Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D02_03B_A01	Ophiuroidea	1

Comments	N/A

EX1811-Dive03 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Buck Island Reef National Monument		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE03		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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	None
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-02T12:30:07.400241 17°, 50.64' N ; 64°, 37.019' W On Bottom: 2018-11-02T13:38:28.060446 17°, 50.737' N ; 64°, 36.849' W Off Bottom: 2018-11-02T19:30:34.665917 17°, 50.395' N ; 64°, 36.812' W Out Water: 2018-11-02T20:36:14.435927 17°, 50.509' N ; 64°, 36.355' W Dive duration: 8:6:7 Bottom Time: 5:52:6 Max. depth: 1812.0 m
Special Notes	N/A

Scientists Involved (provide name, affiliation, email)

Name	Affiliation	Email
Amanda Demopoulos	US Geological Survey	ademopoulos@usgs.gov
Asako Matsumoto	Chiba Institute of Technology	amatsu@gorgonian.jp
Ashley Perez	Tenenbaum Puerto Rico Trench Expedition Team	ashley.perez@bahiapr.com
Brian Kennedy	Boston University	brian@deepsubmergence.com
Cheryl Morrison	US Geological Survey	cmorrison@usgs.gov
Chris Kelley	University of Hawaii	ckelley@hawaii.edu
Clayton Pollock	National Park Service	clayton_pollock@nps.gov
Colleen Peters	URI-ISC	innerspacecenter@googlegroups.com
Daniel Wagner	NOAA/OER	daniel.wagner@noaa.gov
Debi Blaney	NOAA/OER	debi.blaney@noaa.gov
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Jason Chaytor	US Geological Survey	jchaytor@usgs.gov
Jessica Robinson	University of Victoria	jrobinson@uvic.ca
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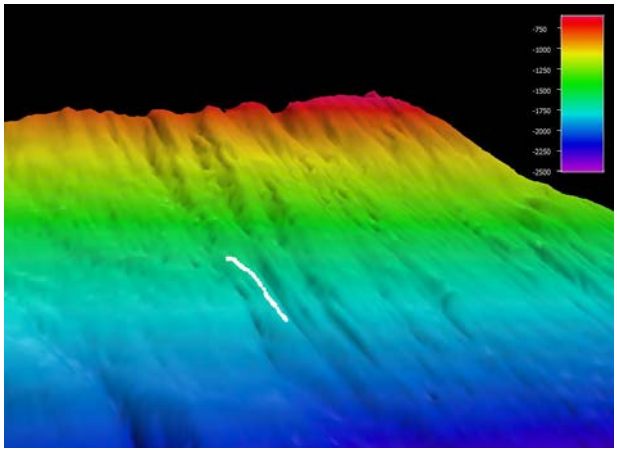
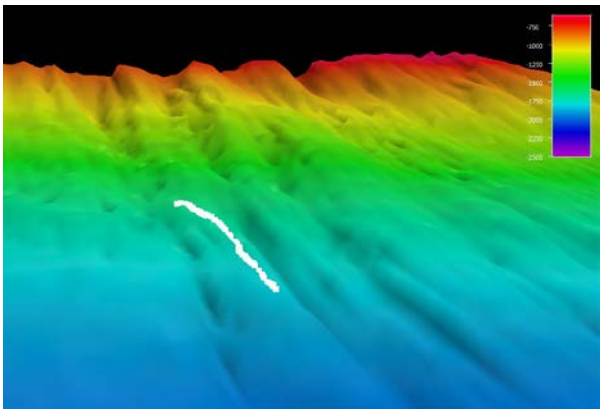
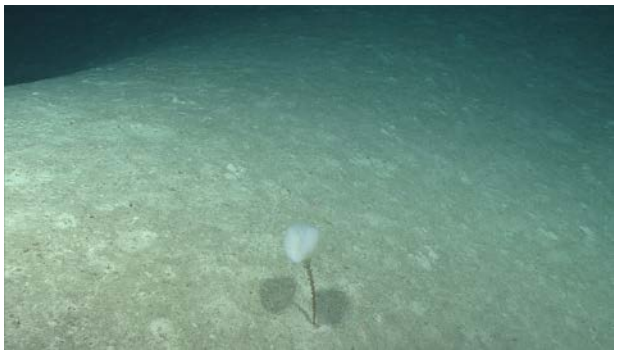
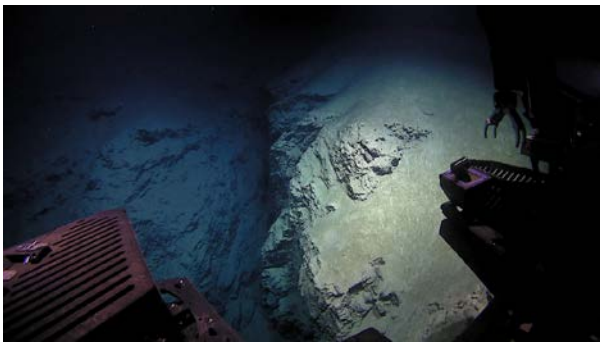
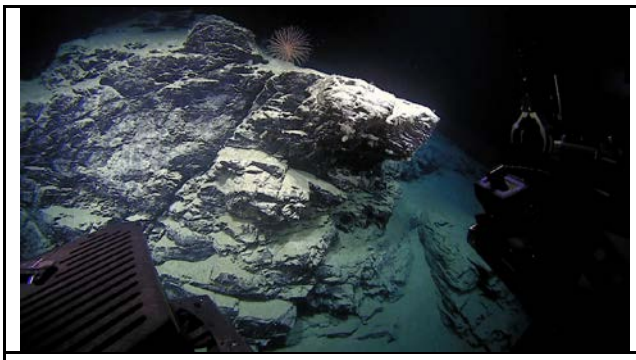
Steven Auscavitch	Temple University	steven.auscavitch@temple.edu
Tina Molodtsova	P.P. Shirshov Institute of Oceanology	tina@ocean.ru

Dive Purpose	The purpose of the dive was exploratory with an emphasis on surveying and characterizing deep-sea coral and sponge communities. The dive also sought to document deep-water demersal fish species, as well as their habitat preferences along the dive track. The dive track was designed to start just outside the Monument boundary and traversed southward into the Monument up a steep slope.

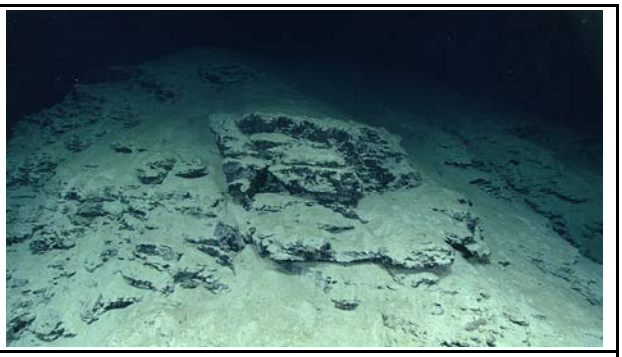
Dive Description	The dive began on a steep sedimented slope to the north of the boundary of Buck Island Reef National Monument at 1812 m. For so much sediment in first half, heading southward into the boundary and upslope, little evidence of wasting or slumping was noted by shore-side geologists. One particularly deep slump, at least 10 m in height, was seen near the half point of the dive with substantial exposed Fe-Mn crusted rock substrate. The second half of the dive from this point transitioned to rocky outcrop and ledge formations of angular black Fe-Mn crusted rocks. This portion of the dive had substantial encrusting and attached life. The diversity of demersal fish species was lower than Dive 02 and about the same as Dive 01. There were more fish identified and observed at the beginning of the dive at deeper depths (1,800 m) and on flat soft sediments. Four species of fish were observed during this dive, with the fish genera *Aldrovandia* and *Ipnops* being most abundant. The species observed at the beginning of the dive (UTC 14:03) in order as observed were *Bathysaurus* sp., *Ipnops murrayi*, *Bathypterois grallator*, and *Aldrovandia* sp. halosaur. At the beginning of the dive there was an isopod seen on the pectoral fin of a fish. We also observed two pieces of wood fall during this dive, both of which looked recent. The first piece has some small crustaceans inhabiting the piece, while the second piece had three squat lobsters. Sea cucumbers were one of the most abundant invertebrates, with three species identified (all likely new species for this cruise). There were a lot of *Enypniastes* sp. swimming holothurians in the water column. There was also a *Phormosoma* sp. at the beginning of the dive. There were only a couple of stalked crinoids and one unstalked crinoid observed. Brittle stars (*Ophiocreas oedipus*) were more common hanging on *Metallogorgia melanotrichos* coral colonies. Some other interesting organisms spotted during the dive were gooseneck barnacles, branching bryozoans, a pinkish corallimorph, scarlet gamba prawns, and squat lobsters. Vase *Euplectella* sp. sponges were common on the flat soft sediment and we also spotted a couple of stalked *Euplectella* sponges. Ferreidea sponges were common and usually small. There was also a long glass sponge *Euritidae pleurochorium*. Demosponges were common on the faces of the rocks and usually small. There were a small blue and black demosponge reoccurring on the faces of the rocks, and some *Geodia* species also observed. Dr. Christopher Kelley made some identifications of sponges observed on the dive: *Caulophacus* sp.*, Hertwigia* sp., Rossellidae, *Heteroscleromorpha* sp., *Hyalonema* sp., and *Tetractinellida* sp. Through the first half of the dive on the heavily-sedimented slope, deep-sea corals were sparse. Two species, one unidentified sea pen and one unbranched bamboo coral, were observed in this section of the dive. Upon reaching hard substrate outcrops and steep terrain, a greater coral diversity was observed. These included black corals (*Bathypathes* spp., *Heteropathes* cf. *americana*, *Stichopathes* sp.), octocorals (*Anthomastus* sp., Stolonifera, *Metallogorgia melanotrichos*, *Iridogorgia splendens*), stylasterids (*Crypthelia* sp.), and occasional sea pens (*Umbellula* sp.) in areas of soft bottom. *M. melanotrichos* was the most abundant coral and occurred in both advanced (no branchlets off main stem except the apical tuft of polyps) and young (numerous branchlets along the main axis) colony morphologies. Occasional small bamboo corals, possibly in the genus *Cladarisis* or similar clade, were also observed on rocky outcrops. Near the dive end black corals similar to *Parantipathes* sp. were observed. Ultimately, the final planned waypoint was never reached in favor of tracking rock hard-bottom ledges to the east of the intended dive track. Off-bottom occurred at 1607 m depth.

Notable Observations	The second half of the dive yielded dramatic rocky terrain (17:45 UTC) with relatively abundant deep-sea corals and sponges.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Soft-sediment bottom was the dominant substrate in the first half of the dive. Stalked sponges, echinoderms, and small fishes were commonly observed here.	Occasional deep gorges were observed as the terrain transitioned to rocky hard-bottom with significantly more attached fauna.



Outcroppings and rocky ledges were the dominant terrain in the second half of the dive. Chrysogorgiid octocorals, black corals, bryozoans, and sponges were commonly attached to hard substrate.



Sediment drape on rocky outcrops was locally heavy and resulted in fewer attached organisms.

Samples Collected

No samples were collected on this dive

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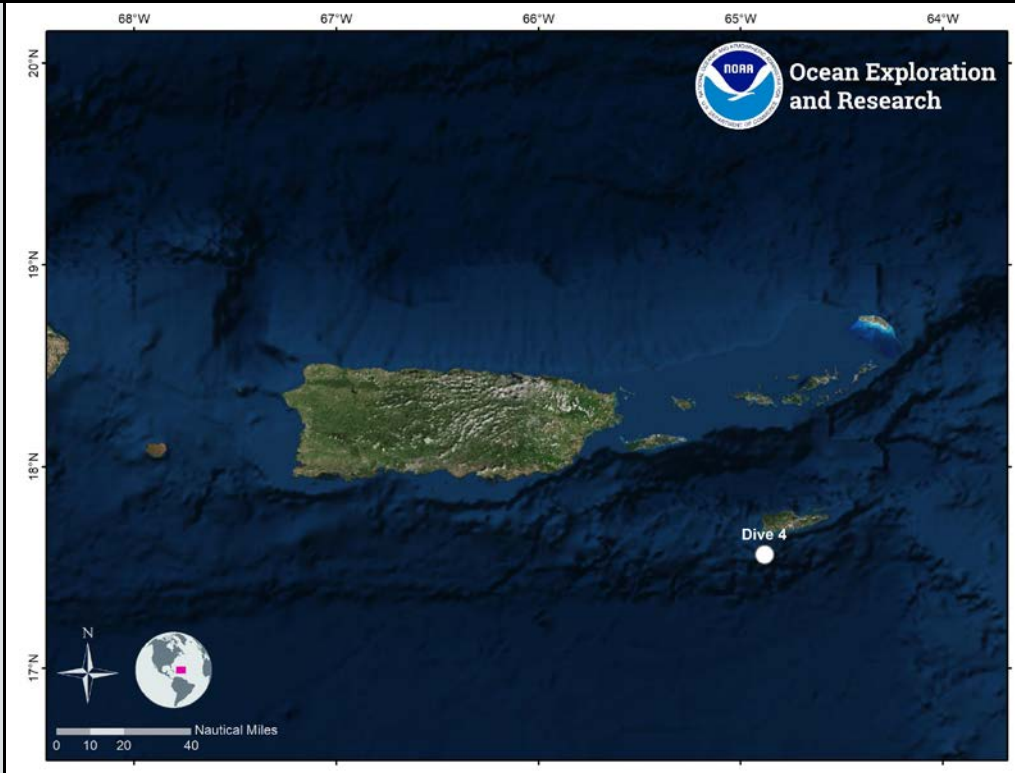
Dive Information	
General Location Map	
General Area Descriptor	U.S. Caribbean Sea
Site Name	St. Croix Amphitheater
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)
Expedition Coordinator	Daniel Wagner (NOAA-OER)
ROV Dive Supervisor	Chris Ritter (GFOE)
Mapping Lead	Derek Sowers (NOAA-OER)

ROV Dive Name	
Cruise	EX1811
Dive Number	DIVE04

Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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Equipment Malfunctions	None
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-04T14:50:25.060877 17°, 35.479' N ; 64°, 53.156' W On Bottom: 2018-11-04T15:17:51.323678 17°, 35.35' N ; 64°, 53.348' W Off Bottom: 2018-11-04T20:09:45.374939 17°, 35.355' N ; 64°, 53.241' W Out Water: 2018-11-04T20:33:44.653192 17°, 35.394' N ; 64°, 53.14' W Dive duration: 5:43:19 Bottom Time: 4:51:54 Max. depth: 564.0 m
Special Notes	N/A

Scientists Involved (provide name, affiliation, email)

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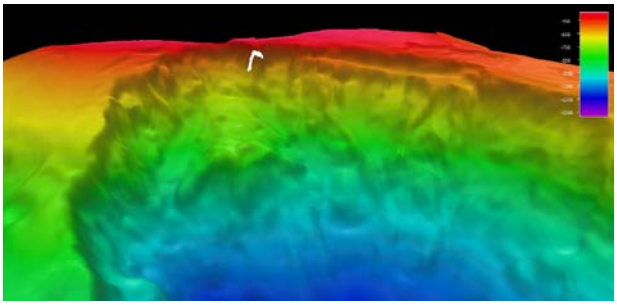
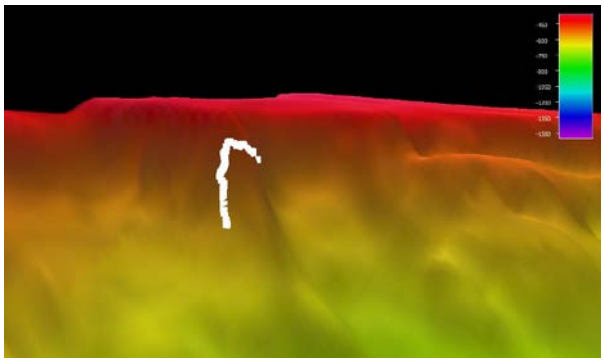
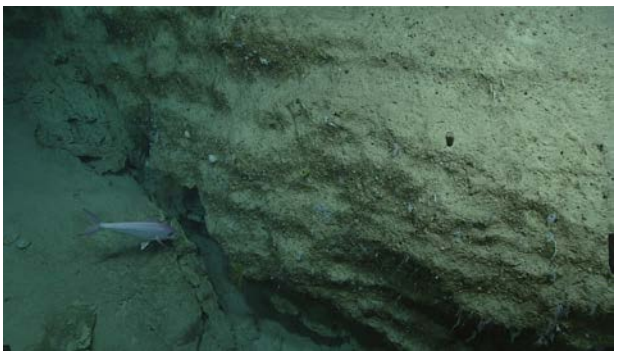
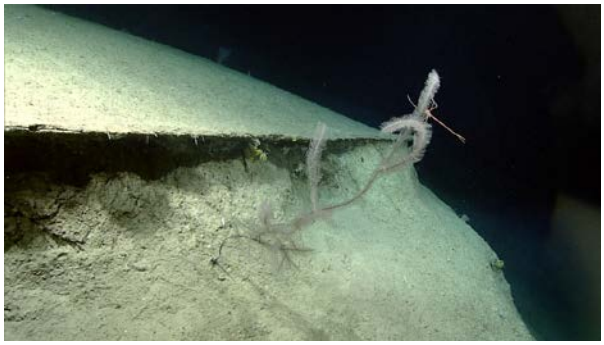
Tina Molodtsova	P.P. Shirshov Institute of Oceanology	tina@ocean.ru

Dive Purpose	The purpose of the dive was exploratory with an emphasis on surveying and characterizing deep-sea corals, specifically *Lophelia pertusa*, as well as deep-water sponges and demersal fish species.
Dive Description	Dive 04 began on a steep slope at the top of what appeared to be a slump feature in the multibeam bathymetry. Early on in the dive the seafloor was heavily sedimented, but rose quickly to near vertical walls of carbonate. Rocks in this area appeared to be dissolved carbonate rock, or karstic, in nature. Layers of sediment and harder rock appeared to be prominent in the rock wall face. Most of the dive occurred on this type of terrain. We also observed occasional deep gorges that extended into the wall which were not accessible by the ROV. Upon reaching what appeared to be the top of this feature, we traversed along the drop-off along a semi-continuous ledge, where we saw many attached organisms and fishes. There were at least 10 species of fish on this dive. The dive began on a gentle slope characterized by consolidated soft sediments. There were a lot of small shiny fish, Mueller's pearlside (*Marrilicus meulleri*) hovering above the sediment. They were the most abundant in this habitat. We witnessed one of them sticking their headsin the sediment, which looked like

	something was preying on it, but they were actually foraging. They seem to be only localized around the soft sediments and at the base of the hardground. There were a couple beardfish, *Polymixia* sp., foraging around the soft sediment. We also saw some green-eye fish (*Bembrops gobiodies*) and a *Chaunax* sp. toadfish in the sandy sediment. The green-eye fish were also common along the wall, along with the roughy (*Gephroberyx* or *Hoplostethus* sp.). We also saw small bluefish with big eyes (*Epigonus* sp.). We observed two queen snappers (*Etelis oculatus*) at ~18:20 and 18:58 UTC. Towards the end of the dive there was *Chlorophthalmus agassizi* and an unknown fish possibly from the family Scorpaenidae (18:28 UTC). There was a small, thin silvery fish observed in the water column, which could be *Benthodesmus tenuis*. At the beginning of the dive and in the soft sediment habitat, there were a lot of dead irregular sea urchins (*Linopneustes* sp.). We did observe one live urchin but otherwise we saw mostly bare skeletons. There was a possibly new irregular sea urchin (red in color) spotted during this dive in the soft sediments. Sea stars were far more abundant at this site than on the last three dive sites. We observed at least four new species for this expedition on this dive, *Peltaster* sp. (small white sea star), *Henricia* sp. (white sea star), *Odontaster*? sp. (orange sea star), and a slime star. These sea stars were more abundant along the gentle sloping faces of the hardground. We also recorded two species of sea cucumber, but there were only located around the end of the dive, towards the tops of the wall and in the soft sediments. Throughout the dive, and mostly along the wall, we found at least two species of sea urchins in the families Cidaridae and Aspidodiadematidae. There was a unique brittle star observed on a whitish and yellowish *Stichopathes* sp. black coral, which might be *Asteronyx* sp. or a close relative. Glass sponges were the most abundant sponges. There were a few scattered colonies in the soft sediment. We observed smaller glass sponges along the walls. A newer, unidentified vase glass sponge was sighted at 17:02 UTC. Most of the sponges were small, whitish or yellowish in coloration. There were some demosponges, but they were mostly small in size. Much of the lower portion of the wall was dominated by black coral whips (*Stichopathes* sp.) with occasional *Asteronyx* sp. brittle stars. Scleractinians were less abundant on the wall compared to black corals. Cup corals (cf. *Javania* sp.), as well as a few colonial scleractinians (*Solenosmila* cf. *variabilis*) were present on vertical faces. *Crypthelia* sp. hydrocorals were also present in abundance throughout this portion of the dive, usually associated with overhangs or lips. On more gentle slopes near the top of this feature, plexaurid octocorals were observed (?*Scleracis* sp.) attached to the underside of overhangs. None of these colonies were particularly large. Large branching structures, thought to be dead octocorals, seemed to be completely dominated by zoanthids over the entire dive length. Near the end of the dive, moving across slope near an extended platform, we encountered one bamboo coral (?*Cladarisis* sp. or similar), as well as a large unidentified black coral (cf. *Tanacetipathes* sp.). In the last half hour of the dive numerous small (<10 cm height) octocoral fans thought to be in the genus Primnoidae (possibly *Acanthopimnoa* sp. or similar) were observed in high densities.
Notable Observations	We observed some predation events. There was an anemone feeding on a pearlside at the beginning of the dive. We also saw a squat lobster feeding on another pearlside that might have been damaged from the ROV thrusters. There were also a lot of broken bivalve shells at the base of the hardground area.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Steep karst formations dominated the seafloor geomorphology for much of this dive. Deep cuts, extending into the wall, were often observed. Small overhangs were colonized by attached fauna.	On vertical surfaces, while organism density was not high, certain portions of the wall contained substantial diversity of colors and forms of cnidarians (zoanthids). The structures they were overgrowing appear to be former octocoral or black coral colonies.
	
Fishes, while rare, were occasionally observed in deep cuts in the rock. One Queen snapper is shown here.	An unidentified black coral under a small overhang that was frequently encrusted and covered with attached organisms like octocoral fans and stylasterids.

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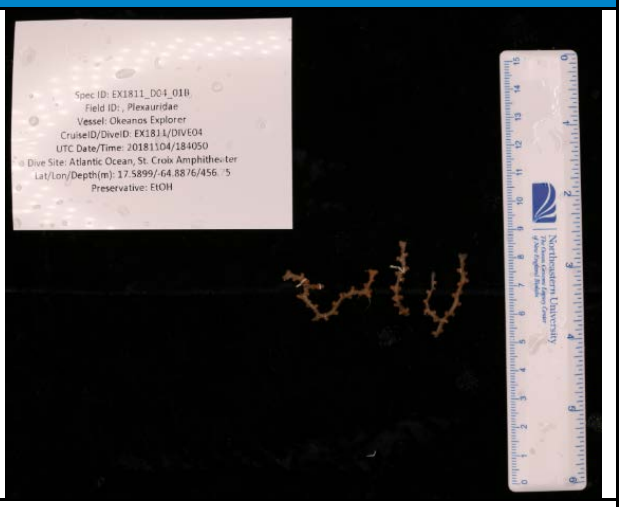
Samples Collected

Sample ID	EX1811_D04_S1B
Date (UTC)	20111104
Time (UTC)	184050
Depth (m)	456.745
Temp. (°C)	13.525
Field ID(s)	Plexauridae
Commensals	No commensals
Comments	Possibly *Scleracis* sp.



