Illuminating pelagic and benthic biodiversity in deep waters off Puerto Rico

NF-22-02
NOAA Ship Nancy Foster, April 6 to 19 2022
NOAA Award NA21OAR0110202

Andrea Quattrini
Chief Scientist

Table of Contents

Cruise Overview

Chief Scientist:

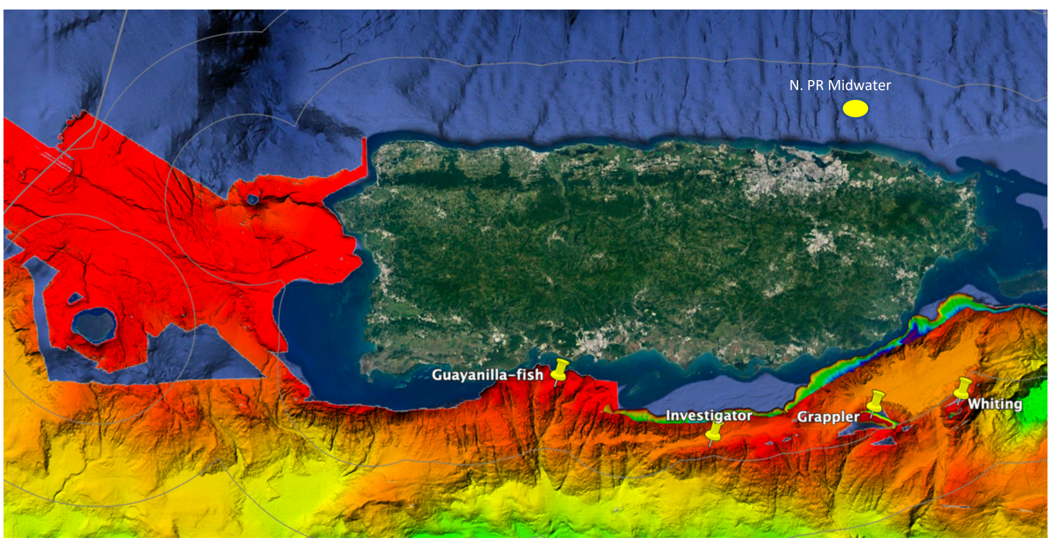
Andrea Quattrini
Research Zoologist and Curator of Corals
Smithsonian Institution National Museum of Natural History
10th and Constitution Ave NW
Washington DC, 20560
Email: quattrinia@si.edu
Twitter: quattrinia

Vessel:

NOAA Ship Nancy Foster
Cruise NF-22-02

Study Areas:

Southern coast of Puerto Rico in the Caribbean Sea, 17.785N, 65.673W, 200-2500 m depth; one dive was conducted in midwater north of San Juan.



Goals and Objectives:

We used a multidisciplinary approach to explore and characterize environmental and biological diversity across benthic habitats in deep waters off Puerto Rico in the U.S. EEZ.

Synopsis of Activities:

The expedition "Illuminating Biodiversity of Puerto Rico" set sail on 9 of April 2022 from San Juan Puerto Rico and returned to port on 19 April 2022. During the cruise we used the ROV *Global Explorer* (Oceaneering) and the CTD Rosette to survey midwater and benthic communities from 200-1300 m. This project was funded by NOAA-OER, NMFS, and

Smithsonian Women's Committee and consisted of a collaboration among the Smithsonian National Museum of Natural History, NOAA Systematics Lab, Temple University, University of Rhode Island, University of Puerto Rico Mayaguez, and Lehigh University.

The following activities were conducted:

1. Conducted 12 hr ROV ops to survey midwater and benthic communities, including canyons and banks, at 200-1300 m
2. Implemented new technologies for water sampling (modified McClane pump) and low-light camera on the ROV
3. Collected specimens via ROV slurp and manipulator and processed them in the wet lab for taxonomic and genetic purposes
4. Collected water samples via niskins on the ROV and CTD Rosette and filtered the water at sea for eDNA
5. Collected and processed push cores from ROV for diversity and eDNA analyses
6. Conducted CTD Rosette operations to gather environmental data
7. Conducted multibeam mapping surveys to help fill in holidays and remap areas in higher resolution
8. Conducted education and outreach via live 30 min Q and A interactions with EcoExploratorio
9. Posted content in English and Spanish to Ocean Explorer Website
10. Reached 100s of people through social media
11. Trained students and mentees at sea

Description of Operations

Participant List:

Name (Last, First)	Role on Cruise	Affiliation	Position
Bertramson, Jim	ROV Team	