Sample ID	EX1811_D04_02B
Date (UTC)	20181104
Time (UTC)	193116
Depth (m)	446.94
Temp. (°C)	13.503
Field ID(s)	Antipatharian

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D04_02B_A01	Chirostylidae	1
EX1811_D04_02B_A02	Shrimp. Possibly Mysid?	2

Comments

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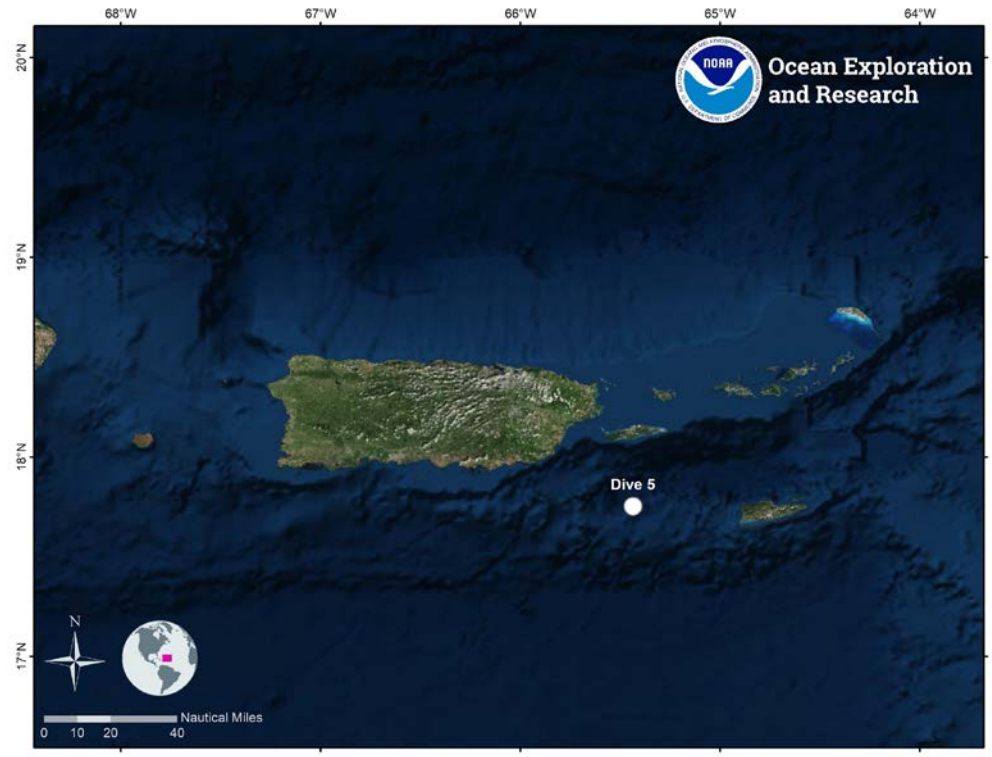
EX1811-Dive05 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Virgin Islands Trough South Wall		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE05		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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Equipment Malfunctions	None
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-05T12:22:15.323685 17°, 46.141' N ; 65°, 25.715' W On Bottom: 2018-11-05T13:42:58.698827 17°, 46.374' N ; 65°, 25.672' W Off Bottom: 2018-11-05T19:26:53.007420 17°, 46.314' N ; 65°, 25.526' W Out Water: 2018-11-05T20:54:47.196295 17°, 46.381' N ; 65°, 24.859' W Dive duration: 8:32:31 Bottom Time: 5:43:54 Max. depth: 2153.0 m
Special Notes	During ROV recovery a storm system passed, so the vehicles were held at 50 m until the storm passed, thus delaying recovery by 20 minutes.
Scientists Involved (provide name, affiliation, email)	

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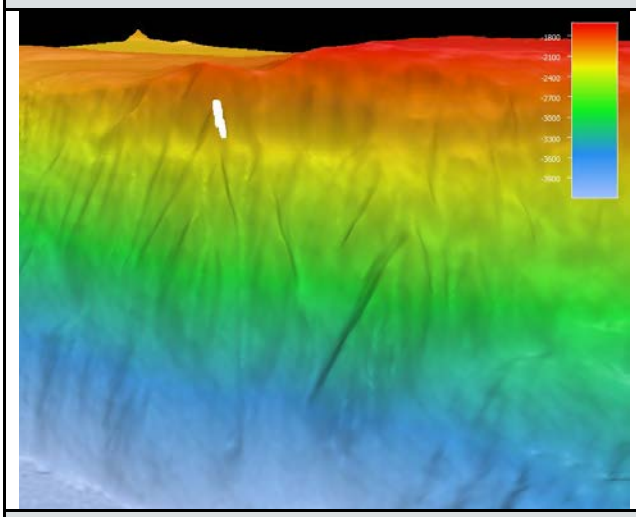
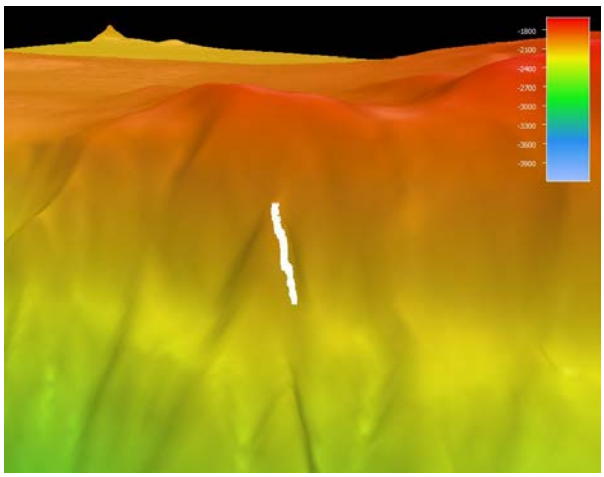
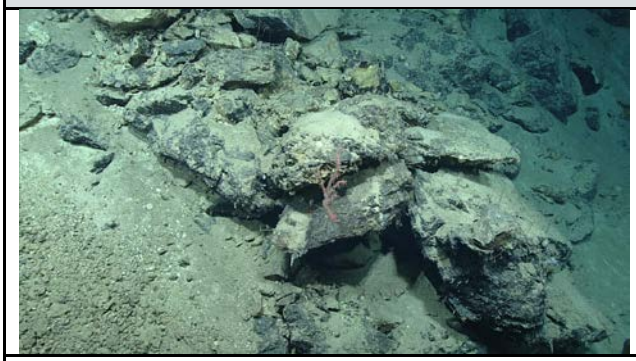
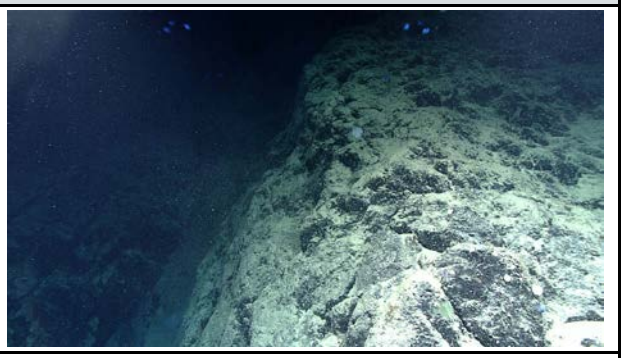
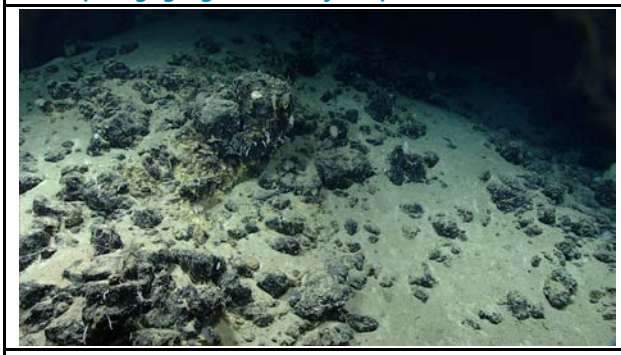
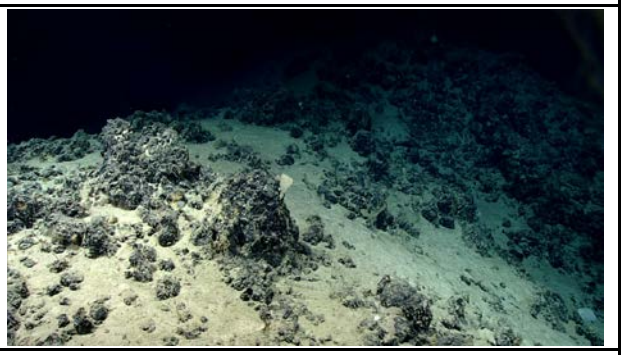
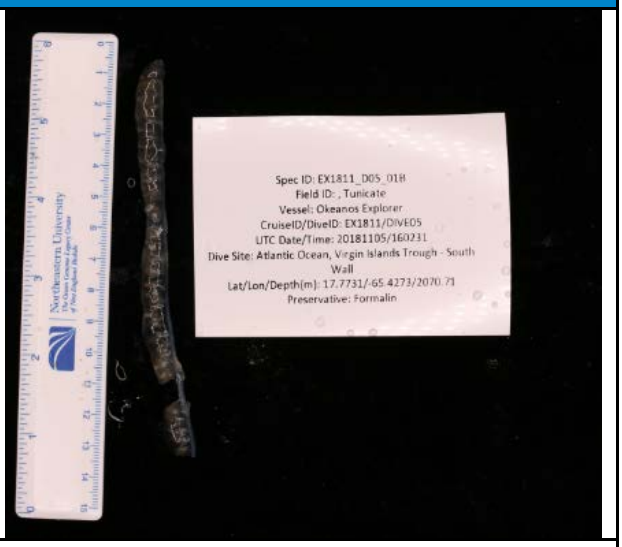
Dive Purpose	The purpose of the dive was to characterize the deep-sea coral and sponge communities in a relatively unexplored ridge feature west of St. Croix. The dive also sought to identify occurrences of deep-water demersal fish species, as well as their habitat preferences along the dive track. The dive track was designed to begin near the top of the south wall of the Virgin Islands Trough and then traversed southward up a steep nose feature in the wall from a depth of 1737 to 2138 m. Slopes expected along this dive track averaged between 30-40° incline. This depth range was selected to better understand deep-water community transitions between steep topography and ridge crests.

Dive Description	The dive started in a habitat dominated by soft sediment and scattered large boulders. Sediment and detritus was draped over the boulders. The current was mild throughout the dive and direction was west-northwest at the beginning of the dive. While the first half of the dive consisted of soft bottom habitats with scattered big boulders, the second part consisted of a steeper terrain with consolidated hardground. Sponges were the dominant organism at this site, across all depths and habitats. However, sponges were less common at the end of the dive, which traversed a narrower ridge feature with rocky ledges and overhangs that was heavily sedimented. Glass sponges contributed the most to the overall sponge composition. The diversity in morphology and species was high. The stalked glass sponges were possibly Hyalonematidae (*Heterorete* sp.) and encrusting glass sponges (*Sceptrulophora* sp.). We saw a lot of euplectillid sponges throughout the dive. The size of these euplectillids was smaller (diameter of osculum) than those that occurred in Dive 04. There was a stalked glass sponge (*Amphidiscella* sp.) and another type of glass sponge (*Tretopleura* sp.). There was a branching glass sponge (planular and bilateral branching) that was common but could not be identified. Demosponges were common, both big and small. There were large lobate, cream to white color demosponges (*Polymastia* sp.) and yellow fan-shaped demosponges, both were common. There were also small ball-like demosponges scattered along the rock faces, as well as an unidentified sponge that was fan-shaped and white. We collected a carnivorous sponge*, Chondrocladia* sp. at the end of the dive (19:16 UTC). Only two species of fish were identified on the dive, halosaurs (*Aldrovandia* sp.) and tripod fish (*Ipnops murrayi*). Halosaurs seemed to be more common than tripod fish. At the beginning of the dive we saw a small larval fish of unknown species. We saw even smaller larval fish later (15:09 UTC), bringing the total to 6 larval fishes. For other invertebrates, we observed a possible pancake sea urchin, dark red to black in color. Sea cucumbers were scattered at all depths. Two species of holothurians were observed. There were many small crinoids attached to hard substrate (*Democrinus* sp.). We collected one of these crinoids on a rock. There was a 10-arm crinoid (Septocrinoidae or Bathycrinoidae). This might be the deepest distribution for this species known to date (17:47 UTC). We saw a couple species of sea stars, and collected one unidentified sea star (Gonasteridae) predating on a bamboo coral. There was a slime star (Pterastridae), and another white sea star, *Pythanaster atlantitidus*. We also observed a brisingid star at 18:00 UTC. Deep-sea corals were well represented with representatives from the Chrysogorgiidae, Isididae, Paragorgiidae, Primnoidae, and Antipatharia. Two chrysogorgiid octocorals were observed, one early in the dive that displayed sparse branching and another at the end of the dive with a bottlebrush morphology. One branched (cf. *Cladarisis* sp.) and one unbranched species (?*Lepidisis* sp.) of bamboo coral were observed, both on steep hard bottom. One species of paragorgiid, *Sibogagorgia* cf. *cauliflora*, was repeatedly observed throughout the dive. One occurrence of primnoid whip was documented, likely C*andidella gigantea*, only recently reported from the Atlantic Ocean in the Bahamas. One occurence of *Heteropathes* sp. (possibly *H. americana*) was also documented. The steepness of the wall at this site did not permit rapid climbing with *D2*.
Notable Observations	We collected a colonial stalked tunicate that appeared to be abundant through the dive. Also, multiple morphologies of bryozoans were encountered at this site. On max zoom, we could see many tiny organisms colonizing the rocks, like foraminifera, crinoids and bryozoans. We also observed one Euritidae sponge (*Pleurochorium* sp.).

Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ❑ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Rock pile assumed to be fallen debris with attached coral (*Sibogagorgia* cf. *cauliflora*).	Steeper section of the wall with attached sponge fauna.
	
Slope with numerous cobble-sized rocks and attached fauna included sponges and cnidarians.	A thin, knife-edge ridge connected the promontory near the second steep climb.
Samples Collected	

Sample ID	EX1811_D05_01B
Date (UTC)	20181105
Time (UTC)	160231
Depth (m)	2070.708
Temp. (°C)	3.836
Field ID(s)	Tunicate
Commensals	No commensals
Comments	



Sample ID	EX1811_D05_02G
Date (UTC)	20181105
Time (UTC)	164156
Depth (m)	2043.424
Temp. (°C)	3.832
Field ID(s)	Rock with attached biology

Sample 2 Photo

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D05_02G_A01	Crinoidea	1
EX1811_D05_02G_A02	*Crypthelia* sp.	1
EX1811_D05_02G_A03	Unknown. Possibly bryozoan	1
EX1811_D05_02G_A04	Polychaeta	2

Comments

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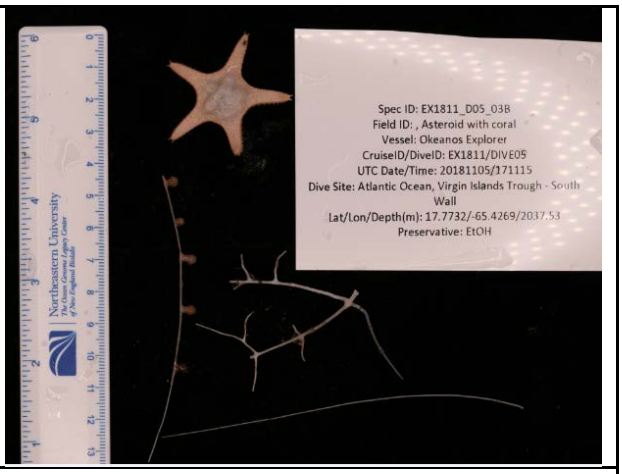
Sample ID	EX1811_D05_03B
Date (UTC)	20181105
Time (UTC)	171115
Depth (m)	2037.533
Temp. (°C)	3.826
Field ID(s)	Asteroida



Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D05_03B_A01	Bamboo Coral	1

Comments

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EX1811-Dive06 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Punta Yeguas		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE06		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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 slippage in the port lower swing arm of *D2* once stowed before recovery, but this did not affect dive operations.
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-06T12:21:27.738704 18°, 0.843' N ; 65°, 44.015' W On Bottom: 2018-11-06T12:59:06.727145 18°, 0.835' N ; 65°, 43.860' W Off Bottom: 2018-11-06T20:09:15.603581 18°, 1.195' N ; 65°, 43.929' W Out Water: 2018-11-06T20:39:31.933231 18°, 1.28' N ; 65°, 43.728' W Dive duration: 8:18:4 Bottom Time: 7:10:8 Max. depth: 877.0 m
Special Notes	N/A

Scientists Involved (provide name, affiliation, email)

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Dive Purpose	The purpose of the dive was exploratory with an emphasis on identifying occurrences of deep-water fish species, corals and sponges, as well as their habitat preferences along the dive track. This dive took place in the Inés María Mendoza Nature Reserve, also known as Punta Yeguas. The dive track was designed to traverse a 200 m tall mound, starting at a steep slope towards the northeast.
Dive Description	The diversity of fish at this site was the highest from any other site surveyed so far on this expedition. We observed at least 19 fish species. The dive began in a flat area dominated by soft sediment and then transitioned to a steep hardground with intermittent flat sedimented plateaus. A gulper shark (*Centrophorus* sp.) immediately passed by us when we reached the seafloor. We saw two additional sharks later in the dive, a bluntnose shark (*Hexanchus griseus*)

	and a catshark. The climb up the wall was steep at times but the substrate leveled in a more soft sediment environment. The most abundant fish species were congrid eels and halosaurs. The other fish identified during this dive were *Neoscolepus marolepidotus*, *Lophiodes beroe*, *Diplacanthopoma* sp., *Aldrovandia* sp., *Bathypeterois viridensis*, *Synagrops bellus*, *Nezumia* sp., *Gonostoma* sp., *Xeniphophorum* sp., *Chaunax* sp., *Grammicolepis brachiusculus*, *Polymixia* sp., and *Perostedion antillarum*. There were two unknown fish species observed, an unknown shiny green fish and another shiny fish that was slender and had a large underjaw. There was an abundance of swimming sea cucumbers (*Enypniastes*? sp.) in the water column as well as near the seafloor. There was another species of holothurian observed. The 7/8-arm sea star (*Solaster* sp.) was common at the beginning of the dive and we also saw a possible goniastrid, bringsid star, and a slime star (Pterastridae) during the dive. There was an unusual cidarid urchin with a red body and white spines. We saw an all-white cidarid and a red fire urchin (*Aerosoma* sp.). There was a pale to white brittle star common along the seafloor that had long arms (*Ophocamistrix* sp.). We also saw the same crinoid that was collected on Dive 05, but it was much bigger. Everything was larger at this site. It could be due to the availability of food, since it is so close to shore. There were quite a bit of crinoids and stalked crinoids throughout the dive. The diversity of sponge species and morphotypes was high. The demosponges were diverse with a lot of encrusting types along the rock faces, and lobate-massive types in the flatter areas. We did a collection, what we think might be *Geodia* sp. sponge. There were also a lot of large basketball looking sponges and big white ball with spikes (possibly *Polymastes* sp. that look like pom pom anemones). However, the glass sponges were more abundant (*Heteroscleromorpha* sp.). There were quite a few Euplectilid sponges in the beginning of the dive. The most abundant glass sponge was the stalked-glass sponge. At one point during the dive in the flat sediment dominated habitat, there were just dead sponge stalks covered by zoanthids. We collected a stalked sponge (maybe Hyalonemtidae) with zoanthids attached to the stalk. We also saw more carnivorous sponges of the family Cladorizidae. However these had a different morphology (cf. *Asbestopluma*). They had these small white ball things located in the center of the colony and many times there were small worms colonizing the base. Deep-sea corals were exceptionally well-represented compared to other sites visited on this expedition. The black corals *Stichopathes* spp. were most common, while other antipatharians including *Tanacetipathes*? sp., *Chrysopathes* spp. and *Antipathes* sp. were also present. This site had the highest diversity of colonial scleractinians seen thus far, including *Solenosmilia variabilis, Madrepora oculata, Enallopsammia rostrata*, as well as many cup corals. Among observed Primnoidae were *Candidella imbricata* and an unknown primnoid (cf. *Narella* sp.) seen on the steepest portion of the dive. Chrysogorgiids of an unknown species (likely *Chrysogorgia* sp.) were also seen toward the end of the dive. Mushroom corals were observed on top of the ridge portion of the dive and were likely in the genus *Anthomastus* or *Psuedoanthomastus*. Stylasterids were common and were represented by *Crypthelia* sp. and *Stylaster* sp. colonies. One plexaurid was observed with brown tissue and white polyps. This coral remains unidentified. Few isidids were observed with the exception of one S1 clade unbranched bamboo coral with yellow discolorations at its base.
Notable Observations	A large number of Munnopsid isopods were observed at the beginning of the dive. Also, there were some really large shrimp (*Aristeus antillensis*?, >30 cm) and two different types of large crabs (*Rochina crassa* and possible *Eumunida* sp.). The colonial tunicate that we observed and collected yesterday (2,000 m) was also observed today at 818 m. There was a lot of trash including corn-meal sacks and old plastic egg cartons (used as fishing pods) at the beginning of the dive. There was also a lot of seagrass and *Sargassum* scattered along the seafloor.

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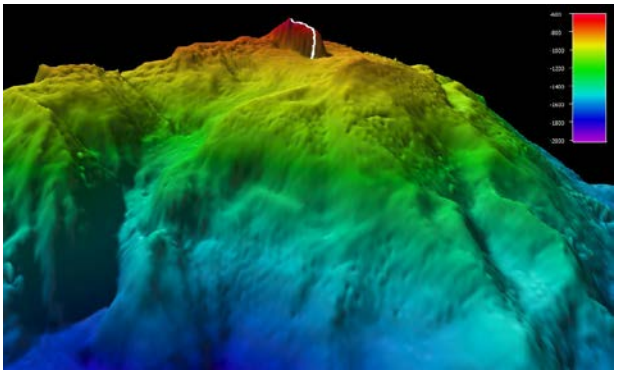
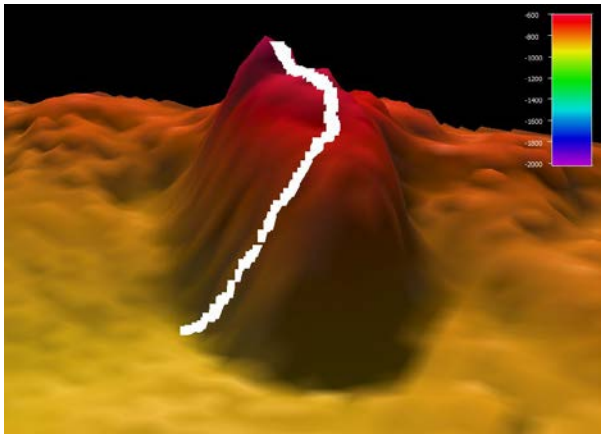
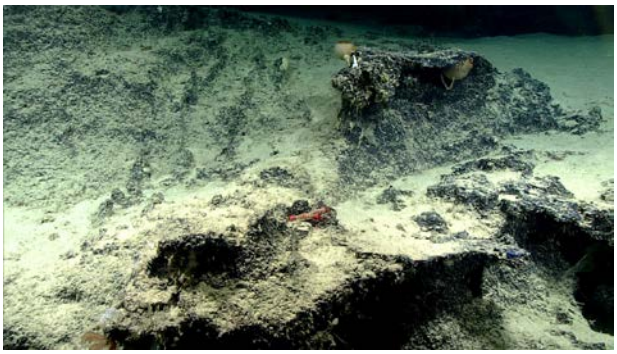
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Rocky outcrops were dominated by sponges and benthic invertebrate fauna. Occasional corals, stony and soft, were most common on this type of seafloor.	Steep slopes were characterized by sponges and occasional attached corals.

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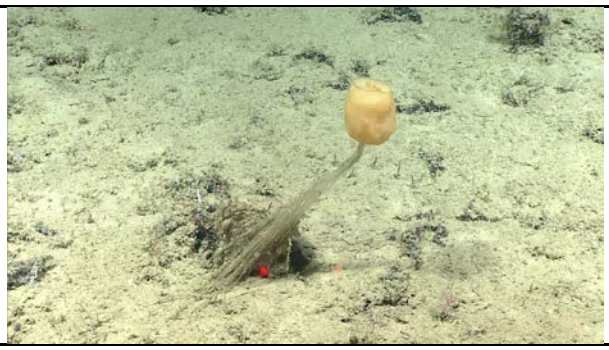
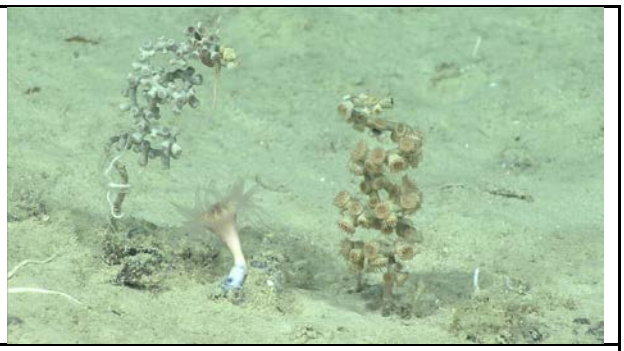


Stalked sponges like this Hyalonematid dominated the benthic fauna in the second half of the dive. Stalks were usually covered in zoanthids.

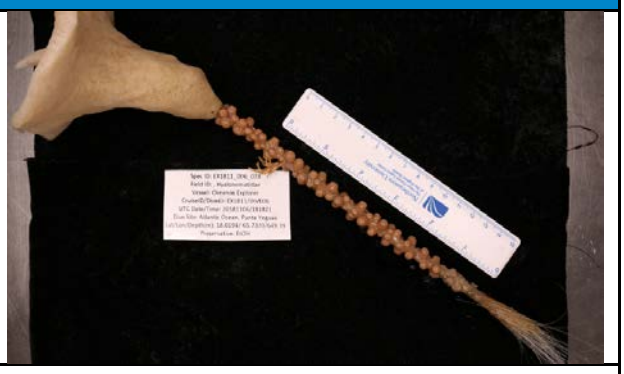


Enigmatic spiral-shaped worm tubes were abundant on a knoll and always covered in zoanthids, shown here next to an unidentified cup coral.

Samples Collected

Sample ID	EX1811_D06_01B
Date (UTC)	20181106
Time (UTC)	163658
Depth (m)	693.232
Temp. (°C)	8.266
Field ID(s)	*Geodia* sp.
Commensals	No commensals
Comments	

Sample ID	EX1811_D06_02B
Date (UTC)	20181106
Time (UTC)	181821
Depth (m)	649.389
Temp. (°C)	9.143
Field ID(s)	Hyalonematidae



Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D06_02B_A01	Zoantharia	~
EX1811_D06_02B_A02	Squat Lobster	1

Comments

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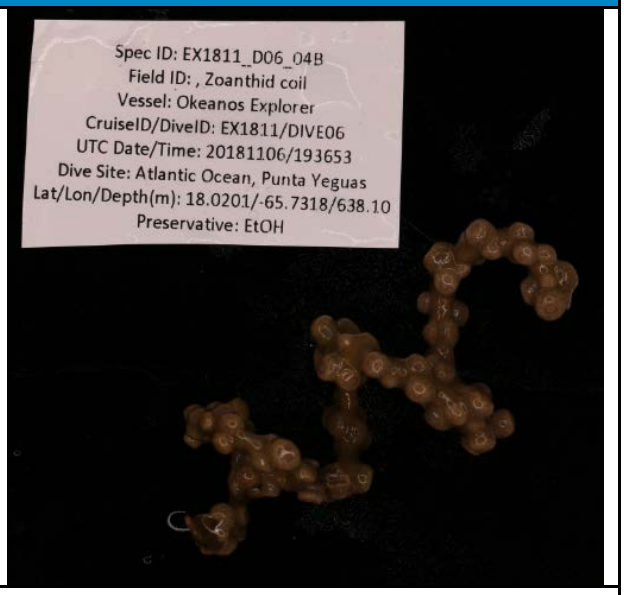
Sample ID	EX1811_D06_03B
Date (UTC)	20181106
Time (UTC)	183528
Depth (m)	648.869
Temp. (°C)	9.212
Field ID(s)	Scleractinia
Commensals	No commensals
Comments	

Sample ID	EX1811_D06_04B
Date (UTC)	20181106
Time (UTC)	193653
Depth (m)	638.101
Temp. (°C)	9.923
Field ID(s)	Zoanthid coil
Commensals	No commensals
Comments	



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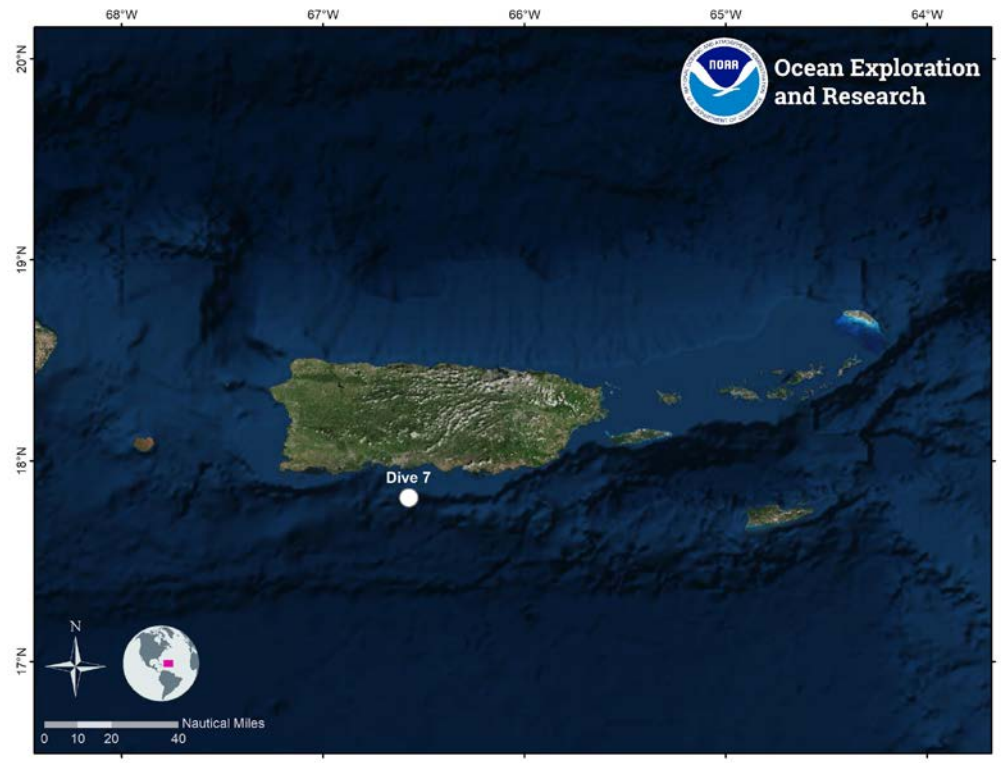
EX1811-Dive07 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Isla Caja de Muertos		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE07		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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Equipment Malfunctions	The digital still camera was secured for a big portion of the dive due to a ground fault.
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-07T16:32:11.515891 17°, 49.374' N ; 66°, 34.09' W On Bottom: 2018-11-07T17:25:38.656590 17°, 49.463' N ; 66°, 34.047' W Off Bottom: 2018-11-07T22:00:38.939958 17°, 49.651' N ; 66°, 33.911' W Out Water: 2018-11-07T22:35:09.110774 17°, 49.645' N ; 66°, 33.617' W Dive duration: 6:2:57 Bottom Time: 4:35:0 Max. depth: 535.0 m
Special Notes	ROV launch was delayed due to the ROV team having to swap out the tether because of bad fiber levels on deck. However, the dive recovery was extended by 2 hours to make up for some of this time.
Scientists Involved (provide name, affiliation, email)	

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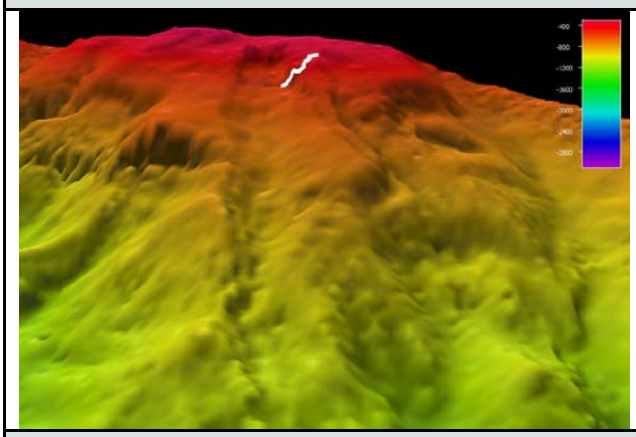
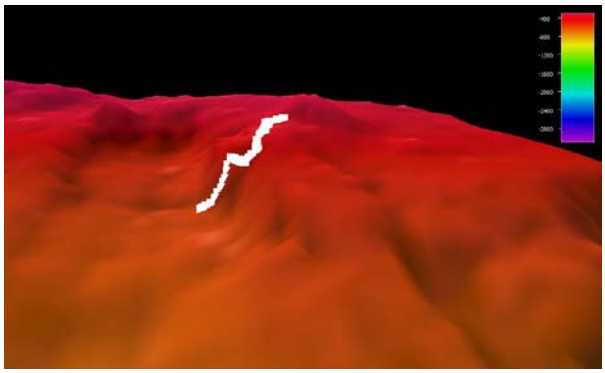
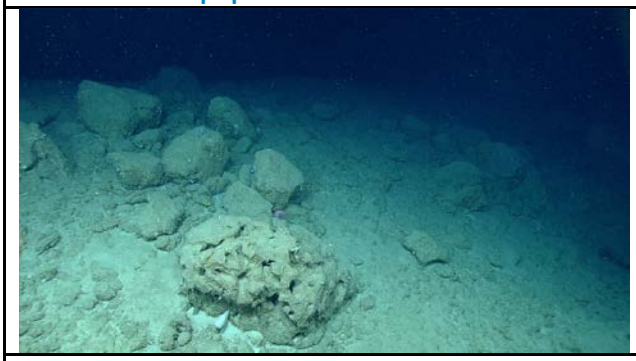
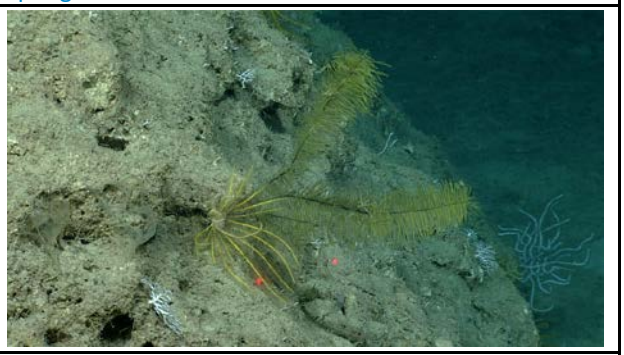
Tom Hourigan	NOAA/NMFS	tom.hourigan@noaa.gov

Dive Purpose	The purpose of this dive was to survey deep-sea coral and sponge communities, as well as deep-water demersal fish species along the dive track. The dive started on a steep slope (40 degrees), while traversing northeast along gentle slope area and then moved up a mound. This site was located to the south of the Caja de Muertos Island, south of Ponce, Puerto Rico.

Dive Description	The dive started in a habitat dominated by soft sediment with a few boulders. There were transitions between larger boulders to smaller boulders to soft sediment. We saw a queen snapper (*Etelis oculatus*) as soon as we arrived on the seafloor at a depth of 539 m. This is a new depth record for queen snapper, as they were only known to exist as deep as 450 m. We saw at least one more queen snapper later in the dive at 432 m, and maybe another at 400 m, which could be the second fish following the ROV. Fish diversity was much higher at the deeper depths. We observed at least 10 species of fish during the dive. The fish observed were *Bathyclupea schroederi*, *Cyttopsis rosea*, Conger eel, *Hoplostethus* sp., *Monomitopus* sp., *Epigonus* sp., and *Ostichthys trachypoma*. We also saw three unidentified fish at the beginning at the dive. The most common fish was *Monomitopus* sp., which were observed at all depths and a lot of times hiding behind octocorals and black corals. They would face vertical behind branches. Deep-water corals had a moderate diversity at this site with 12 species from the Antipatharia, Isididae, Stylasteridae, Chrysogorgiidae, Plexauridae, Ellisellidae, Neptheidae, and solitary Scleractinia. Antipatharians observations were primarily composed of *Stichopathes* spp. whips, as well as two different color morphs of the genus *Elatopathes* (black and yellow). Bamboo whips in the S1 clade (*Cladarisis* sp.) were the most common isidids. Stylasterids were quite abundant with *Stylaster* sp. and *Crypthelia* sp. being the most common. One Chrysogorgiid, possibly *Chrysogorgia desbonni*, was observed throughout the dive. White octocoral fans, one unidentified plexaurid (*Scleracis*? sp.) and one *Nicella* sp., were also observed later on in the dive on boulders. A small unidentified neptheid species was also observed in boulder habitats. Sponge abundance and diversity was overall low. Most of the sponges were small in size. There were very few glass sponges, Euplectillids and *Farrea occa*. There were some larger demosponges that looked like *Geodia* sp., but mostly were encrusting. There was a blue encrusting sponge that was common throughout the dive and shore-side scientist had an interest in collecting it, but it was always located in unaccessible habitats on large boulders. The echinoderm diversity was relatively high at this site. There were strange cidarid urchins at the beginning of the dive. They had modified spines that looked like paddles. These were identified during the 2015 *Okeanos Explorer* expedition to Puerto Rico as *Cidaris blakei*. We also saw an *Aspidodiadema* sp. and another strange sea urchin with long spines with red bands on the spines (*Stylocidaris lineata*). The second species may be another Diadematoid, because it looked like it might have an anal cone. We also saw another cidarid and some *Areosomas* sp. in the shallower depths. We saw a group of irregular sea urchins, *Conolampas sigbei*, close to the transition between habitats when there was more hardground and larger boulders. Chris Mah stated that these urchins have never been seen alive. There were three species of sea cucumbers observed. One was very small attached to face of the hard substrate. There were three species of sea stars, slime star, white seastar, and a cookie star (Gonoasteridae). Brittle stars (*Asteronyx* sp.) were very common and they were mostly attached to octocorals and black corals. We collected one octocoral with two commensal brittle stars. This brittle star was smooth and white with brown bands along the arms. Yellow crinoids were very common throughout the dive. They were frequently attached to bamboo corals. There was a *Holopus* sp. crinoid along the dive and we also observed stalked crinoids.
Notable Observations	Queen snapper (*Etelis oculatus*) at 539 m depth. There was a lot of trash at this site. Mostly glass bottles, but we did see some cloth and metal cable. We also saw two hermit crabs using hollowed wood pieces.

Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Early on in the dive, carbonate boulders provided significant relief for benthic megafauna, particularly fishes and shrimp species.	Slopes encountered on this dive were not heavily colonized by attached fauna, but could be seen with sponge and invertebrate fauna.
	
The second half of the dive along the ridge was dominated by carbonate boulders with intermittent soft-bottom expanses. Hard substrate was colonized by corals, sponges and other encrusting life.	Larger boulders were typically observed to have a higher species diversity. Here black corals, stylasterids, and octocorals are shown on one of the larger boulders in one field.

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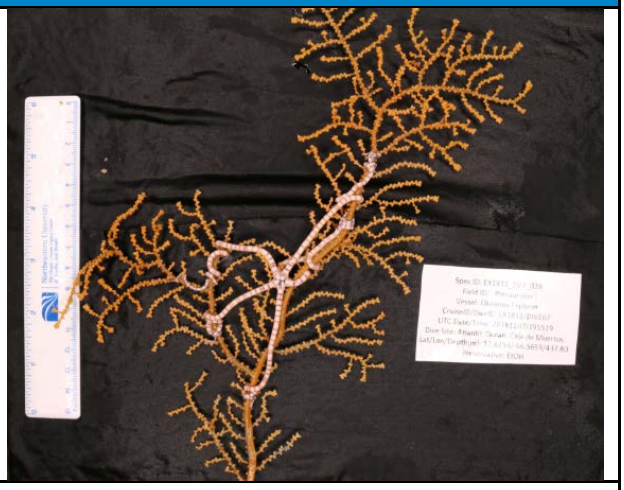
Samples Collected

Sample ID	EX1811_D07_01B
Date (UTC)	20181107
Time (UTC)	185139
Depth (m)	489.474
Temp. (°C)	13.347
Field ID(s)	*Pennatula* sp.
Commensals	No commensals
Comments	

Sample ID	EX1811_D07_02B
Date (UTC)	20181107
Time (UTC)	195519
Depth (m)	437.801
Temp. (°C)	14.414
Field ID(s)	Plexauridae



Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D07_02B_A01	Brittle stars	2
EX1811_D07_02B_A02	Shrimp	2

Comments

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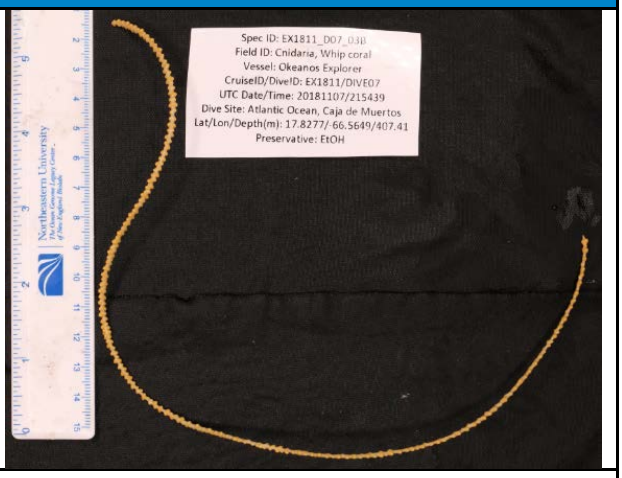
Sample ID	EX1811_D07_03B
Date (UTC)	20181107
Time (UTC)	215439
Depth (m)	407.409
Temp. (°C)	15.364
Field ID(s)	Octocoral whip coral
Commensals	No commensals
Comments	



EX1811-Dive08 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	La Parguera Ridges		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE08		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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Equipment Malfunctions	None
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-08T12:21:14.498731 17°, 51.088' N ; 67°, 3.427' W On Bottom: 2018-11-08T13:04:18.271158 17°, 51.118' N ; 67°, 3.318' W Off Bottom: 2018-11-08T20:01:21.986265 17°, 51.495' N ; 67°, 3.007' W Out Water: 2018-11-08T20:44:03.748931 17°, 51.251' N ; 67°, 2.408' W Dive duration: 8:22:49 Bottom Time: 6:57:3 Max. depth: 1101.0 m
Special Notes	N/A

Scientists Involved (provide name, affiliation, email)

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Upasana Ganguly	University of Louisiana at Lafayette	upasana.ganguly1@gmail.com

Dive Purpose	The purpose of the dive was to characterize deep-sea coral and sponge communities in an unexplored ridge feature off La Parguera. The dive also sought to identify occurrences of deep-water demersal fish species, as well as their habitat preferences along the dive track. The dive track began near the bottom of a steep slope (average 30 degree incline) and continued eastward toward a more moderate ridge.

Dive Description	During this dive we slowly climbed a gentle slope dominated by soft sediment. The fish diversity was relatively high, considering there was not much structure or refuge during the dive. We observed 13 fish species. The most common fish along the dive were ophidiform (*Dicrolene*? sp.) and a halosaur (*Aldrovandia* sp.). Congrid eels (*Arisoma* sp.) and *Bathypterois* spp. were also abundant towards the second half of the dive. The other fish observed were halosaurs (*Aldrovandia affinis*), *Bathypterois* sp., unknown ophidoform (big with black head, navy blue, and black pectoral fins), *Bathytyphlops* sp., bristlemouth, *Neoscopelus* sp., *Bathypterois viridensis*, *Squalus cubensis*, *Peristedion* sp. and the skate *Fenestraja ishiyamai*. Several fish had ectoparasites (parasitic copepods and isopods), as well as scars. Corals were not particularly well represented in this area. The majority of the species observed were sea pens (Protoptilidae), one of which was collected for identification purposes (?Anthoptilidae). Sea pens were not abundant in this area. Curiously, one live colonial scleractinian (*Madrepora oculata*) was observed growing on soft bottom. One sponge was observed to be colonizing part of the exposed skeletal material, often growing over branch material. Upon collection, it was revealed that a significant mass of dead skeleton was hidden under the soft substrate. The sponge diversity was low in this area compared to previous dives. We only saw two species of glass sponges, *Euplectella* sp. and a stalked sponge in the family Hyalonematidae. Their stalks were mostly covered with zoanthids and usually had commensal squat lobsters or crinoids on them. One sponge was collected (?*Geodia* sp.) It was observed growing on dead and live *Madrepora oculata* skeleton. In addition, we made several observations of cladorhizids sponges, one of which was collected off St. Croix (*Chondrocladia* sp.) on an earlier dive, and the other is new for the expedition (possibly *Asbestopluma* sp.). Echinoderms were by far the most diverse and most abundant taxa. Sea cucumbers were very abundant throughout the dive. We observed four different species of holothurians. A small opaque holothurian (Elpidiidae), *Enypniastes* sp., one Deimatidae, and an unknown smooth pinkish sea cucumber. One of the first holothurians observed had numerous gastropod and amphipod parasites on its back. Crinoids were also present throughout the dive, both stalked and unstalked. Most common was a 10-armed species from the Atelecrinidae. One stalked crinoid was *Rouxicrinus vestitus* and was recently described in 2010 by Chuck Messing. The deepest record for this species was 887 m, and we saw it deeper on this dive. We saw only one species of sea star (mud star, Asteropectinidae), and one had a really enlarged madreporite. We saw two urchin species, *Phormosoma* sp. and *Cidaris blakei*.
Notable Observations	There was quite a few pieces of wood fall (one fragment was collected for faunal identification) and debris, like seagrass blades and *Sargassum*. For anthropogenic debris, we saw an aluminum can and a glass jar during the dive. Large burrows in the sand were common in the slope-side and could be from large isopods (*Bathynomus gigantea*) or the blind lobsters observed on this dive.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ❑ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

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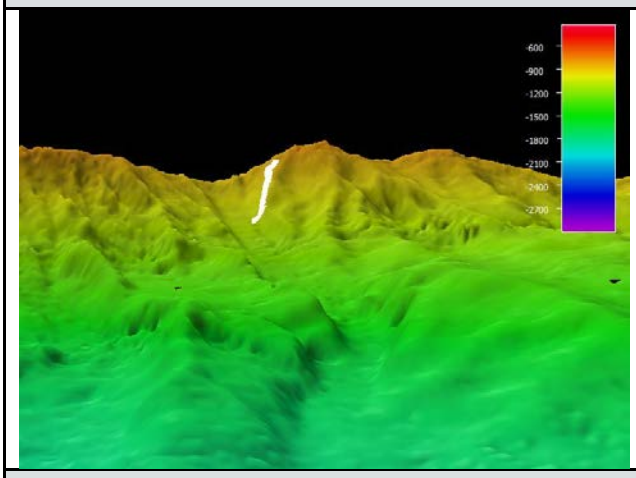
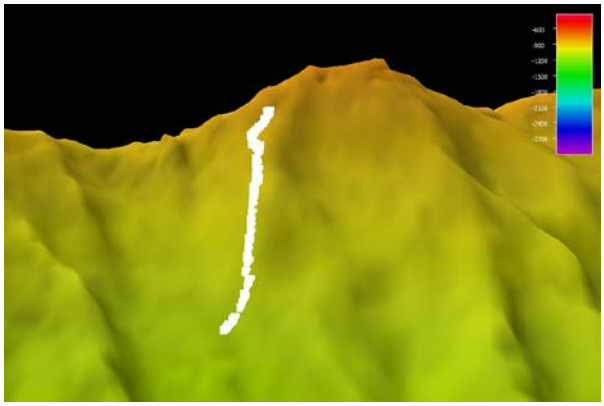
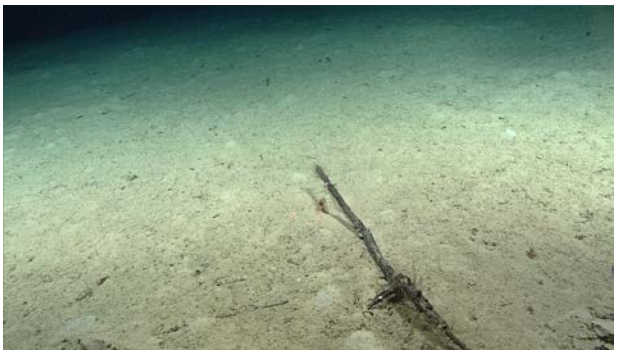
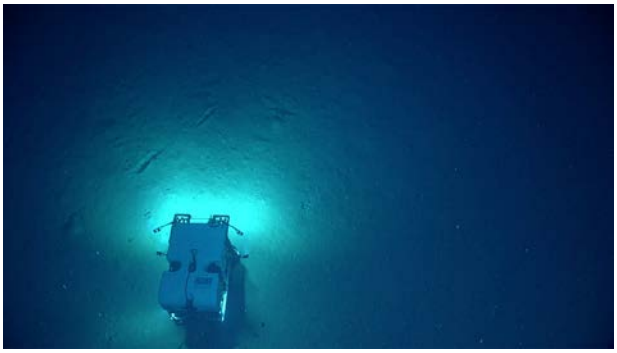
Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Wood falls, based on visual counts, were likely the most biodiverse communities observed on this dive. Mangrove material was suspected to be the dominant type, but bamboo pieces were also seen.	Seafloor here was largely homogeneous in composition, but some areas contained substantial evidence of burrowing or otherwise bioturbated sediments.
	
Scours and burrows were also common in this area. Burrows were possibly created by crustaceans observed on this dive. Long scours were thought to be created by beaked whale activity.	*Madrepora oculata* and *Geodia* sp. sponge found on hard bottom. This observation was unusual for this soft bottom habitat. This specimen was collected.

Samples Collected

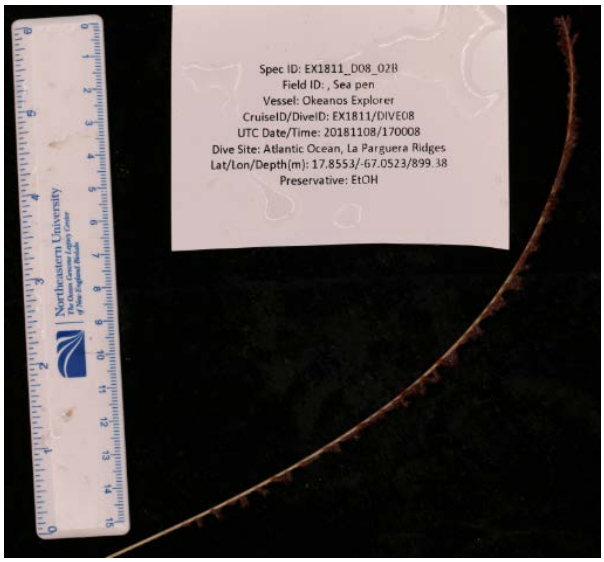
Sample ID	EX1811_D08_01B
Date (UTC)	20181108
Time (UTC)	163721
Depth (m)	907.436
Temp. (°C)	6.294
Field ID(s)	wood fall

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D08_01B_A01	Crinoidea	1
EX1811_D08_01B_A02	Crinoidea	1
EX1811_D08_01B_A03	Gastropoda	1
EX1811_D08_01B_A04	Polyplacophora	3
EX1811_D08_01B_A05	Polychaeta	1

Comments

Sample ID	EX1811_D08_02B
Date (UTC)	20181108
Time (UTC)	170008
Depth (m)	899.384
Temp. (°C)	6.339
Field ID(s)	*Pennatula* sp.



Commensals	No commensals
Comments	

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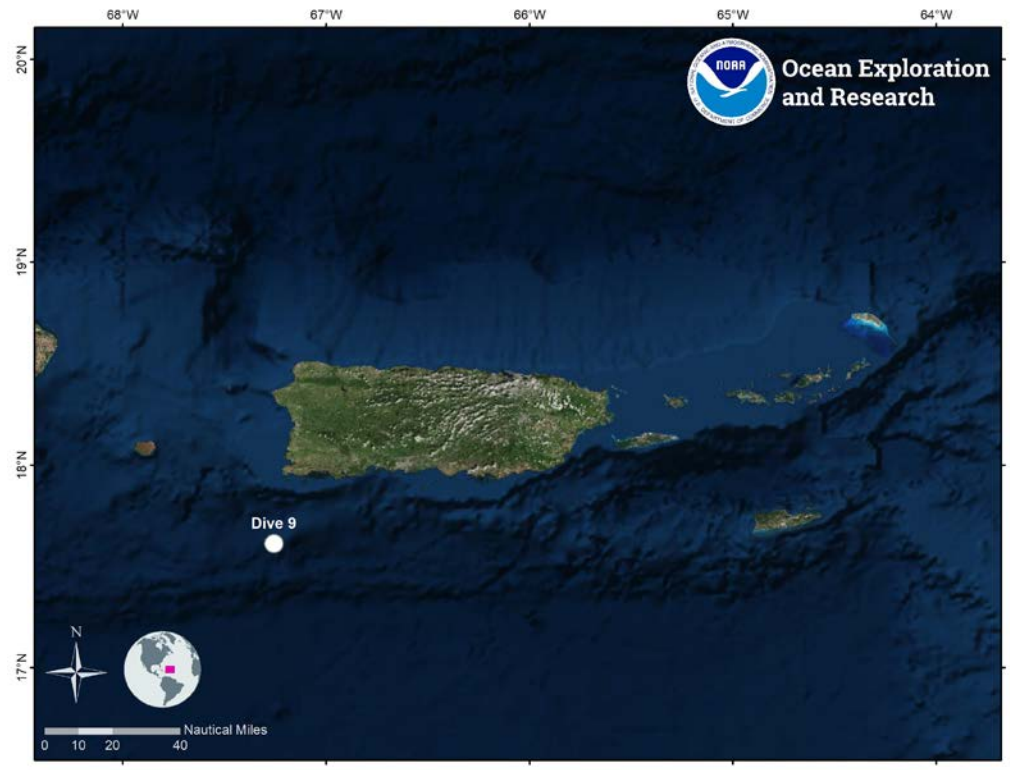
Sample ID	EX1811_D08_03B
Date (UTC)	20181108
Time (UTC)	174656
Depth (m)	890.817
Temp. (°C)	6.372
Field ID(s)	*Madrepora oculata*

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D08_03B_A01	Porifera	1
EX1811_D08_03B_A02	Polychaeta	1

Comments

EX1811-Dive09 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Jaguey Spur		
Science Leads	Stacey Williams (ISER) and Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE09		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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 joylock button did not work properly during ROV pre-dive operations, but this did not affect dive operations. During ROV recovery the VSAT lost signal for a couple of minutes.
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-09T12:36:05.682904 17°, 36.412' N ; 67°, 16.606' W On Bottom: 2018-11-09T14:18:25.066223 17°, 36.343' N ; 67°, 16.493' W Off Bottom: 2018-11-09T19:06:11.809417 17°, 36.441' N ; 67°, 16.38' W Out Water: 2018-11-09T20:38:36.523901 17°, 36.171' N ; 67°, 15.715' W Dive duration: 8:2:30 Bottom Time: 4:47:46 Max. depth: 2789.0 m
Special Notes	N/A

Scientists Involved (provide name, affiliation, email)

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Dive Purpose	The purpose of this dive was to characterize deep-sea coral and sponge communities in an unexplored ridge feature and slope off the southwest coast of Puerto Rico. The dive also sought to identify occurrences of deep-water demersal fish species, as well as their habitat preferences along the seafloor. The dive track was designed to explore a steeply sloped ridge between depths of 2,786 to 2,502 m.

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Dive Description	This dive started on a relative steep slope dominated by sediment. Two species of fish were observed on this habitat, *Ipnops murrayi* and an unknown ophidiform. There looked to be another ophidiform far in the distance when we started to climb the steep rocky wall. Most of the dive was spent climbing a very steep wall with occasional pinnacle structures jutting out of the slope. Debris, both organic and anthropogenic was common here and consisted of tree branches, seagrass, a toothpaste tube, a bottle, and plastic. A third species of fish, the tripod fish *Bathypterois* sp., was observed at the end of the dive which ended in soft sediment. Deep-sea corals were unknown from Jaguey Spur prior to this exploration. We observed nine different species from the Antipatharia, Scleractinia, and octocoral families Coralliidae, Isididae, and Chrysogorgiidae. Isidids were by far the most abundant coral observed at this site. At least three different morphologies were observed, primarily from the J-clade, as well as one from the node-branching "*Isidella*"-clade. Chrysogorgiid occurrences were dominated by several observations of the large *Iridogorgia magnispiralis* with most colonies between 1-2 m in height. One of the largest fans observed on the dive was a colony of *Corallium* cf*. niobe* on a vertical wall above a sediment chute in the slope. One *Chrysogorgia* sp., more fan-shaped than bushy, was observed on three occasions. Only one black coral, *Heteropathes* cf. *americana*, was found on the boulder substrate, and only one genus of stony coral was observed (*Javania* sp.) on the dive. Throughout the dive numerous thick bases and branch debris, thought to be from old coral colonies, was found covered in Fe-Mn crusts. Though many were observed dead, no live representatives were found alive in the area. On these old bases, small colonies of yellow and white stoloniferous octocorals were seen. Sea stars contributed the most to the echinoderm diversity. We observed five species of sea stars. At the beginning at the dive at the sediment-dominated habitat, the sea star *Ceramaster* sp. was relatively abundant. We observed other sea stars along the rocky wall. These were *Pythonaster atlantidis*, which was eating a big glass sponge, *Pteraster* sp. and a bringsid star. No sea urchins were observed. There was only one brittle star found and one stalked crinoid (10 arms) right at the end of the dive. Sea cucumbers were common at all depths on soft sediments. We observed at least two species of sea cucumbers in the family Elpidiidae. The sponge diversity was also low at this site, and the majority of sponges were encrusting species. Glass sponges were also common. There were a lot of stalked glass sponges in the soft sediment and along the rock faces, including Hyalonematidae, *Amphidiscella* sp. bulbous glass sponges and *Dictyocalyx sp.* or Corbatellinae. We also saw one Euplectillid sponge, and a large vase sponge (~1.2 m tall), (*Bathydorus*? sp.), that was being grazed upon by a *Pythonaster* sp. sea star. Translucent demosponges and bryozoans were observed throughout the dive encrusting on rocky surfaces.
Notable Observations	Large Fe-Mn crusted bases of presumably dead corals and debris. Massive colonies of *Iridogorgia magnispiralis*, *Corallium* cf. *niobe*, and a Hexactinellid sponge. Rocky vertical landscape.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

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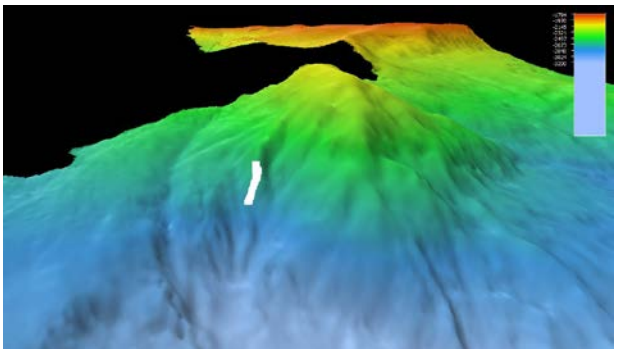
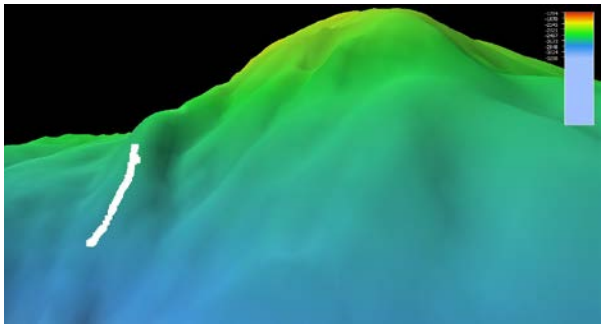
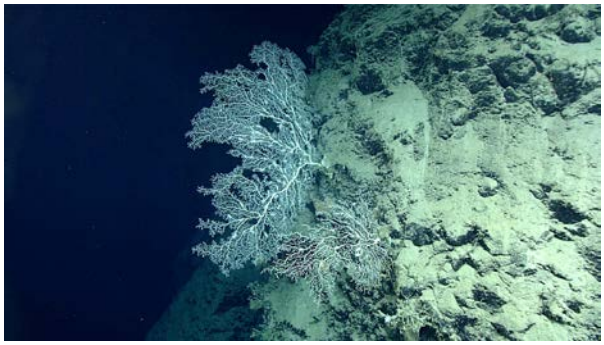
Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
A 1.2 m tall sponge, possibly in the Rosselidae, being predated upon by a seastar (*Pythonaster* sp.).	Two large colonies of *Corallium* cf. *niobe*, one of the few Coralliids observed on this expedition, were found attached to vertical surfaces of the wall.
	
Thick black stems and bases, suspected to be from corals, were abundant throughout the dive. Many organisms, including sponges, corals and echinoderms were observed colonizing or attached to this hard substrate.	Rocky pinnacles were occasionally found jutting out of the hillside. These pinnacles typically had higher abundances of attached fauna and Fe-Mn covered coral bases.

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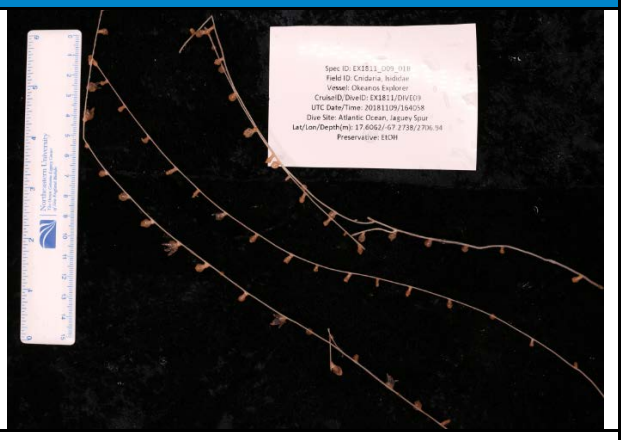
Samples Collected

Sample ID	EX1811_D09_01B
Date (UTC)	20181109
Time (UTC)	164058
Depth (m)	2706.942
Temp. (°C)	4.141
Field ID(s)	Isididae



Commensals	No commensals
Comments	

Sample ID	EX1811_D09_02G
Date (UTC)	20181109
Time (UTC)	183024
Depth (m)	2638.711
Temp. (°C)	4.142
Field ID(s)	Rock

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D09_02G_A01	Sponge	1
EX1811_D09_02G_A02	Glass Sponge	1
EX1811_D09_02G_A03	Bryozoan	1

Comments	

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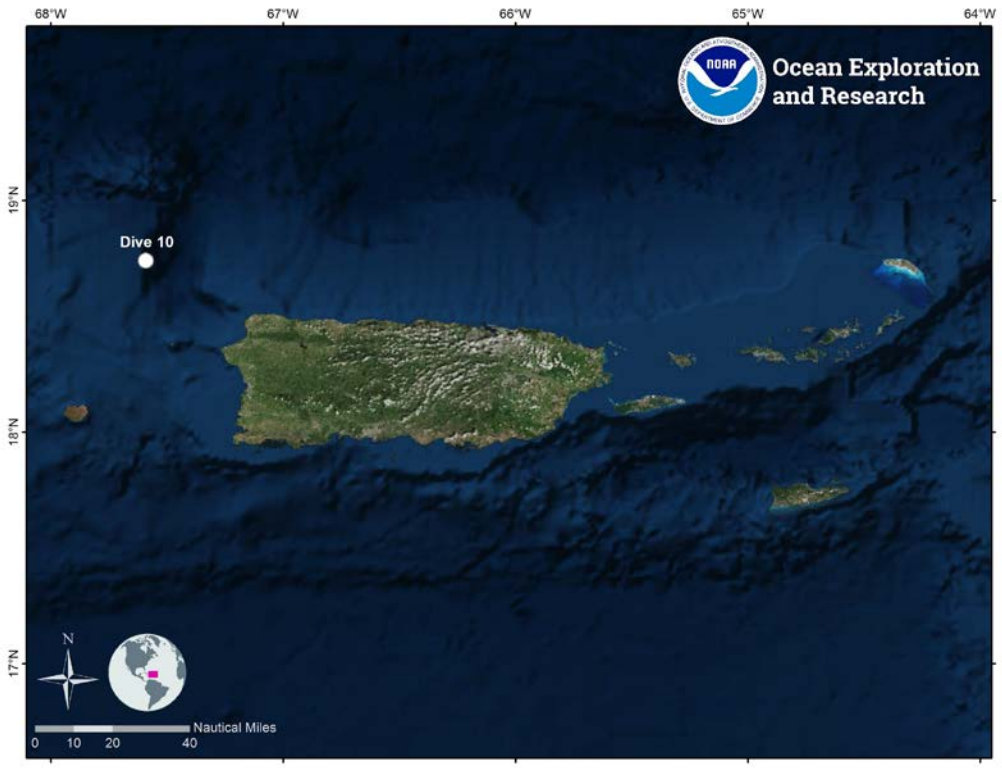
EX1811-Dive10 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Mona Canyon West Wall		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE10		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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Equipment Malfunctions	The seafloor portion of the dive ended ~30 min earlier than initially planned due to an issue with the winch motor. Midwater transects were conducted thereafter.
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-10T12:25:32.904509 18°, 44.945' N ; 67°, 35.461' W On Bottom: 2018-11-10T13:58:09.099646 18°, 45.074' N ; 67°, 35.218' W Off Bottom: 2018-11-10T17:34:52.671357 18°, 45.129' N ; 67°, 35.332' W Out Water: 2018-11-10T22:31:59.134203 18°, 45.176' N ; 67°, 35.268' W Dive duration: 10:6:26 Bottom Time: 3:36:43 Max. depth: 2766.0 m
Special Notes	N/A
Scientists Involved (provide name, affiliation, email)	

Name	Affiliation	Email
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Zach Proux	NOAA/CSS	prouxzs@g.cofc.edu

Dive Purpose	This dive was an extended (10 h) dive consisting of two parts. The first part explored the geology of a landslide scarp at Mona Canyon at 2,500-2,800 m depths, which is believed to have caused the major tsunami of 1918. This part of the dive sought to add additional observations on the geology of Mona Canyon to those made during previous dives in the canyon off the E/V *Nautilus* in 2013 and NOAA Ship *Okeanos Explorer* in 2015. The second part included a series of midwater transects at depths between 2,000 m and 300 m in order to explore the pelagic fauna of the area.

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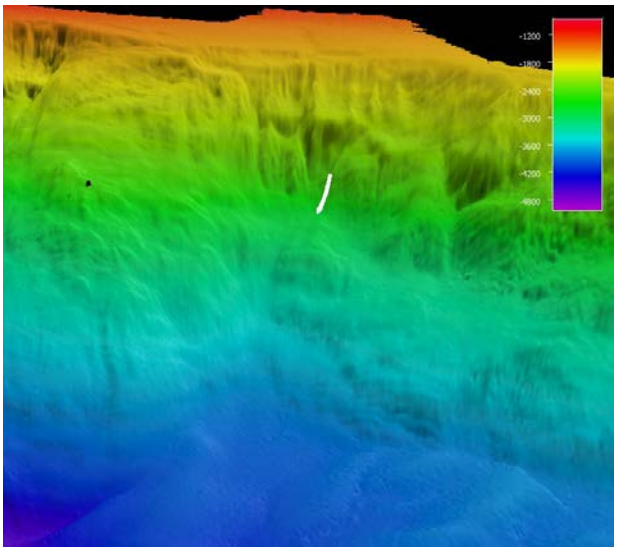
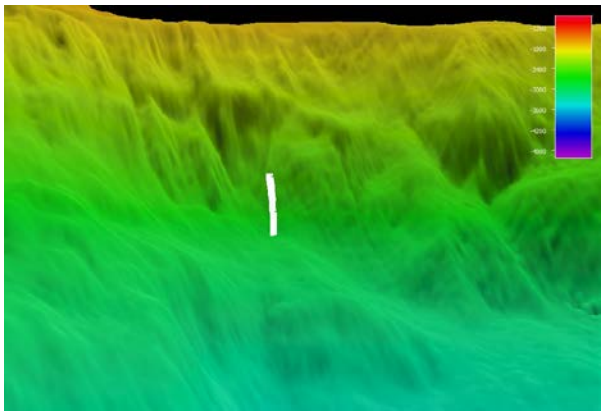
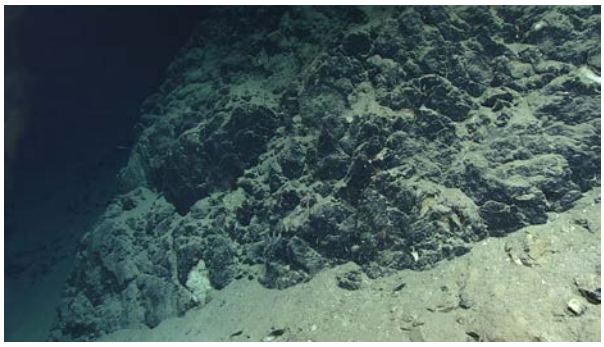
Dive Description	The dive began at a flat landing site at a depth of 2,761 m. Immediately after landing on bottom, rocky carbonate talus material was observed extended in a dense field upslope toward the west. Material ranged in size from cobble to boulder. One angular rock, white to tan in coloration, was collected from this rockslide. Moving westward the slope gradually increased to slopes estimated to be 35-40 degrees in incline. Large blocky material was observed below an area suspected to be a large rock failure at 16:00 UTC. Fresh surfaces (within Fe-Mn crusts) were seen where rocks were suspected to have cracked and fell downslope. Several of these smaller failures were several meters in height. After 16:00 UTC, rock surfaces appeared to be dominated more by Fe-Mn crusts. Biology was remarkably sparse throughout the dive. A majority of the life at these depths and on this terrain was small and consisted of encrusting species. Only two coral colonies were observed during the entire time on the bottom, one *Umbella* sp. sea pen and an unbranched bamboo coral with thick tissue, column-shaped polyps, and yellowish node coloration. Sponges were slightly more diverse with at least four morphotypes observed, one *Euplectella* sp. vase sponge, a stalked tulip-shaped sponge, at least two different morphologies of cladorhizids, and several encrusting sponges. Mobile benthic invertebrates generally were dominated by echinoderms including *Benthodytes* sp. holothurians, *Hymenaster* sp. sea stars, and one 10-armed crinoid. Only three species of fish were observed, one large *Bathysaurus* sp. (1 m in length), an *Ipnops murrayi* tripod fish, and an ophidiiform. A winch failure contributed to our need to come off the bottom at 17:00 UTC to make necessary repairs. Repairs were completed by 17:34 UTC. Time was not available to reacquire bottom, and we therefore moved directly into the midwater portion of the dive after the winch issue was resolved. The midwater portion of the dive began at 17:59 UTC at 2,000 m depth, and ended at 21:13 UTC at a depth of 300 m. Midwater transects were conducted at 2,000 m, 900 m, 700 m, 500 m and 300 m. Each transect lasted 25 minutes followed by a brief ascent to the above-lying transect. Using EK60 data a deep scattering layer was found around 500 m depth. Fauna at each midwater transect consisted of midwater fishes, euphausids, salps, medusae, ctenophores, larvaeceans, and siphonophores.
Notable Observations	Large vertical rock surfaces and failures on the seafloor. Many groups of midwater planktonic animals were imaged.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ❑ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Upon landing on the seafloor, we encountered an extensive field of light colored cobble and boulder carbonate talus material thought to have fallen from the slope above.	Closer to the vertical slope we encountered larger blocky material that assumed a two-tone coloration, part FeMn crusted and part newly exposed carbonate rock.
	
During the steepest portion of the dive a majority of the rock surface had a rough texture with FeMn crust. Most attached biology was found on this substrate type.	Occasional failures were observed in the slope which appeared to have a lighter coloration indicating more recent exposure to seawater. We attempted to sample a rock from these failures but were unsuccessful.

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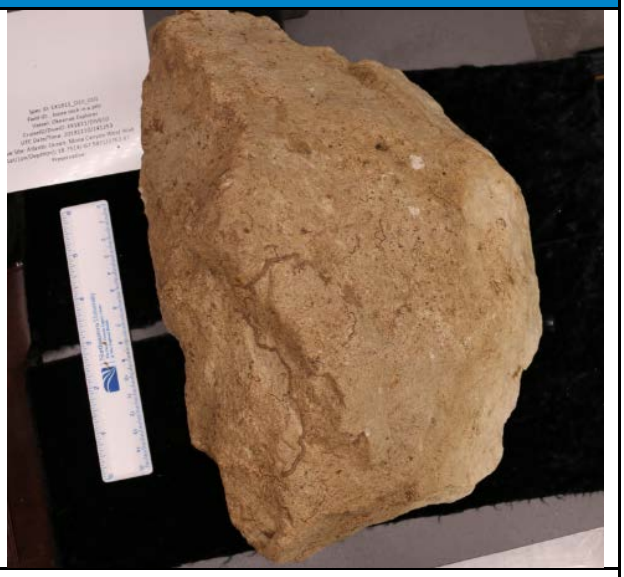
Samples Collected		
Sample ID	EX1811_D10_S01G	
Date (UTC)	20181110	
Time (UTC)	141253	
Depth (m)	2763.866	
Temp. (°C)	2.855	
Field ID(s)	Rock	
Commensals	No commensals	
Comments		

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EX1811-Dive11 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Vega Baja Landslide		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE11		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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Equipment Malfunctions	The salinity measurements by the CTD sensors on *D2* showed erroneous values throughout the dive. After the dive, the faulty salinity measurements from the *D2* sensors were replaced with correct values from the *Seirios* sensors in SeaTubeV2.
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-11T12:20:20.662907 18°, 50.779' N ; 66°, 24.048' W On Bottom: 2018-11-11T14:16:50.110047 18°, 50.812' N ; 66°, 23.841' W Off Bottom: 2018-11-11T18:52:41.297116 18°, 50.726' N ; 66°, 23.666' W Out Water: 2018-11-11T20:41:16.206855 18°, 50.846' N ; 66°, 22.78' W Dive duration: 8:20:55 Bottom Time: 4:35:51 Max. depth: 3342.0 m
Special Notes	N/A
Scientists Involved (provide name, affiliation, email)	

Name	Affiliation	Email
Asako Matsumoto	Chiba Institute of Technology	amatsu@gorgonian.jp
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Debi Blaney	NOAA/OER	debi.blaney@noaa.gov
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Robert Stern	University of Texas at Dallas	rjstern@utdallas.edu
Scott France	University of Louisiana at Lafayette	france@louisiana.edu
Stacey Williams	Institute for Socio-Ecological Research	stcmwilliams@gmail.com
Steven Auscavitch	Temple University	steven.auscavitch@temple.edu
Tara Harmer Luke	Stockton University	luket@stockton.edu

Dive Purpose	The purpose of this dive was to explore a landslide scarp north of Vega Baja, Puerto Rico. The site was originally proposed by partners at USGS due to its potential as a geohazard. The dive sought to make observations on the geology of exposed rocks and collect samples to determine the age of any recent geological activity in the area. Further, the dive sought to characterize the seafloor fauna of the area, focusing on deep-sea corals, sponges and demersal fishes.

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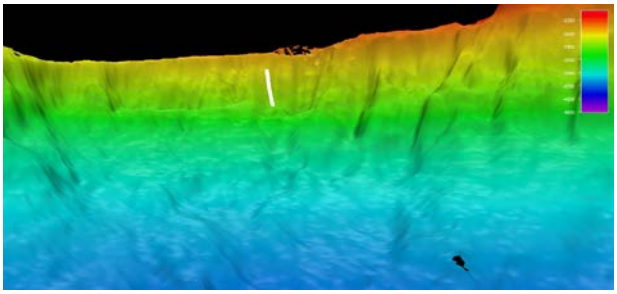
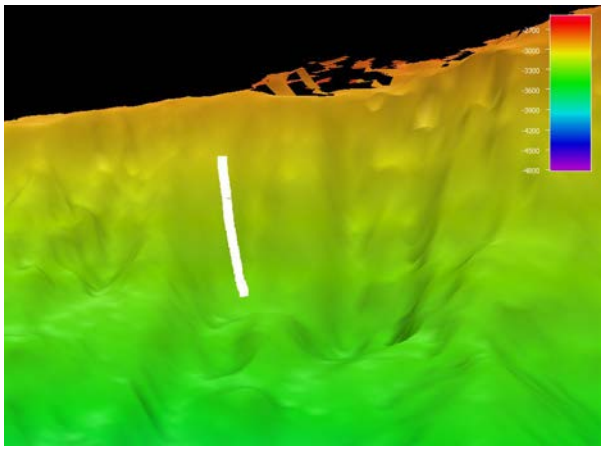
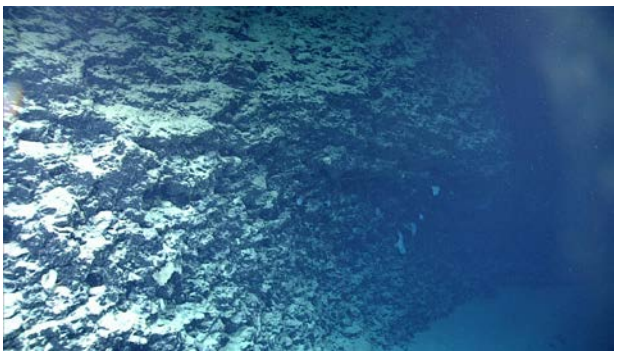
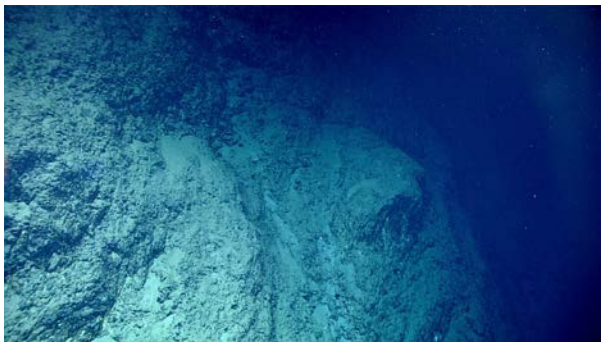
Dive Description	The habitat at the beginning of the dive was characterized by soft sediment mixed with step-like formations of rock draped heavily with soft sediments. Soft substrate throughout most of the dive was composed of pteropod shells, foraminiferan shells, and sponge debris. Much of the dive took place on hard, consolidated bottom with significant FeMn crusts, threby making rock sampling difficult. Vertical or steep slopes (>45 degrees) dominated much of the dive. Little evidence was found of failures in the rock indicated by freshly exposed surfaces. This may indicate that this landslide may not have been as active as previously thought. Even though the end waypoint was not quite reached, we made important observations of geological foundations in this area over a significant vertical depth range (3,024-3,342 m). There were only six fish species of demersal fish at this location, and most occurred at the beginning of the dive. These species included grenadier (*Nezumia* sp.), *Bathysaurus* sp., Halosaurs (*Aldrovandia* sp.), *Ipnops murrayi*, synaphobranchid eels, and one ophidiform. We saw two *Bathysaurus* sp., which appeared quite large, greater than 1 m in length. They also had the same white amphipods on the pectoral and caudal fins, which were interpreted as being parasitic on an earlier dive. There was a large fish at the very end of the dive, but the ROV was already ascending and we didn't get a good close-up view. Sponges were the most dominant organism at this site. Glass sponges made up most of the sponge fauna during the dive. There was a bell-shaped glass sponge very common at the beginning of the dive. We made one collection of a glass sponge (17:55 UTC) that was common towards the end of the dive around 3,100 m. This sponge was identified as *Poliopogon* cf. *amadou*, which has been observed in the mid and eastern North Atlantic at similar depths. It has not been identified for the U.S. Caribbean and our collection of this may represent a new species or substantial range extension. There were some different stalked sponges and possibly a euplectillid, but we could not get close enough. We also saw a cladorizid sponge, but it was very small. Echinoderms were the second most dominant group observed during this dive. Sea cucumbers were seen throughout the dive. We saw about five species of holothurians, a small stalked crinoid, and an unstalked crinoid. We also observed four species of sea stars. We collected one sea star, Pedicellasteridae, which might be a new species. This sea star had six arms. We tried to collect a small Goniasteridae sea star, but it was too small to be scooped. A brisingid, and slime star was also identified during the dive. We saw quite a few shrimp, including the swimming shrimps (Aristeidae). Other organisms identified during this dive were small branching bryozoans, a carnivorous tunicate (*Megalodicopia*-like), ctenophores, cerianthid anemone, a possible corallimorph, an interesting possible plated polychaete worm, and a skeleton of a whale barnacle. We also observed scattered trash, including fishing line and beverage cans.
Notable Observations	We observed scattered trash including fishing line and beverage cans throughout the dive.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ❑ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
High vertical relief dominated the seafloor for much of the early and middle portion of the dive. Only small glass sponges were observed on these features.	Smoother rock surfaces on the well exhibited substantial sediment build up. No attached fauna was observed on this substrate type.
	
An unknown Pedicellasterid sea star was found in the final moments of the dive at a depth of 3,035 m. This star is likely an undescribed species, as this group is very poorly known from this depth range.	During the final 100 m of the dive, we encountered a relatively high-density of hexactinellid sponges (*Poliopogon* cf. *amadou*) compared to the earlier portion of the dive. These sponges are not well studied from the Western Atlantic and may constitute a substantial range extension or new species.

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Samples Collected

Sample ID	EX1811_D11_01G
Date (UTC)	20181111
Time (UTC)	174907
Depth (m)	3033.858
Temp. (°C)	2.717
Field ID(s)	Rock

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D11_01G_A01	Bryozoan	1
EX1811_D11_01G_A02	Glass Sponge	1
EX1811_D11_01G_A03	Glass Sponge	1

Comments

Sample ID	EX1811_D11_02B
Date (UTC)	20181111
Time (UTC)	175654
Depth (m)	3033.963
Temp. (°C)	2.72
Field ID(s)	Porifera

Commensals	No commensals
Comments	

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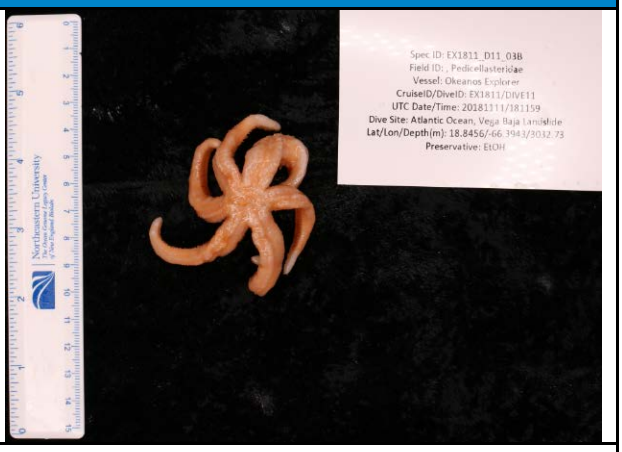
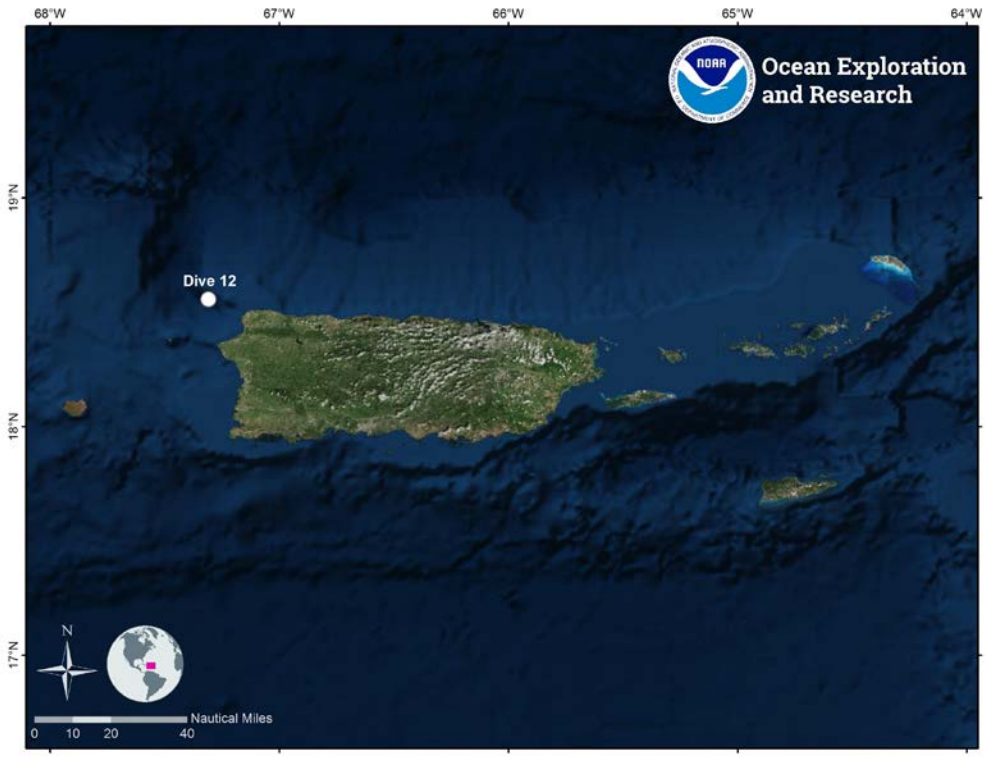
Sample ID	EX1811_D11_03B
Date (UTC)	20181111
Time (UTC)	181159
Depth (m)	3032.727
Temp. (°C)	2.735
Field ID(s)	Pedicellasteridae
Commensals	No commensals
Comments	



EX1811-Dive12 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Mona Canyon East Wall		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE12		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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Equipment Malfunctions	The salinity measurements by the CTD sensors on *D2* showed erroneous values throughout the dive. After the dive, the faulty salinity measurements from the *D2* sensors were replaced with correct values from the *Seirios* sensors in SeaTubeV2.
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-12T13:56:05.729674 18°, 32.442' N ; 67°, 17.683' W On Bottom: 2018-11-12T15:19:44.891228 18°, 32.611' N ; 67°, 17.706' W Off Bottom: 2018-11-12T21:22:35.165507 18°, 32.672' N ; 67°, 17.424' W Out Water: 2018-11-12T22:35:55.208154 18°, 32.864' N ; 67°, 16.993' W Dive duration: 8:39:49 Bottom Time: 6:2:50 Max. depth: 2415.0 m
Special Notes	The deployment of the ROV was delayed by ~1.5 hours due to a winch issue. However, the ROV recovery time was extended to recover dive time that would have otherwise been lost.
Scientists Involved (provide name, affiliation, email)	

Name	Affiliation	Email
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Zach Proux	NOAA/CSS	prouxzs@g.cofc.edu

Dive Purpose	The purpose of the dive was to characterize deep-sea coral and sponge communities in an unexplored steep ridge feature located on the eastern side of the Mona Canyon, off the northwestern shore of Puerto Rico. The dive also sought to identify the occurrences of deep-water demersal fish species, as well as their habitat preferences along the dive track.

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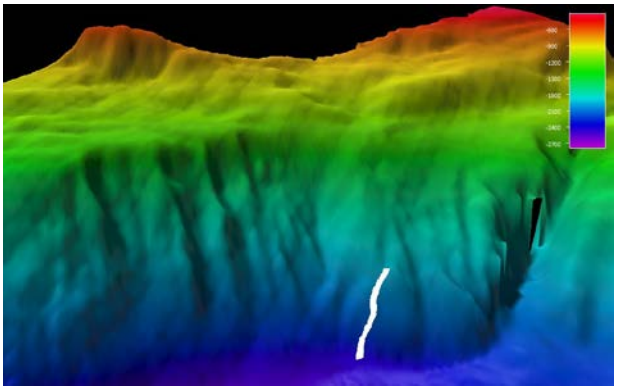
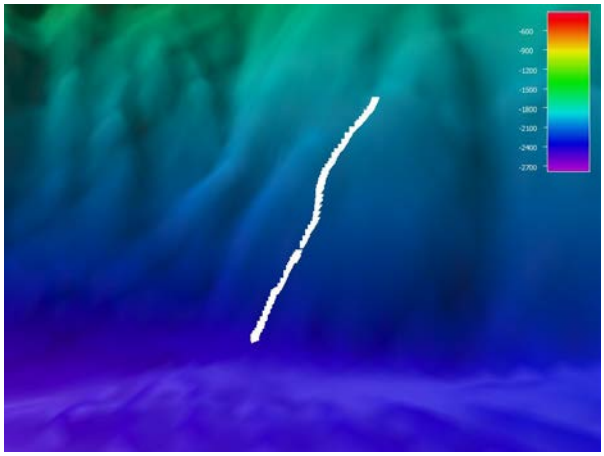
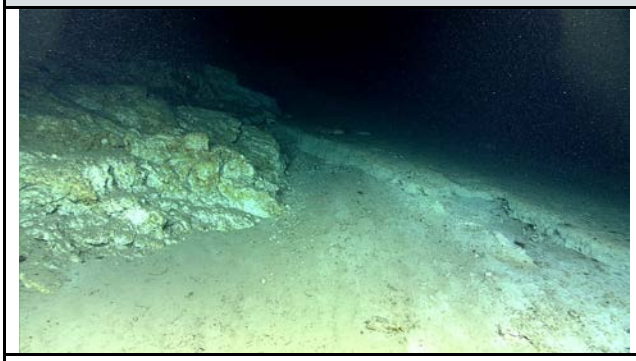
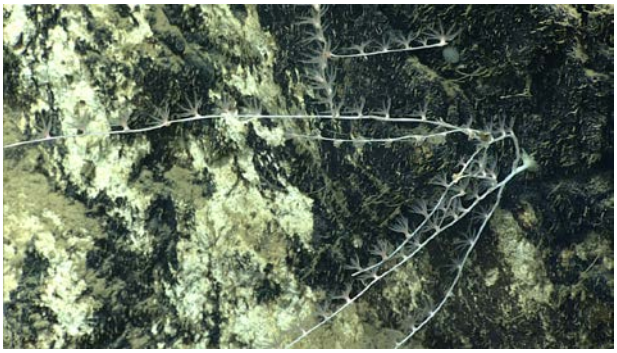
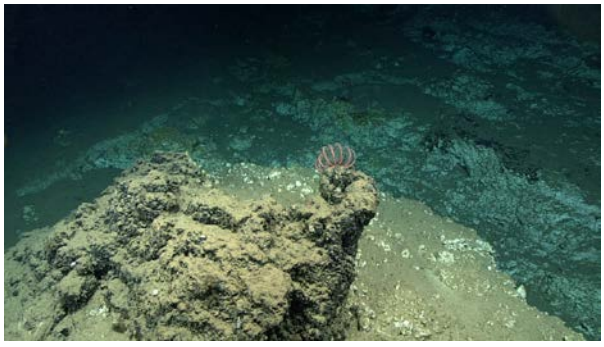
Dive Description	The dive started in a soft sediment habitat. The current at this site was strong and heading from south to north. There were even ripples in the sand. The substrate changed to more jagged rocky outcrops, which were not coated with iron manganese. The most common and abundant fish at this site was the cusk eel *Barathrodenus manatinus*. Two other of fish species were halosaurs and *Ipnops murrayi*, however, fish were very sparse throughout the dive. Halosaurs and *Ipnops murrayi* were located in the shallower parts of the dive. Rock that was sampled at the end of the dive appeared to be more of a conglomeration of soft carbonate sediments and sand, rather than hard consolidated carbonates down below. Sponge diversity was low and glass sponges contributed the most to the overall sponge composition. At the beginning of the dive we observed *Poliopogon* sp., which was also sighted on a previous dive. Also observed were a *Euplectella* sp., *Farrea* sp., and stalked glass sponge. There were some small encrusting demosponges on the manganese-covered rock faces. Carnivorous sponges were also observed at this site, but they were not as common. Deep-sea corals were not well represented at this site with only two species present, one Isidid and one primnoid. The deepest coral was the Isidid (possibly J-clade, internodal-branching) species reminiscent of one collected previously at Jaguey Spur. The other coral, the primnoid *Candidella imbricata*, was found throughout the dive, but much larger colonies (>20 cm) were found deeper along the dive track. All deep-sea corals were exclusively found with bases attached to rock encrusted with FeMn coating. Echinoderms again were the most abundant and common organism at this site, with sea cucumbers and brittle stars being the most abundant taxa. The majority of the time the brittle stars were out in the open and not hiding under rocks. We saw about five species of sea cucumbers across all explored depths. Three species of sea stars were noted, a slime star, *Zoraster fulgens*, and brisingid stars, the latter of which were very common throughout the dive. We saw two species of sea urchins, a small *Phormosoma* sp. and possibly a Diadematid urchin. There were small five-arm crinoids and we also saw a couple of 10-arm unstalked crinoids.
Notable Observations	We observed peculiar molluscs that looked like a snail at the beginning of the dive in the soft sediment. The foot was extended and had a small white shell. We observed numerous different shrimp throughout the dive, the most common of which were the swimming shrimps in the family Aristeidae. Some trash was also observed on the seafloor near the ROV landing site. Trash consisted of plastic and a glass bottle.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ❑ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Upon reaching the seafloor rocks were observed to be highly fractured forming extensive talus fields. Rocks were often friable and the first few sampling attempts resulted in consolidated mud "rocks" that fell apart. Holothurians and other soft-sediment echinoderms dominated the benthic communities in these environments.	Bright white colored carbonate faces stood in contrast to FeMn-coated rock faces which may indicate recent rock failures. Biology was only found on FeMn crusts.
	
Larger attached megafauna, like this bamboo coral were only observed on FeMn coated rock surfaces and never on white to tan colored carbonate surfaces.	Small pinnacle features dominated the last few meters of bottom distance with occasional attached fauna consisting of *Crypthelia* sp. hydrocorals and sea stars in the family Brisingidae.

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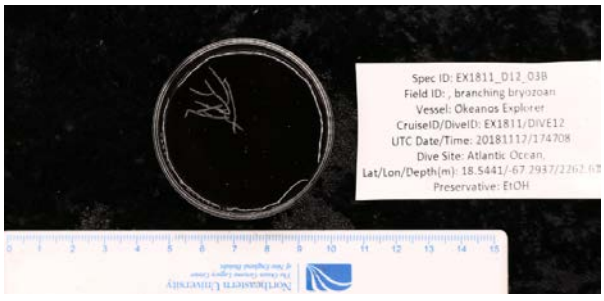
Samples Collected		
Sample ID	EX1811_D12_01G	
Date (UTC)	20181112	
Time (UTC)	163945	
Depth (m)	2348.072	
Temp. (°C)	3.046	
Field ID(s)	Rock	
Commensals	No commensals	
Comments		
Sample ID	EX1811_D12_02B	
Date (UTC)	20181112	
Time (UTC)	173430	
Depth (m)	2264.843	
Temp. (°C)	3.204	
Field ID(s)	*Candidella* sp.	
Commensals	No commensals	
Comments		
Sample ID	EX1811_D12_03B	
Date (UTC)	20181112	
Time (UTC)	174708	
Depth (m)	2262.614	
Temp. (°C)	3.258	
Field ID(s)	Branching Bryozoan	
Commensals	No commensals	
Comments		

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Sample ID	EX1811_D12_04G
Date (UTC)	20181112
Time (UTC)	204040
Depth (m)	1989.822
Temp. (°C)	3.621
Field ID(s)	Rock

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D12_04G_A01	Polychaeta	1

Comments

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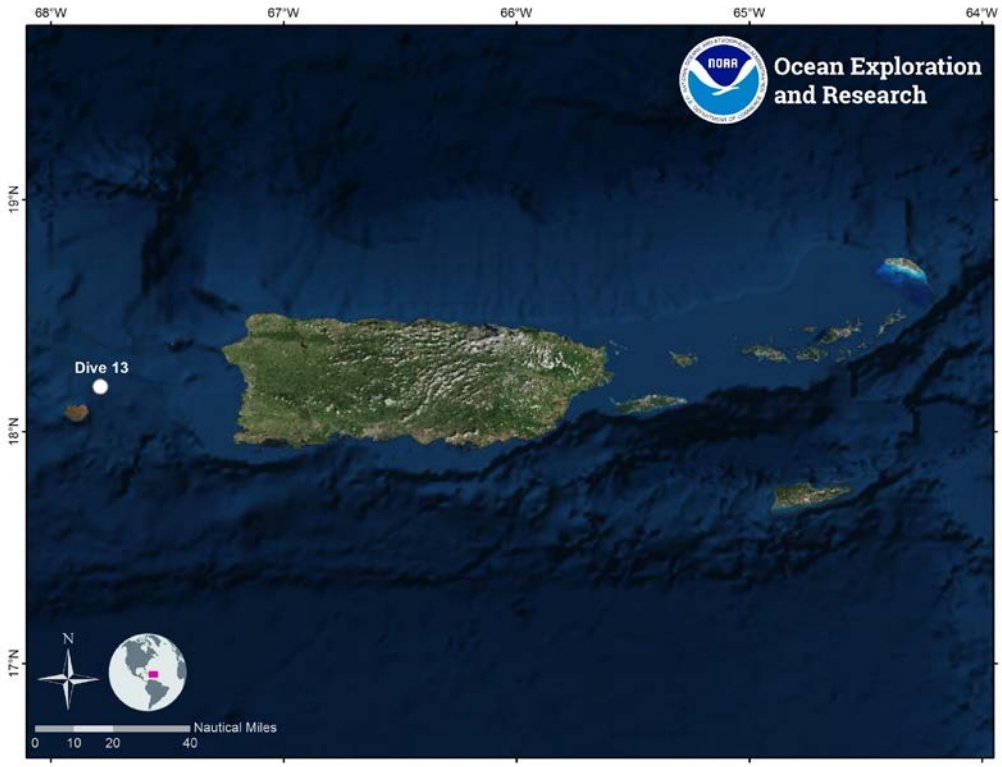
EX1811-Dive13 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Mona Island Escarpment		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE13		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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Equipment Malfunctions	None
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-13T12:30:00.602661 18°, 12.5' N ; 67°, 48.19' W On Bottom: 2018-11-13T13:13:08.507289 18°, 12.531' N ; 67°, 48.096' W Off Bottom: 2018-11-13T20:08:17.027967 18°, 12.457' N ; 67°, 48.325' W Out Water: 2018-11-13T20:32:09.392948 18°, 12.572' N ; 67°, 48.157' W Dive duration: 8:2:8 Bottom Time: 6:55:8 Max. depth: 566.0 m
Special Notes	The CTD sensor values from *D2*, which showed erroneous readings on the last two dives, produced good data throughout the dive. As a precaution, the data team swapped the CTD values in the science chatroom from D2 to *Seirios* prior to the dive.
Scientists Involved (provide name, affiliation, email)	

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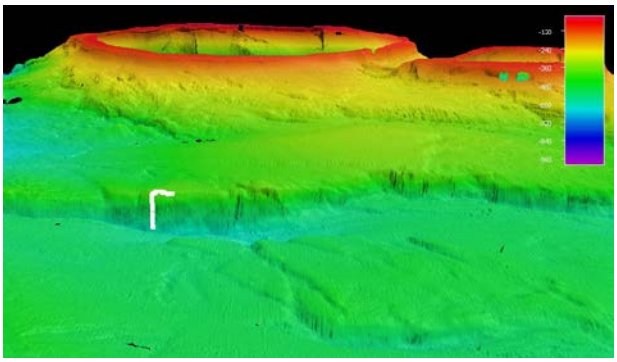
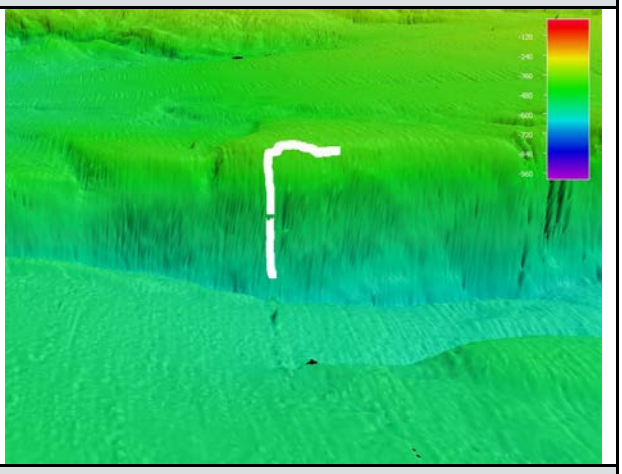
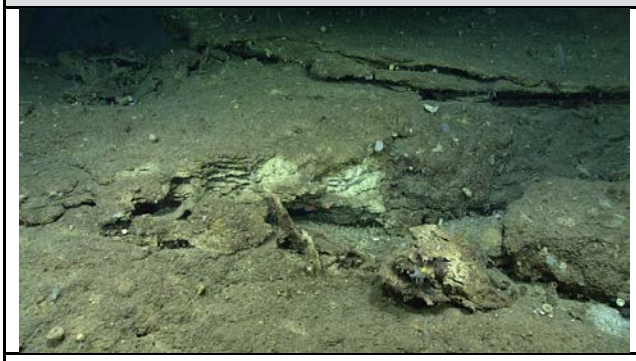
Steven Auscavitch	Temple University	steven.auscavitch@temple.edu
Tara Harmer Luke	Stockton University	luket@stockton.edu

Dive Purpose	This dive targeted potential habitats of commercially valuable deep-water fishes, including snappers and groupers. The depth profile and topography both fell in the habitat preferences of the commercially important deep-water fishes as reported by the local fishing community in the region. The dive also sought to characterize the habitats of deep-sea corals, sponges and other demersal fish communities.

Dive Description	This dive started at a depth of 550 m and reached as shallow as 399 m to explore deep-water fish and coral communities in the Mona Passage. The substrate consisted of broken off carbonate veneers on a rather steep slope. These veneers created relief and small crevices for many organisms to hide in. The substrate turned to a smoother carbonate pavement when we reached close to the plateau at the top of the escarpment. Fish diversity was relatively low compared to that of the attached and encrusting benthic megafauna. In total, we observed seven species of fish. The most common fish was the orange roughy (*Gephyroberyx* sp.). We saw three queen snapper (*Etelis oculatus*), at 454 m, 419 m and 409 m, respectively. They passed the camera and swam away quite fast. The other species noted were toadfish (*Chaunax* sp.), snake eels (*Aoterichtus distocopera*), shortnose greeneye (*Chlorophthalmus agassizi*), *Polylepion* sp. and Scorpanids. Roughys utilized the seafloor relief and topography as habitat and rarely strayed off the bottom. Also, some of the *Polylepion* sp. had 8 white stripes down their body and no dark blotch on the caudal fin. These color markings are different from what has been reported for this species in this region. This site was among the most diverse for deep-sea corals throughout the entire expedition. Black corals were the most diverse group with six species represented (*Leiopathes cf. glaberrima*, *Stylopathes* sp., *Stichopathes* spp. in both grey and orange morphotypes, *Antipathes atlantica*, and *Chrysopathes* sp.). This was followed by the Primnoidae with five species (*Callogorgia* spp.; possibly 2 different species, *Plumarella* sp., *Acanthoprimnoa cf. goesi*, *Narella cf. bellissima*) that were regularly observed throughout the dive. *Callogorgia* spp. were most common on the steeper, current swept slope than on top of the ridge crest. One *Chrysogorgia* sp. was observed. Toward the end of the dive we encountered thin Ellisellid whip corals with yellow polyps and white coenenchyma. Plexaurids and Acanthogorgiids dominated the coral fauna at the top of the ridge crest with one recurring deep purple *Paramuricea* sp. that was more common on vertical surfaces (one was collected) and *Acanthogorgia aspera* (collected and identified at the surface), which was more common on flat or gentle sloping surfaces. We also observed one colony of the structure-forming *Solenosmilia variabilis* on a steep overhang early in the dive, but only small cup corals thereafter. Stylasterids were represented by the three most common genera observed on this expedition at this depth, *Crypthelia* sp., *Stylaster* sp., and *Distichopora* sp. in orange coloration. Sponge diversity and abundance was impressive at this site, but sizes of individuals remained small. Demosponges contributed most to the overall sponge composition. There were a lot of unidentified blue, red and yellow encrusting sponges. The sponges increased in size toward shallower depths. The most common sponges were large lobate morphologies with white to cream coloration (possibly Pachastrellidae or Corallistidae). We also observed *Geodia* sp. and Haplosclerids (volcano-shaped sponges), and some suspected Euplectillids. Among the echinodermata, sea urchins, especially cidarids, were the most abundant. There were two species of cidarids, *Histocidaris* sp. and *Cidaris mirandus*. We witnessed *Histocidaris nuttingi* grazing on a black coral colony (*Chrysopathes* sp.). We also saw a couple of *Araeosoma* sp. urchins at shallower depths. Crinoids, both stalked and unstalked forms, were very abundant and at all depths on this dive. We also observed several *Holopus rangii* on vertical surfaces and overhangs. Most brittle stars were associated with octocorals and black corals. At least a couple of these brittle stars were euryalids, *Hemieuryale pustulata*. We did not observe any sea cucumbers at this site. Other invertebrate fauna were also locally abundant. We observed a lot of shrimp hiding in crevices or behind sponges. Some of these shrimp included *Heterocarpus ensifer*. These were noteworthy because they may be prey items of the queen snapper. We also saw a slitshell gastropod and a catshark egg case on an octocoral fan. Fishing line laid across the seafloor

	was common and we found a rebar and hooks that fishers use for weights on vertical long lines.
Notable Observations	Sea urchin predation on Antipatharians. High diversity of fishes and deep-sea corals.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Broken carbonate ledges and cobble to boulder-sized rock was the dominant substrate type along the sloped portion of this dive. Sponges were dominant in this terrain and attached to both horizontal and vertical surfaces.	A queen snapper was briefly imaged coming from upslope and was observed following a ledge away from ROV *D2*. Small fishes were observed under some of these overhangs.

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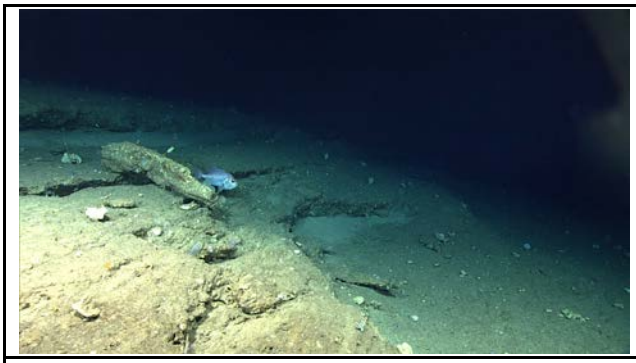
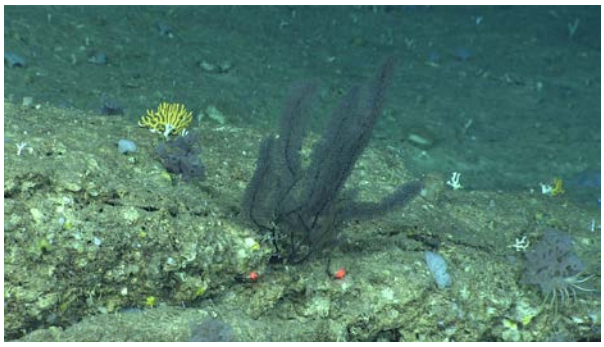


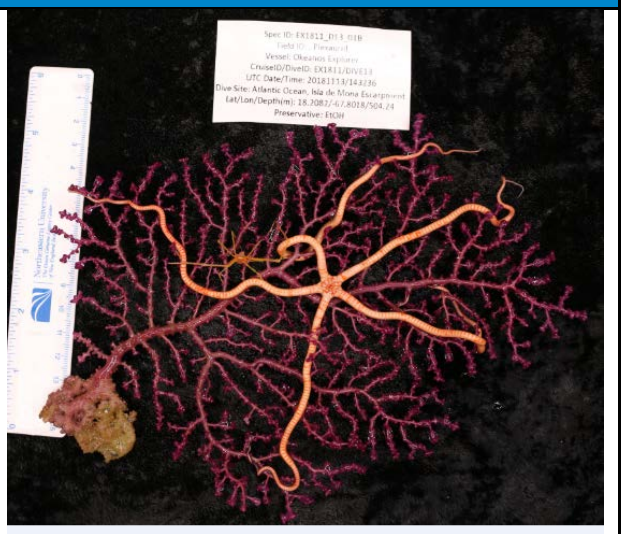


Relief at this site was created by stepwise outcrops and rock falls. Fishes (primarily roughy) were the primary inhabitants of rocky ledges and outcrops.

On the crest above the drop off, unbranched and branched black corals (*Chrysopathes* sp.) and stylasterids (*Distichopora* sp.) pictured here were among the dominant attached megafauna observed throughout this site. Black corals were also subject to grazing by cidarid urchins. Octocoral fans were more sparsely observed in this habitat.

Samples Collected

Sample ID	EX1811_D13_01B
Date (UTC)	20181113
Time (UTC)	143236
Depth (m)	504.236
Temp. (°C)	12.466
Field ID(s)	Plexaurid



Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D13_01B_A01	Brittle Star	1
EX1811_D13_01B_A02	Squat Lobster	1

Comments

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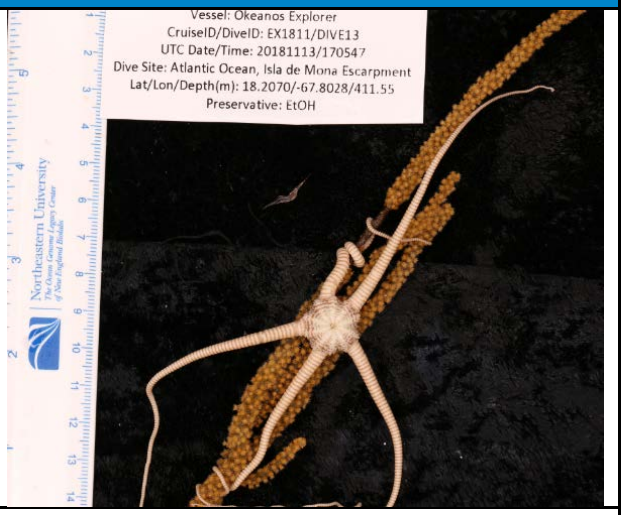
Sample ID	EX1811_D13_S02B
Date (UTC)	20181113
Time (UTC)	160020
Depth (m)	427.2625
Temp. (°C)	14.495
Field ID(s)	Raspailiidae sponge

Commensals	No commensals
Comments	

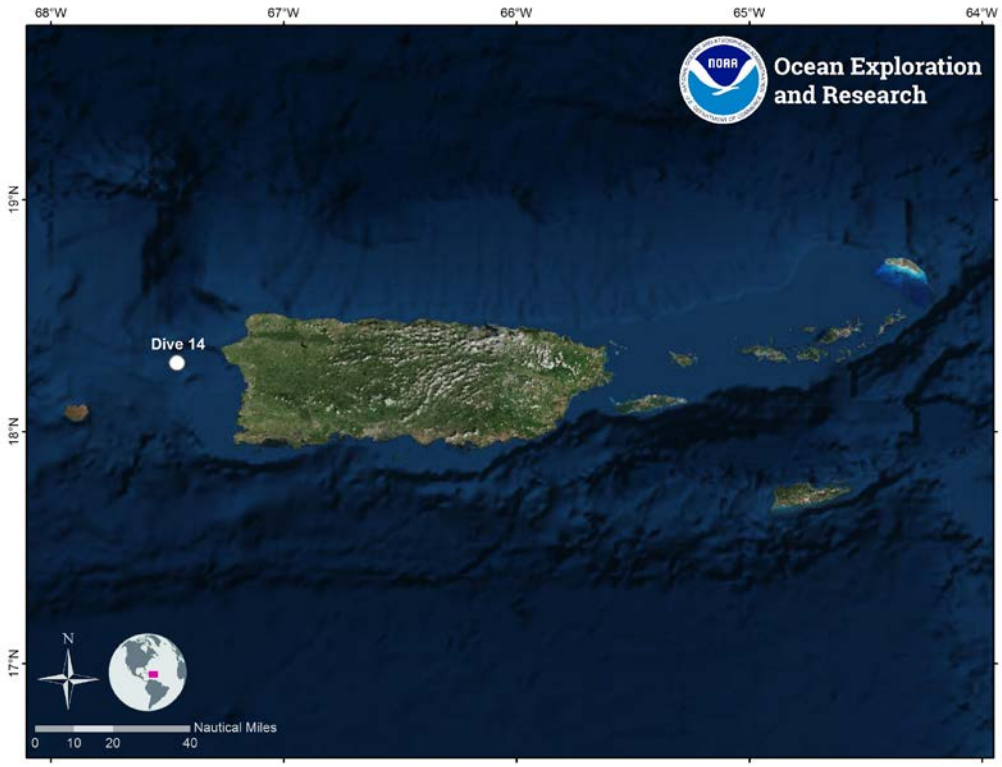
Sample ID	EX1811_D13_03B
Date (UTC)	20181113
Time (UTC)	170547
Depth (m)	411.554
Temp. (°C)	14.064
Field ID(s)	Octocoral (*Acanthogorgia aspera*)



Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D13_03B_A01	Brittle Star	1
EX1811_D13_03B_A02	Shrimp	1

Comments	

EX1811-Dive14 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	North of Bajo de Sico		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE14		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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Equipment Malfunctions	Immediately after *D2* was deployed, the pilot had trouble locking it into auto heading. The ROV stayed near the surface for an extended time until the issue was solved, at which time the ROV descended to the seafloor to commence the dive.
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-14T16:33:41.427034 18°, 17.097' N ; 67°, 27.854' W On Bottom: 2018-11-14T18:56:43.127663 18°, 17.378' N ; 67°, 27.589' W Off Bottom: 2018-11-14T21:58:41.001773 18°, 17.589' N ; 67°, 27.661' W Out Water: 2018-11-14T22:31:28.550295 18°, 17.925' N ; 67°, 27.278' W Dive duration: 5:57:47 Bottom Time: 3:1:57 Max. depth: 398.0 m
Special Notes	The ROV dive was shorter than usual today as sea conditions delayed launching, followed by an issue with the ROV software controls near the surface.
Scientists Involved (provide name, affiliation, email)	

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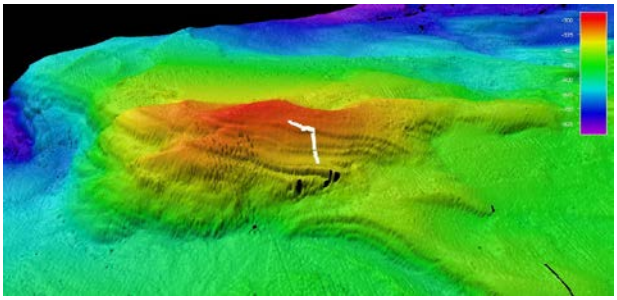
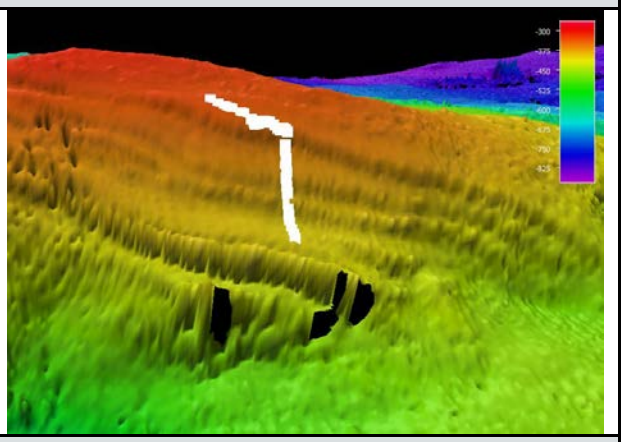
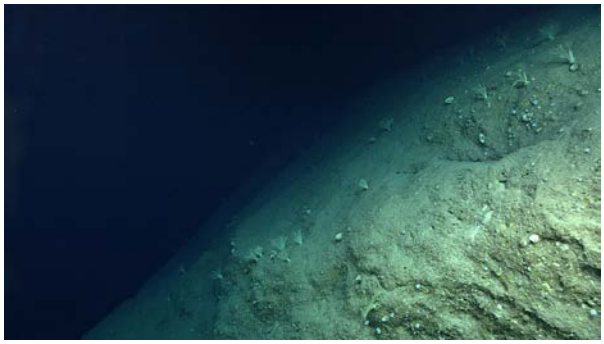
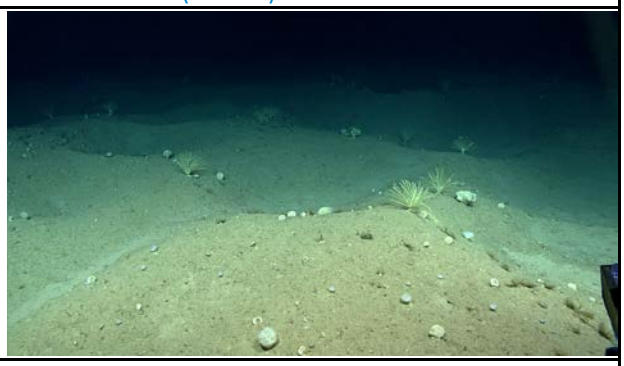
Tara Harmer Luke	Stockton University	luket@stockton.edu

Dive Purpose	This dive explored a submarine bank north of Bajo de Sico in the Mona Passage. The purpose of this dive was to make observations of potential habitats and occurences of deep-water fish species, including snappers and groupers. The depth profile and topography fell in the habitat preferences of commercially important fishes as reported by the local fishing community. This dive further sought to characterize the habitats of deep-sea corals, sponges, mobile invertebrates, and other demersal fish communities.

Dive Description	The dive started on a flat hard substrate that was covered by a thin veneer of sediment. The substrate was broken in a stepwise fashion with sand channels and drifts dividing the steps. The substrate was rather smooth and there were ripples in the sand, indicating that this site experiences high currents. The main benthic fauna at this site were sponges and echinoderms. Tiny white, cotton ball-looking sponges were were scattered all over the seafloor. There were also table-top white sponges that were common throughout the dive. It is unclear if these are glass or demosponges. Yellow encrusting sponges were common along the wall faces, and other encrusting sponges (orange and blue) were in high abundance. Overall, the sponge abundance and diversity was high. Possible, Corallistidae and Petrosiidae (one looked to be encrusting), and *Farrea* sp. were present in high quantities. Deep-sea corals were poorly represented with only four species observed from the Primnoidae, Nepthiidae, Antipatharia, and Scleractinia. Near the ROV landing spot on the seafloor, we observed small primnoid fans (likely *Plumarella* sp.), as well grey black coral whips (*Stichopathes* sp.), but neither of these were present later in the dive on top of the feature. Several species of 2-3 cm tall cup corals were quite common when zooming close to the substrate at most locations, but were unidentifiable from video. One nepthiid, similar to one observed off Caja de Muertos, was observed on an overhang near the crest of this mound. This site had the most crinoids when comparing to other dives on this expedition. These crinoids were different in that they had many more arms from what we have been seeing so far. We saw a lot of *Holopus* sp. crinoids. They were often at the edge of the ledges. We saw three types of sea stars, *Tamaria* sp., *Plinthaster* or *Peltaster* sp. (white small cookie star), and *Plinthaster dentatus* eating a sponge. We also saw two species of sea cucumbers, a pink one that looks like a sea pig, and another one that we haven't seen before (cream background with darker marks or spots) which looks like a shallow-water species. We identified three species of sea urchins (*Calocidaris* sp.*, Histocidaris* sp., and *Areosoma* sp.). Fish richness was low with only seven species observed. We did see a new fish for this expedition, yellowfin flagfish (*Aulopus filametosus*). Fishers mentioned catching this fish while targeting snappers and groupers. The other fishes observed were boarfish (*Antigonia capros*), orange roughy (*Hoplostethus atlanticus*), *Polylepion* sp., greeneye (*Chlorophthalmus agassizi*), *Epigonus sp.* and queen snapper (*Etelis oculatus*). The queen snapper was relatively small (~ 25 cm) and was sighted at 345 m. It was swimming down slope from the shallow ledges to the deep. Small fishes like the deep-sea cardinalfishes, *Epigonus* sp.*,* were observed under the ledges. These may be prey fish for the queen snapper. A fisher stated that snappers do not like to go around boarfish because boarfish will not let the queen snappers feed. We also some shrimp, but not as many as yesterday's dive at the north Mona Escarpment. We saw a *Heterocarpus* sp. shrimp. We also saw some fishing line and weights (rebars) at this site. There was an interesting anemone that was seen two times but unidentified. Small cracks and crevices in this area were often filled with small squat lobsters and crabs.
Notable Observations	Aggregations of yellow crinoids near edges of walls.
Community Presence/ Absence (*community is more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Overhangs and erosional features were common attachment points of sessile fauna. These features were also the primary refuge for fish species we observed on this dive.	The upper ridge was found to drop off rapidly as we travelled along the crest. This habitat was expected to be ideal for deep-sea fishes, like queen snapper. One small individual (~25 cm) was observed on this dive.
	
Overhangs along the ledges of the step-wise slope were heavily encrusted with sponges, stylasterids, and *Crinometra* sp. feather stars.	Summit microtopography was found to be irregular and hummocky. These pits and channels were approximately 20-30 cm deep. Seafloor on these mounds and channels was hardpan or rocky bottom, only with soft sediments or shell material gathered in the center of the pits.
Samples Collected	
No samples were collected	

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EX1811-Dive15 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Pichincho Wall East		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE15		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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<table>
<tr><td>Equipment Malfunctions</td><td>There were no issues with the ROVs, but the ADCP display, an important tool for assessing ship’s speed through the water, did not work for ~15 minutes during recovery.</td></tr>
<tr><td>ROV Dive Summary Data (from processed ROV data)</td><td>In Water: 2018-11-15T12:34:22.605756
18°, 22.28' N ; 67°, 45.169' W

On Bottom: 2018-11-15T13:57:51.695400
18°, 22.203' N ; 67°, 45.293' W

Off Bottom: 2018-11-15T19:31:01.979099
18°, 22.281' N ; 67°, 45.454' W

Out Water: 2018-11-15T20:46:47.671171
18°, 21.44' N ; 67°, 44.906' W

Dive duration: 8:12:25

Bottom Time: 5:33:10

Max. depth: 366.0 m</td></tr>
<tr><td>Special Notes</td><td>N/A</td></tr>
<tr><td>Scientists Involved (provide name, affiliation, email)</td><td>
<table>
<tr><th>Name</th><th>Affiliation</th><th>Email</th></tr>
<tr><td>Aurea Rodriguez</td><td>University of Puerto Rico at Mayagüez</td><td>auryro@gmail.com</td></tr>
<tr><td>Daniel Wagner</td><td>NOAA/OER</td><td>daniel.wagner@noaa.gov</td></tr>
<tr><td>Debi Blaney</td><td>NOAA/OER</td><td>debi.blaney@noaa.gov</td></tr>
<tr><td>Enrique Salgado</td><td>NOAA/CSS</td><td>enrique.salgado@noaa.gov</td></tr>
<tr><td>Graciela Garcia-Moliner</td><td>Caribbean Fishery Management Council</td><td>graciela_cfmc@yahoo.com</td></tr>
<tr><td>Kate Overly</td><td>NOAA/NMFS</td><td>katherine.overly@noaa.gov</td></tr>
<tr><td>Megan Cromwell</td><td>NOAA/NCEI</td><td>megan.cromwell@noaa.gov</td></tr>
<tr><td>Megan McCuller</td><td>North Carolina Museum of Natural Sciences</td><td>megan.mcculler@naturalsciences.org</td></tr>
<tr><td>Michael Vecchione</td><td>NOAA/NMFS</td><td>vecchiom@si.edu</td></tr>
<tr><td>Michelle Schärer</td><td>HJR Reefscaping</td><td>michelle.scharer@upr.edu</td></tr>
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<tr><td>Rachel Bassett</td><td>NOAA/NCCOS</td><td>rachel.bassett@noaa.gov</td></tr>
<tr><td>Scott France</td><td>University of Louisiana at Lafayette</td><td>france@louisiana.edu</td></tr>
<tr><td>Stacey Williams</td><td>Institute for Socio-Ecological Research</td><td>stcmwilliams@gmail.com</td></tr>
<tr><td>Steven Auscavitch</td><td>Temple University</td><td>steven.auscavitch@temple.edu</td></tr>
<tr><td>Tara Harmer Luke</td><td>Stockton University</td><td>luket@stockton.edu</td></tr>
</table>
</td></tr>
<tr><td>Dive Purpose</td><td>This dive targeted potential habitats of deep-sea fish species, including snappers and groupers. The depth profile and topography, fell in the habitat preferences of commercially important deep-water fishes as reported by the local fishing community. The dive also sought to characterize the habitats of deep-sea corals, sponges, mobile invertebrates and other demersal fish communities.</td></tr>
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Dive Description	Structural relief at this site was very impressive, often composed of fallen carbonate ledges and overhangs. Overhangs, crevices and large boulder-like features were frequent spots for fish and other organisms to take refuge in. On descent, we saw a big school of snappers, maybe queen or silks hovering at a depth of about 200 m. The diversity of corals, sponges and fishes at this site was likely the highest of all sites thus far on this expedition. The bigeye soldierfish (*Ositchtys trachypoma*) was the most abundant fish and was observed throughout the dive from 365 m to 250 m. At least one misty grouper (*Hyporthodus mystacinus*) was observed right in the beginning of the dive and the same individual may have been sighted several times later during the dive. Silk snappers (*Lutjanus vivanus*) were the second most abundant fish during the dive. We also saw yellowfin flagfish (*Aulopus filametosus*), blackfin snapper (*Lutjanus buccanella*), ?*Epigonus* or *Serranus notospilus*, *Cookeolus japonicus* or *Priacanthus*, roughtongue bass (*Pronotogrammus martinicensis*), small fish with forked caudal fin (maybe *Choranthias* sp.), boarfish (*Antigonia capros*), *Polylepion* sp, and queen snapper (*Etelis oculatus*). One of the most striking observations was a translucent egg case of a catshark and a small catshark embryo attached to an ellisellid whip coral. We were able to observe that the catshark was still connected to the yolk sac and actively swimming inside. Sponge diversity and abundance was high at this site. We observed mostly encrusting species and demosponges. We did see many Corallistidae sponges and the small, yet unidentified, cotton ball-sized sponges. We collected an encrusting red sponge thought to be growing over a corallistid structure. There were a couple of new encrusting sponges observed at this site, like a bright blue encrusting sponge (black and red). Deep-sea corals were notably diverse at this location in addition to being locally abundant. Stylasterids were small (<5 cm), but` were the most numerically abundant organism on the dive. Some stylasterid fans (*Crypthelia sp*., *Stylaster* sp., possibly *S. erubescens*), particularly on ledges and overhangs, reached 30 cm or more in height and width. The diversity of stylasterids was difficult to identify visually, but estimates exceed 6 different colony morphologies based on what we could discern by eye. Orange-colored *Distichopora* sp. colonies were also seen at this site. Within the stylasterid communities, we also observed other live scleractinian corals, including dense clusters of *Madracis cf. myriaster* and *Madrepora* sp. colonies. One *Madrepora* cluster was sampled to determine a species-level identification. Soft corals were also well represented with plexaurids being the most common and speciose group (*Thesea* sp., cf. *Paracis* sp., *Paramuricea* sp.). We also observed ellisellid whips in abundance toward the end of the dive. Small true soft corals, possibly *Scleronepthya* sp., were occasionally observed. Scattered throughout the dive we also observed thin black coral stalks, which were always unbranched (likely *Stylopathes* sp. or *Parantipathes* sp.). Sea stars were more abundant than any other echinoderm group. We saw *Linckia* sp. and the goniasterid *Plinthaster dentatus* on the faces of the ledges. There was a darker color sea star spotted during the dive, but this may have been a more heavily pigmented *Linckia* sp. individual. We also saw a couple of *Calocidaris micans* urchins during the dive. One looked like it was eating or propped on a sponge. We did not observe any crinoids or sea cucumbers. There were four squids observed right at the beginning of the dive. They were identified as *Doryteuthis* sp. by Michael Vecchione and Roger Hanlon. We saw a lot of crabs (*Mithrax* sp.) during this dive, more so than any other dive. We also spotted a couple of dead slitshell gastropods and a couple of unidentified brown-colored corallimorpharians or anemones.
Notable Observations	Dense stylasterid and stony corals on overhangs and ledges. Catshark embryo on Ellisellid coral.

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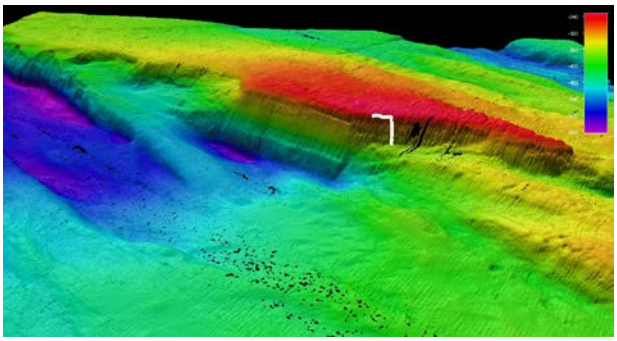
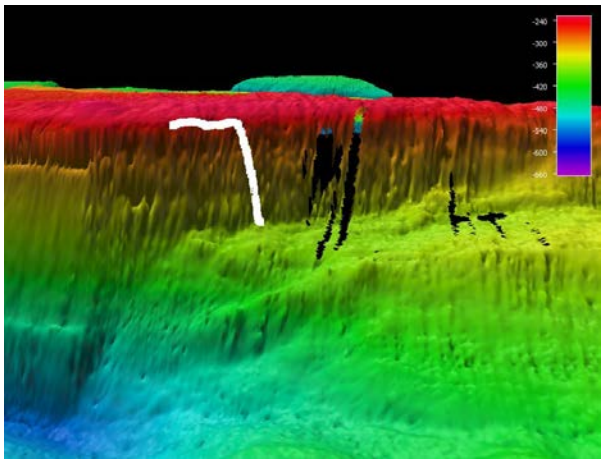
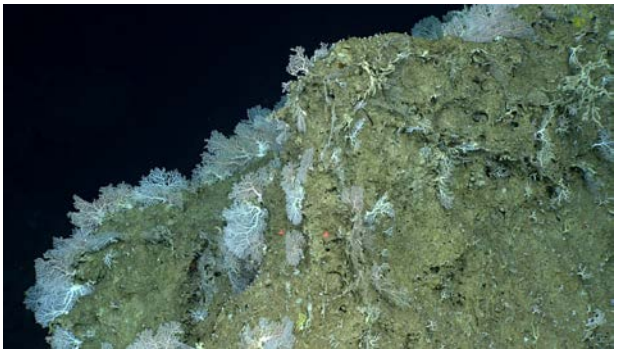
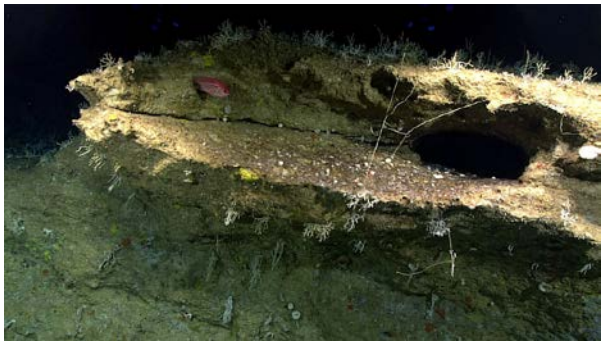
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Stony corals (*Madrepora* sp.) and stylasterid hydricorals (*Stylaster* spp. and *Distichopora* sp.) were the dominant attached fauna on block and boulder substrate. Vertical surfaces and edges were preferred settlement surfaces.	Karstic terrain dominated the seafloor geomorphology. Many overhangs were observed with dense attached faunal communities. Fishes often inhabited caverns under overhangs.

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One of the highlights for the dive included a translucent occupied shark egg case. This case was attached to an Ellisellid ocotcoral whip. These egg cases are rare to find since they are usually dark to opaque and often without embryos inside.

Deep-water fishes, most actively fished by the local fishing community, were constantly observed throughout the dive track. Larger-bodied groupers and snappers were occasionally observedc loser to the vehicle. Fishes often maintained their distance just out of the lights of the vehicle or withdrawn to caves or ledges.

Samples Collected

Sample ID	EX1811_D15_01B
Date (UTC)	20181115
Time (UTC)	151524
Depth (m)	320.072
Temp. (°C)	16.813
Field ID(s)	Porifera
Commensals	No commensals
Comments	

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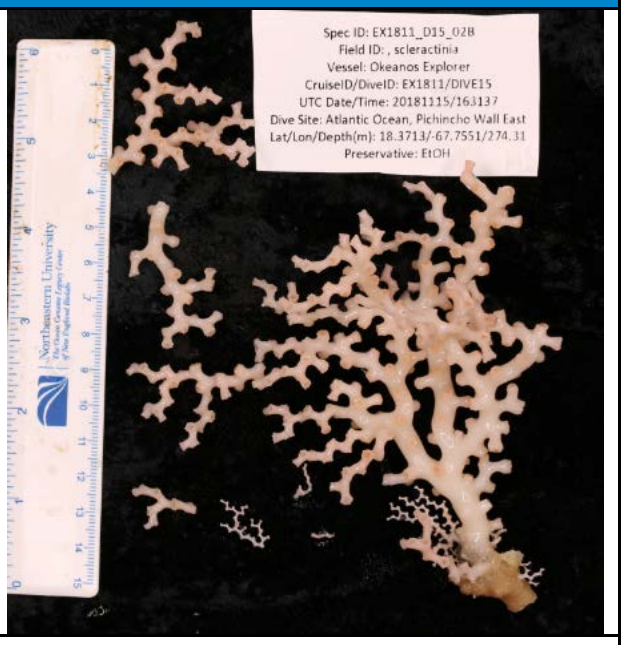
Sample ID	EX1811_D15_02B
Date (UTC)	20181115
Time (UTC)	163137
Depth (m)	274.305
Temp. (°C)	17.986
Field ID(s)	scleractinia



Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D15_02B_A01	Stylasteridae	1

Comments

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EX1811-Dive16 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Pichincho Fish Tail		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE16		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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	None
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-16T12:29:18.142470 18°, 31.19' N ; 67°, 50.25' W On Bottom: 2018-11-16T13:07:11.546465 18°, 31.082' N ; 67°, 50.186' W Off Bottom: 2018-11-16T20:07:09.667886 18°, 31.082' N ; 67°, 49.807' W Out Water: 2018-11-16T20:34:15.035535 18°, 31.082' N ; 67°, 49.71' W Dive duration: 8:4:56 Bottom Time: 6:59:58 Max. depth: 521.0 m
Special Notes	There were no issues with the ROVs, but the ADCP dropped out during launch.
Scientists Involved (provide name, affiliation, email)	

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Mary Wicksten	Texas A&M University	m-wicksten@tamu.edu
Megan Cromwell	NOAA/NCEI	megan.cromwell@noaa.gov
Megan McCuller	North Carolina Museum of Natural Sciences	megan.mcculler@naturalsciences.org
Michelle Schärer	HJR Reefscaping	michelle.scharer@upr.edu
Rich Mooi	California Academy of Sciences	rmooi@calacademy.org
Scott France	University of Louisiana at Lafayette	france@louisiana.edu
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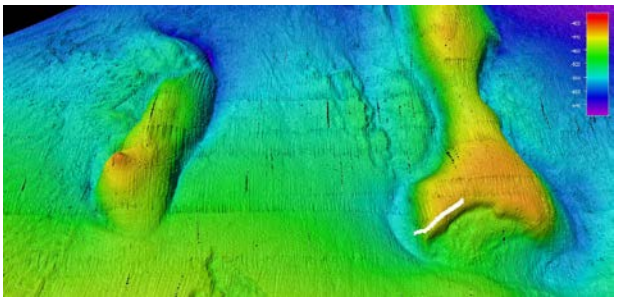
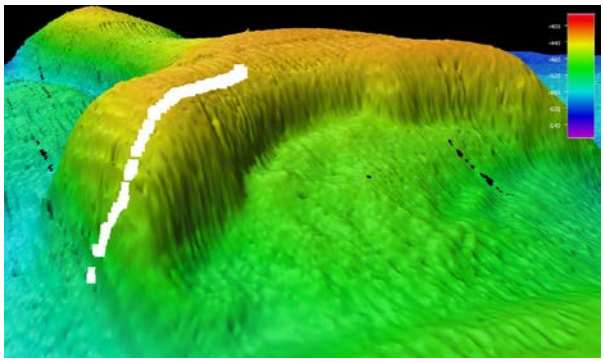
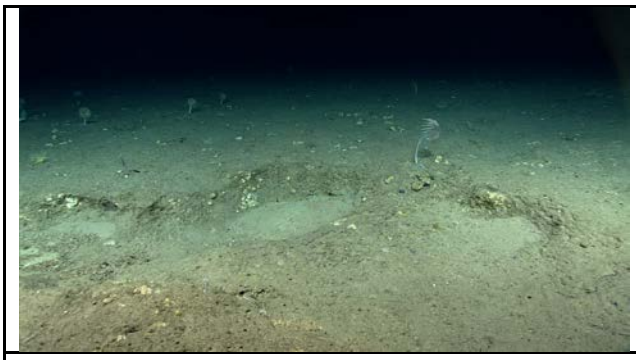
Steven Auscavitch	Temple University	steven.auscavitch@temple.edu
Tara Harmer Luke	Stockton University	luket@stockton.edu
Tom Hourigan	NOAA/NMFS	tom.hourigan@noaa.gov
Zach Proux	NOAA/CSS	prouxzs@g.cofc.edu

Dive Purpose	This dive targeted potential habitats of deep-water fish species, including snappers and groupers. The depth profile and topography, fell within the habitat preferences of commercially important deep-water fishes as reported by the local fishing community in the region. The dive also sought to characterize the habitats of deep-sea corals, sponges, mobile invertebrates and other demersal fish communities along the seafloor.

Dive Description	During this dive we traversed over a gently-sloped hardbottom consisting of carbonate. The seafloor was in most places well-swept by currents. The current was strong at the beginning of the dive going to the southeast and changed throughout the dive both in direction (eastward) and decreased in intensity. Fish diversity was relatively low with only 10 species identified. The most abundant fish species was the greeneye (*Chlorophthalmus agassizi*). We did see five queen snappers (*Etelis oculatus*) during the dive, which were rather large snappers. They approached the ROV and then swam off quickly. The other fish seen during the dive were bearded brotula (*Brotula barbata*), dogfish, cat shark (*Scyliorhinus* sp.), boarfish (*Antigonia capros*), *Pontinus atophthalmus*, roughy (*Gephyroberyx* sp.), and dory (*Cyttopsis rosea*). There was also a small silvery fish that was not identified. Deep-sea corals were characteristic of other coral assemblages found at depths shallower than 500 m depth at other sites in the Mona Passage. Stylasterids were small but abundant and composed of three species (*Stylaster* sp., *Distichopora* sp. and *Crypthelia* sp.). Black corals were well represented with *Stylopathes* sp. being most common, followed by *Parantipathes* sp., *Stichopathes* sp., and *Antipathes* sp. colonies. Among the Primnoidae, we encountered large sea fans of *Narella cf. bellissima* (>20 cm tall) and smaller *Plumarella* sp. colonies. Chrysogorgiid bottlebrush colonies were also periodically seen throughout the dive. Toward the dive's end on top of the mound we observed a greater density of S1 clade bamboo corals (*Cladarisis* sp.). Plexaurids displayed different color morphs from yellow to purple, that were initially thought to be the same species of Paramuricea. Finally, we observed a few colonies of *Acanthogorgia* cf. *aspera*, similar in morphology to those observed north of Mona Island. Sponges were in high abundance. However, many were encrusting or small in diameter. The larger sponges were the cup or foliose-shaped sponge (one of which we collected during this dive) and *Phakellia* sp. demosponges, the latter of which were common at this site. There were also Euplectillids at this site and we collected a long, thin vase-like morphotype. There was also another euplectillid morph that occurred in clusters, but this was only observed once during the dive and was not sampled. Echinoderm behavioral observations at this site were particularly noteworthy. The most numerically abundant echinoderm group were the crinoids, both stalked and unstalked. We collected a stalked crinoid, *Endoxocrinus* sp. that was poorly known from this area. There were also a lot of small yellow crinoids, *Crinometra brevipinna*. The primnoid octocorals had numerous brittle star associates, often with several per colony. Besides the crinoids, there were a lot of brittle stars, and many times the brittle stars were wrapped around the cidarid spines, which was an unusual behavior. This may have been an effort to extend their grasp beyond the benthic boundary layer. We saw two basket stars, and both had their arms open. We also observed one pink holothurian, two sea star species, *Mediaster* sp. and an unknown goniasterid. We saw about five species of sea urchins, *Calocidaris* sp., *Stylocidaris* sp., *Histocidaris nuttingi*, *Areosoma* sp. and *Cidaris rugosa*. We saw a *C. rugosa* grazing the cirri off one of the stalked crinoids. We saw three more *H. nuttingi* eating a smaller stalked crinoid and two bamboo corals. Broken bamboo coral branches were frequently seen and might be from cidarid predation. We also recorded some trash, a couple of bottles, some cloth or fabric, and what looked to be like broken metal broom stick.
Notable Observations	Predation by urchins on other echinoderms and corals.

Community Presence/ Absence (*community is defined as more than two species*)	✓	Corals and Sponges
	❑	Chemosynthetic Community
	✓	High biodiversity Community
	❑	Active Seep or Vent
	❑	Extinct Seep or Vent
	❑	Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
At this site we found some of the largest queen snapper observed thus far on this expedition. Often shying away from *D2*'s presence or lights, at least five occurrences of queen snapper strafing the vehicle were noted.	Some of the most noteworthy highlights were several occurrences of cidarid urchins grazing on other echinoderms, primarily isocrinids, and bamboo corals. This behavior has been long hypothesized but rarely observed *in situ*.



Hard carbonate pavement dominated the seafloor throughout the entirety of the dive track. Small dissolutional or erosional features like pits and holes were at times used as habitat by both fishes and invertebrates.

The slopes of this feature had some of the highest currents and density of attached organisms like this *Callogorgia* sp. seafan with numerous echinoderm associates (basket stars, brittle stars). Many colonies were permanently bent or leaning, indicating a relatively strong velocity and constant downslope current direction.

Samples Collected

Sample ID	EX1811_2D16_01B
Date (UTC)	20181116134746
Time (UTC)	134746
Depth (m)	497.568
Temp. (°C)	12.821
Field ID(s)	Tunicate

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D16_01B_A01	Crustacean	1
EX1811_D16_01B_A02	Sponge	1

Comments

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Sample ID	EX1811_D16_02B
Date (UTC)	20181116
Time (UTC)	144502
Depth (m)	473.814
Temp. (°C)	12.838
Field ID(s)	Euplectillidae

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D16_02B_**A01**	Brittle Star	1
EX1811_D16_02B_A02	Hydroids	Many

Comments	

Sample ID	EX1811_D16_0SPEC03B
Date (UTC)	20181116
Time (UTC)	164704
Depth (m)	434.18
Temp. (°C)	14.462
Field ID(s)	Porifera

Commensals	No commensals
Comments	

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Sample ID	EX1811_D16_04B
Date (UTC)	20181116
Time (UTC)	171357
Depth (m)	433.331
Temp. (°C)	14.084
Field ID(s)	*Endoxocrinus* sp.
Commensals	No commensals
Comments	

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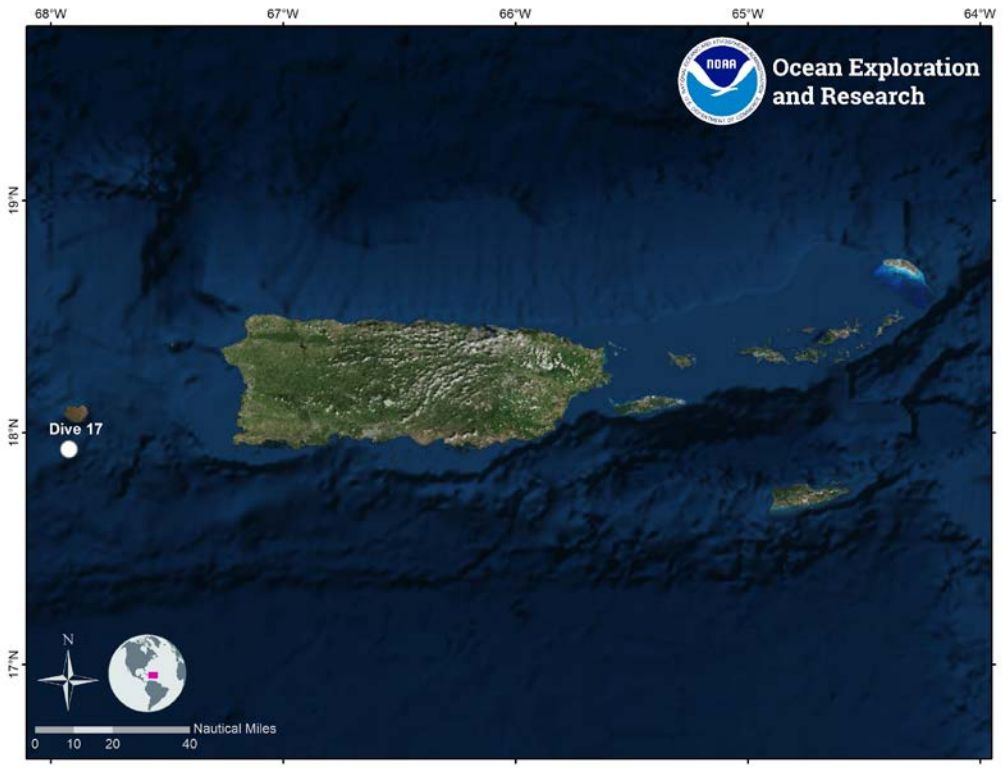
EX1811-Dive17 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Mona South Ridge		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE17		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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	During the dive one of the ship's generators overheated and went down. The ROVs were pulled off the bottom and held at 900 m until the ship generators came back online.
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-17T12:21:47.677710 17°, 56.903' N ; 67°, 53.447' W On Bottom: 2018-11-17T13:05:51.902217 17°, 56.865' N ; 67°, 53.387' W Off Bottom: 2018-11-17T17:14:29.559180 17°, 56.717' N ; 67°, 53.192' W Out Water: 2018-11-17T22:44:35.106375 17°, 56.466' N ; 67°, 52.623' W Dive duration: 10:22:47 Bottom Time: 4:8:37 Max. depth: 1212.0 m
Special Notes	N/A

Scientists Involved (provide name, affiliation, email)

Name	Affiliation	Email
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Tom Hourigan	NOAA/NMFS	tom.hourigan@noaa.gov
Tracey Sutton	Nova Southeastern University	tsutton1@nova.edu

Dive Purpose	This was a two-part dive, with the first part targeting seafloor habitats at 1,000-1,200 m depths south of Mona Island, and the second part including midwater transects at 300-900 m depths. The purpose of the first portion of the dive was exploratory with objectives to characterize seafloor communities, both hard and soft bottom. Hardbottom faunal communities, including coral and sponges, were expected on steeper-sloped terrain and on top of the ridge feature.
Dive Description	Arriving on bottom, we encountered a primarily sediment-dominated seafloor with a low-profile outcrop of FeMn-coated rock running approximately north to south. Attached organisms were commonly observed on rocky outcrops, including corals, sponges and echinoderms. The main substrate was soft, but we did arrive at a steep section of hard ground that was void of FeMn coating. Three species of fish were observed at this site. We saw two halosaurs, a grenadier (*Coryphaenoides* sp.) and *Bathytyphlops* sp. tripod fish. They were all located on soft sediment area. Deep-sea corals were very well represented at this site. We observed three species of black corals (*Trissopathes* sp., *Stichopathes* sp., *Parantipathes*-like sp., and an unknown, possible *Trissopathes* sp.). Among the Octocorallia we observed representatives from the Primnoidae, Plexauridae, Chrysogorgiidae, Isididae, and Coralliidae. Primnoids included *Candidella*

imbricata and *Candidella gigantea*. One plexaurid (*Paramuricea* sp.) was observed. A single bottlebrush morphology of *Chrysogorgia* sp. was observed with multiple crustacean associates. At least one, possibly two, *Corallium* species were observed on this dive, but colonies tended to be smaller than 10 cm. Of these, one colony was white (likely *Corallium niobe*), while the other had a pink wash or tone at the central portion of the axis. One stylasterid, *Crypthelia* sp., was observed to create numerous small colonies (<5 cm) on available hard substrate. The majority of the Antipatharia and Octocorallia were exclusively found on hard substrate. One bamboo coral, *Acanella* sp., was found to occur in exclusively soft sediment. Two occurences of predation by goniasterid stars (?*Circeaster* sp.) were found on this species of bamboo coral.
Scleractinians, while not diverse, were some of the most abundant corals observed on this dive. The two represented species were *Madrepora oculata* and *Javania* sp. cup corals. *M. oculata* was often sparsely branched and found to occur more in soft sediment than on hard bottom. Older exposed skeletal material was at times covered with FeMn crust and indicated additional rubble below the surface of the sediment. Hard surfaces produced by older *Madrepora* skeletal material was observed to be a significant source of hard substrate for attachment of larger coral colonies in the predominantly soft-bottom habitat.

There were a few stalked glass sponges (Hyalonematidae) on soft sediment slopes. Some of these stalked individuals had zoanthids covering the base. Euplectellids were the second most common sponges observed. One Euplectillid had about 6 shrimps inside the sponge. Farreid sponges were also found in this area, but took a yellow coloration that was not previously observed. There were also small sponges, possibly demosponges encrusting the FeMn-coated rocks. We observed a red cidarid urchin (*Histocidaris purpurata*) eating a carnivorous sponge (*Chondrocladia* sp.), which has not been previously observed on this expedition.

Sea cucumbers were commonly observed on soft sediments. There were at least two species of sea cucumbers observed on bottom. *Enypniastes eximia* was also seen hovering above the seafloor, and none were observed on the seafloor. We also saw small recruits of possible sea stars and sea urchins.

At 16:05 UTC vehicles were required to come off bottom to troubleshoot a generator issue. A call was made to hold at 900 m depth in the midwater until the issue could be resolved. At 16:56 UTC the issue was resolved and we proceeded to the midwater portion of the dive, which consisted of horizontal transects at 900, 700, 500, and 300 m. Midwater assemblages at this location were much more diverse than at the last midwater dive done at Mona Canyon (Dive 10). We observed a number of organisms, including ctenophores, radiolarians, shrimp, medusae, siphonophores, and fish. There were at least 200 annotations in SeaTubeV2 during the midwater portion of the dive. A time table of each transect in UTC time is shown below.

Depth (m)	Start time (UTC)	End time (UTC)	Length (h:min)
900	17:47	18:40	0:53
700	19:03	19:50	0:47
500	20:15	20:58	0:43
300	21:21	22:06	0:45

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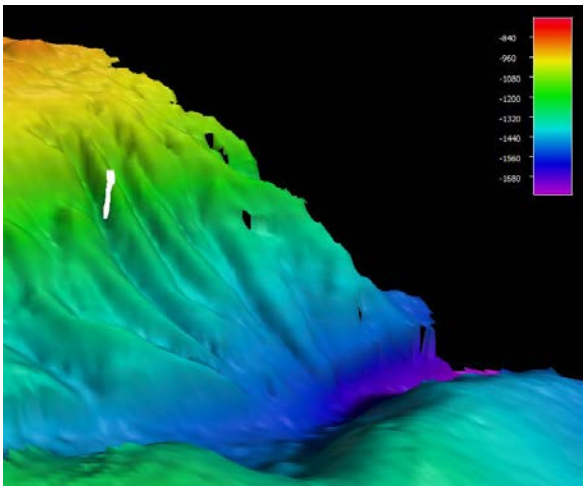
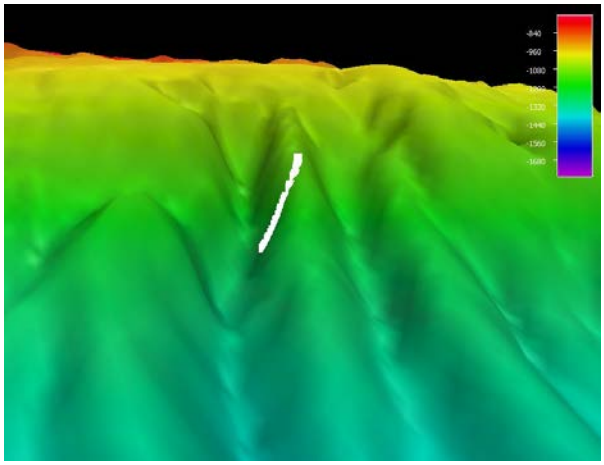
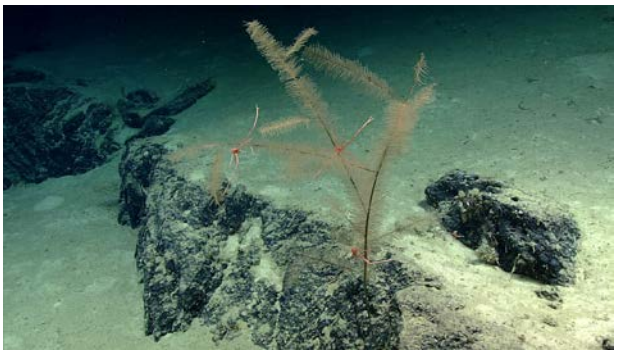
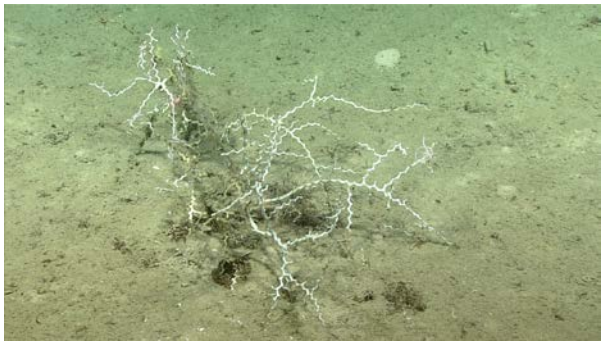
Notable Observations	Large black coral fans on rocky outcrops, echinoderm predation on sponges and corals. Excellent imagery of midwater plankton (particularly the radiolarians).
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	

Representative Photos of the Dive

	
Black corals (possibly *Trissopathes* sp.) were among the largest observed colonies attached to hard substrates.	Colonies of *Madrepora oculata* were commonly observed on soft sediment.

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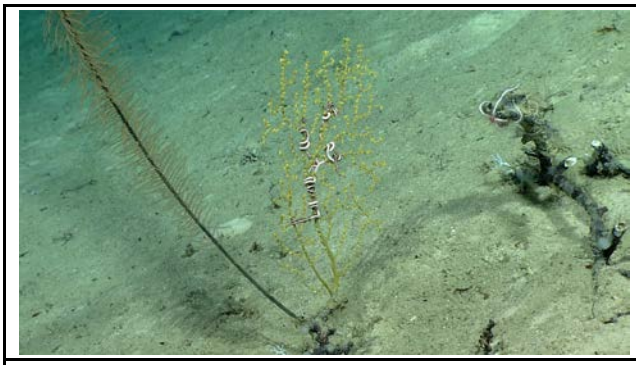


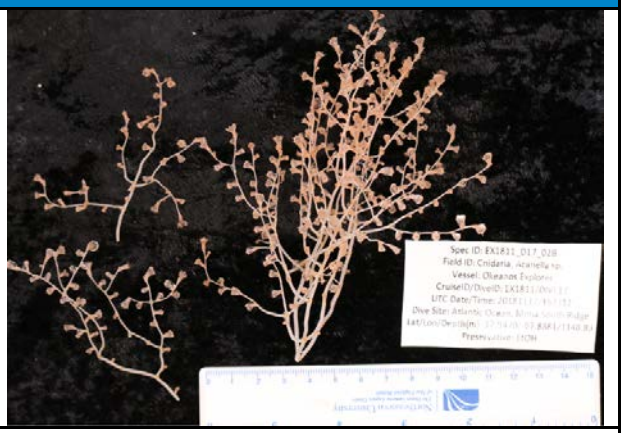
Using *Madrepora* skeleton as a hard attachment point, small octocoral and black coral colonies found habitable space that was often dominated by soft sediments.

Goniasterid sea stars were seen grazing on at least two bamboo coral colonies, both seen with extensive coral tissue loss.

Samples Collected

Sample ID	EX1811_D17_01B
Date (UTC)	20181117
Time (UTC)	140037
Depth (m)	1192.558
Temp. (°C)	4.896
Field ID(s)	Black Coral
Commensals	No commensals
Comments	

Sample ID	EX1811D17_02B
Date (UTC)	20181117
Time (UTC)	152212
Depth (m)	1148.829
Temp. (°C)	5.011
Field ID(s)	*Acanella* sp.



Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D17_02B_A01	Polychaeta	1

Comments

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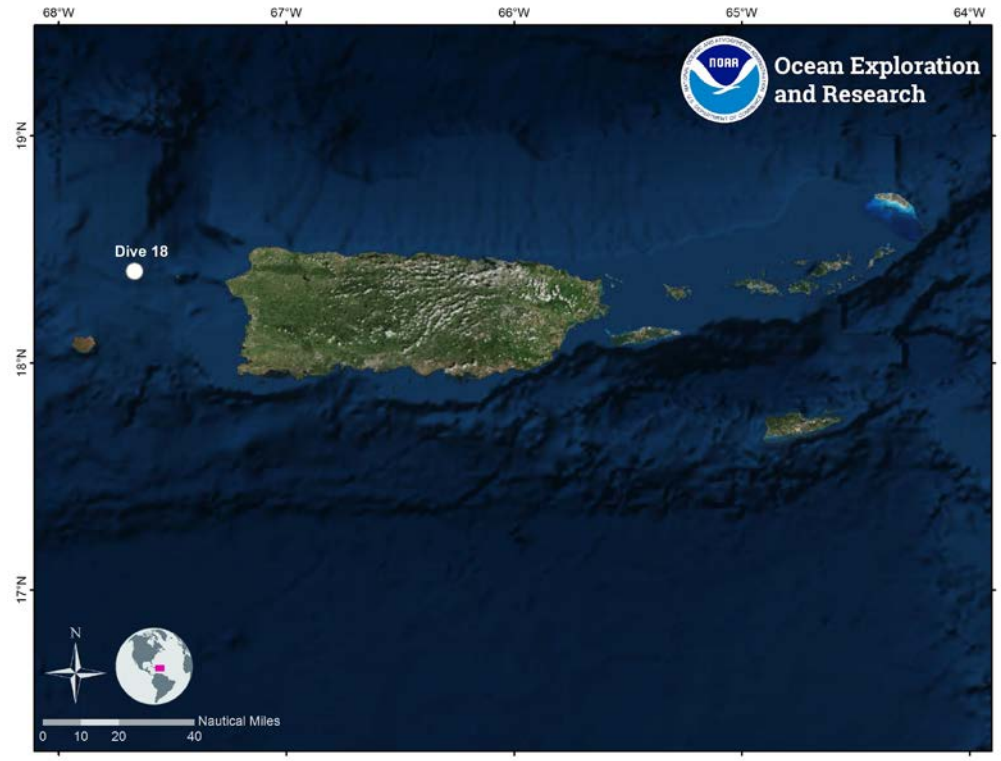
EX1811-Dive18 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Desecheo Ridge		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE18		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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	Midway through the dive, the ship had trouble holding station, and as a result the ROVs were temporarily pulled off the bottom until the ship could find a heading that allowed it to hold station. The ROVs were put back on bottom and the remainder of the dive went smoothly.
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-18T15:30:25.288562 18°, 23.809' N ; 67°, 39.368' W On Bottom: 2018-11-18T16:23:05.154552 18°, 23.818' N ; 67°, 39.301' W Off Bottom: 2018-11-18T20:08:44.496789 18°, 23.719' N ; 67°, 39.208' W Out Water: 2018-11-18T20:38:29.123218 18°, 23.609' N ; 67°, 39.255' W Dive duration: 5:8:3 Bottom Time: 3:45:39 Max. depth: 367.0 m
Special Notes	N/A

Scientists Involved (provide name, affiliation, email)

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Dive Purpose	This dive targeted potential habitats of deep-sea fish, including snappers and groupers. The depth profile and topography fell in the habitat preferences of commercially important deep-sea fishes as reported by the local fishing community. The dive also sought to characterize the habitats of deep-sea corals, sponges, and other demersal fish communities. Further, the dive targeted a range of different slope types to evaluate the influence of topography on deep-sea fish and benthic communities.

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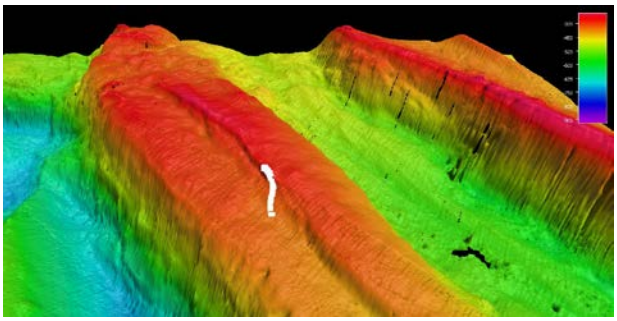
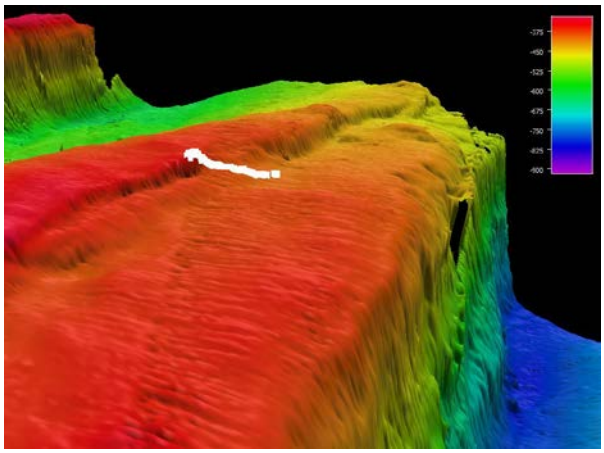
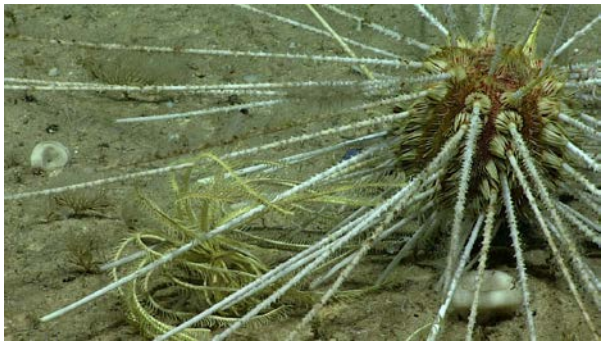
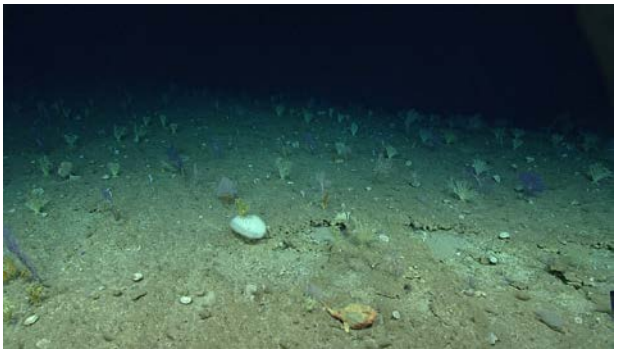
Dive Description	This dive began on a 350 m depth submarine ridge in the Mona Passage, due west of Desecheo Island. Soon after our initial touchdown on bottom, we had to pull the ROVs off bottom for a bit because *Sargassum* was clogging the ship's thrusters. There was a second descent and the ROV was on the bottom for about 1 ½ hours. The organisms in highest abundance on this ridge were crinoids, sponges, and branching octocorals. Deep-sea corals, in addition to being abundant, were more diverse than at other sites in this depth range. Antipatharians (*Stichopathes*, *Bathypathes* sp. , *Elatopathes* sp., *Stylopathes* sp.) and Primnoid octocorals (*Paracalyptrophora duplex*, *Acanthoprimnoa* sp., *Plumarella* sp., *Callogorgia* sp.) were the most species-rich taxa with four represented species for each group. *Chrysogorgia* colonies were common through the entire dive with many small black colonies seen on both sloped and flat hard bottom. The most dense deep-water coral communities occurred at the topographic high point of the ridge (~350 m), where we encountered an abundance of mixed-species assemblages, including two Plexaurids (*Paramuricea* sp. and cf. *Scleracis*?), *Acanthogorgia aspera*, *Nicella* sp., stylasterids, and cup coral species. The sponge cover was very high, especially on the edge and on top of the ridge. A foliose cream-colored sponge was the most common, and we secured a sample. We did see the other table-top forming sponge at this site. Encrusting sponges were common on the face of the ridge and on top. These encrusting species were usually small. Small brown bryozoans were extremely abundant on the top of the ridge crest. We also saw an anemone, slitshell gastropod, and *Heterocarpus* sp. shrimp. The fish richness was low, with only seven species identified. The most abundant fish on the dive was the queen snapper, *Etelis oculata*. There was one individual recorded right at the beginning of the dive at 367 m. We saw possibly six queens on the second decent, all larger than 25 cm in length. They were located at the base of the ridge like feature at 357 m. The other fish spotted on the dive were *Chaunax* sp., *Polylepion* sp., *Antigonia capros*, *Aulopus filametosus*, *Ositchtys trachypoma*, and an unknown smaller fish that looked like a wrasse and had distinct white line running dorsally. Ross Robertson later identified this fish as *Plectranthias garrupellus*. Fishing gear (line and weights) were widespread at this site. The fields of crinoids were very impressive. There were many *Crinometra* sp. along the edges of the ridge and on top. We collected one *Crinometra* sp. at the very end of the dive as it was considered characteristic of this site and needed for taxonomic Identification. There were a lot of *Endoxocrinus* sp., and the swimming crinoid, *Stylmetra spinifera*. We collected *S. spinifera* as an associate on a *Paracalyptrophora* sp. sea fan. Also, *Holopus rangii* were very common at this site. There were tiny sea stars at this site resembling *Linckia* sp. stars. There were quite a few cidarid urchins, *Stylocidaris sp.*, *Histocidaris* sp. and *Cidaris rugosa*. We saw a *Histocidaris* sp. eating a *Crinometra* sp. crinoid. It had it pinned down and was eating one of the arms, a new behavior observed in this species of urchin. There were also *Araeosoma* sp. pancake urchins on flat portions of the seabed.
Notable Observations	High-density, high-diversity coral community. Dense crinoid beds. Queen snapper aggregation at landing.
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ✓ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	
Representative Photos of the Dive	
	
Queen snapper were observed several times over the course of the dive track. Fishing gear and weights were also frequently observed here, often on rocky ledges and along the ridge crest among deep-water corals habitat.	An additional record of histocidarid urchin predation on crinoids, *Crinometra* sp., was observed at this site. In this instance, the urchin spines were observed to pin down the target from moving while grazing on the arm tips of the crinoid.
	
Deep-sea corals along the ridge crest occurred in high density and high diversity through the second half of the dive. These communities included primarily gorgonian octocorals and black corals.	Near the off-bottom point, dense beds of *Crinometra* sp. crinoids were observed. These were the dominant echinoderm species recorded at this site.

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Samples Collected

Sample ID	EX1811_D18_01B
Date (UTC)	20181118
Time (UTC)	190304
Depth (m)	352.053
Temp. (°C)	16.227
Field ID(s)	Porifera

Commensals	No commensals
Comments	

Sample ID	EX1811_D18_02B
Date (UTC)	20181118
Time (UTC)	191136
Depth (m)	352.066
Temp. (°C)	15.903
Field ID(s)	Primnoid

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D18_02B_A01	Squat lobster	1
EX1811_D18_02B_A02	Crinoid	1
EX1811_D18_02B_A03	Squat lobster	1

Comments	

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Sample ID	EX1811_D18_03B
Date (UTC)	20181118
Time (UTC)	200318
Depth (m)	349.076
Temp. (°C)	15.57
Field ID(s)	*Crinometra* sp.

Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D18_03B_A01	Brittle Star	1

Comments

EX1811-Dive19 Information			
General Location Map			
General Area Descriptor	U.S. Caribbean Sea		
Site Name	Mona Seamount		
Science Team Leads	Stacey Williams (ISER) Steven Auscavitch (Temple)		
Expedition Coordinator	Daniel Wagner (NOAA-OER)		
ROV Dive Supervisor	Chris Ritter (GFOE)		
Mapping Lead	Derek Sowers (NOAA-OER)		
ROV Dive Name			
Cruise	EX1811		
Dive Number	DIVE19		
Equipment Deployed			
ROV	*Deep Discoverer*		
Camera Platform	*Seirios*		
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

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Equipment Malfunctions	None
ROV Dive Summary Data (from processed ROV data)	In Water: 2018-11-19T12:23:42.510783 19°, 16.692' N ; 67°, 41.201' W On Bottom: 2018-11-19T15:20:26.233199 19°, 16.686' N ; 67°, 41.041' W Off Bottom: 2018-11-19T17:52:48.952520 19°, 16.759' N ; 67°, 41.039' W Out Water: 2018-11-19T20:45:51.230493 19°, 16.736' N ; 67°, 40.756' W Dive duration: 8:22:8 Bottom Time: 2:32:22 Max. depth: 4998.0 m
Special Notes	N/A
Scientists Involved (provide name, affiliation, email)	

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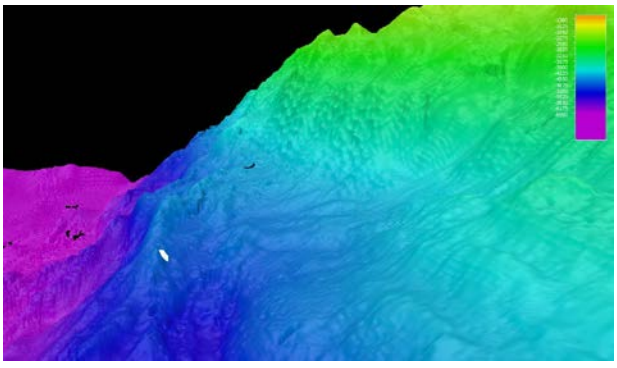
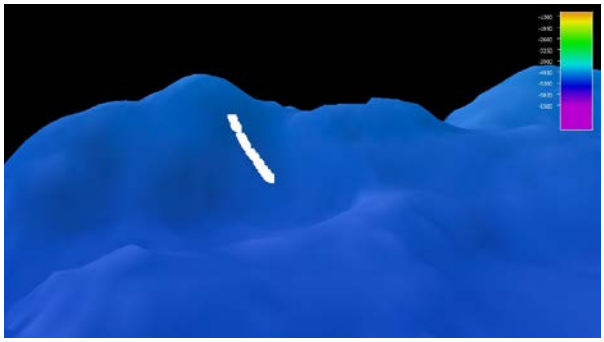
Dive Purpose	The purpose of the dive was exploratory with objectives to characterize seafloor faunal communities, both on hard and soft bottom habitats. Hardbottom faunal communities, including deep-sea coral and sponges, were anticipated on steep sloped terrain. The dive also sought to to identify deep-sea fishes, as well as the geology of Mona Seamount.

Dive Description	We began the dive on a flat area of a ridge on the north slope of Mona Seamount. Thick soft sediment dominated the first half hour of the dive with occasional patches of cobble and boulder sized rock. There were also several tracks of irregular sea urchins and other *lebensspuren*. Currents throughout the dive were slight and ran downslope. Despite the depth, significant rafts of *Sargassum*, blades of *Thalassia* seagrass, and wood material were commonly observed throughout both rocky and soft bottom on this dive. Rocky outcrops displayed linear features initially thought to be bedding planes. These layers ran in and N-S orientation upslope. Jason Chaytor (USGS) noted that these were very similar to limestone formations observed on the south side of Mona Seamount in previous expeditions. We followed these rocky outcrops to a depth of 4,922 m. Some rocky outcrops, typically composed of cracked angular rock, were observed to be relatively fresh surfaces. Their white-tan coloration contrasted the dark colored surrounding material encrusted with FeMn. Two coral species were present on this dive, one sea pen and one black coral. Two colonies of the same species of *Umbellula* sp. (with 4-polyp colonies) were observed in soft sediments and one individual of the black coral *Abyssopathes cf. lyra* was seen on cobble-sized boulders well-set into the sedimented slope. The latter colony was sampled for confirmation of identification. Three individuals of the ophidiform, *Leucicorus atlanticus* Nielsen, 1975, were observed, typically at the bottom of rocky terrain. We observed at least two species of sponges, both Cladorhizids. The first was tentatively identified as *Asbestopluma sp*., and the other, an unknown Cladorhizid, was sampled. Other invertebrates were surprisingly diverse and included Munnopsid isopods (cf. *Storthyngula* sp., one possibly carrying an egg mass), tube-dwelling and other anemones, polynoid worms, *Munidopsis* sp. squat lobsters, a stalked crinoids (*Discolocrinus iselini*), echiurans, a Rhodaliid siphonophore, and foraminifera (Xenophyphores and arborescent forams).
Notable Observations	Unknown cladorhizid sponge; *Abyssopathes* sp. black coral, few ophidiform fishes, striking rock outcroppings
Community Presence/ Absence (*community is defined as more than two species*)	✓ Corals and Sponges ❑ Chemosynthetic Community ❑ High biodiversity Community ❑ Active Seep or Vent ❑ Extinct Seep or Vent ❑ Hydrates

Overall Map of the ROV Dive Area	Close-up Map of Main Dive Site
	

Representative Photos of the Dive	
	
Ophidiform *Leucicorus atlanticus* was observed on three occasions drifting on the downslope side of rock outcrops. Two of these individuals were found to have distended guts suggesting recent feeding or carrying eggs.	Geological bedforms were observed over the steep rocky slope portion of the dive. These formations were often cracked and full of loose debris. Rock surfaces were often FeMn encrusted with exceptions where fresher surfaces were exposed.
	
One of the two species of coral observed on this dive, *Abyssopathes lyra*. This cosmopolitan genus is among the deepest-dwelling corals known to occur. Only one individual was encountered on this dive.	Cladorhizid sponges were the only poriferans present at this site. At least two species were observed. One of the most unusual forms, pictured here, was collected.

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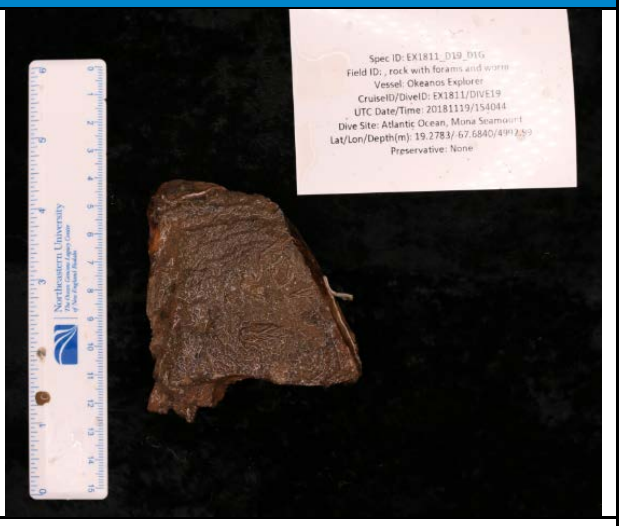
Samples Collected

Sample ID	EX1811_D19_01G
Date (UTC)	20181119
Time (UTC)	154044
Depth (m)	4992.988
Temp. (°C)	2.189
Field ID(s)	Rock with forams and worm



Commensals

Commensal Sample ID	Field Identification	Count
EX1811_D19_01G_A01	Serpulidae	1
EX1811_D19_01G_A02	Foramnifera	1

Comments

Sample ID	EX1811_D19_02B
Date (UTC)	20181119
Time (UTC)	164139
Depth (m)	4965.573
Temp. (°C)	2.232
Field ID(s)	*Abyssopathes lyra*

Commensals	No commensals
Comments	

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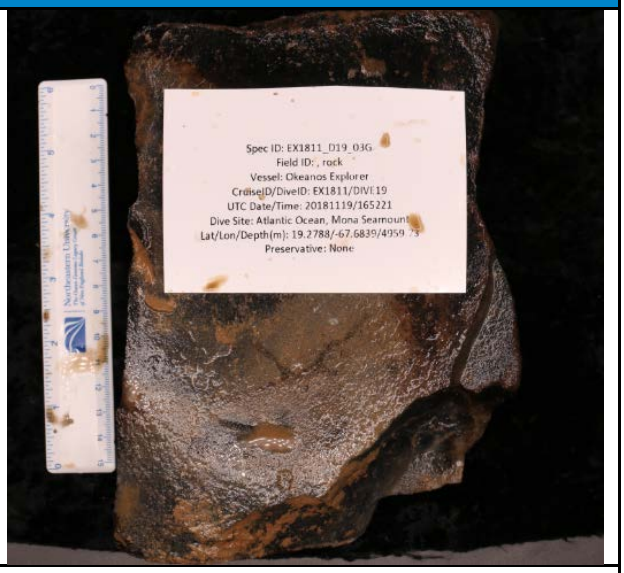
Sample ID	EX1811_D19_03G
Date (UTC)	20181119
Time (UTC)	165221
Depth (m)	4959.725
Temp. (°C)	2.23
Field ID(s)	Rock
Commensals	No commensals
Comments	



Sample ID	EX1811_D19_04B
Date (UTC)	20181119
Time (UTC)	173949
Depth (m)	4932.134
Temp. (°C)	2.227
Field ID(s)	Cladorhizidae
Commensals	No commensals
Comments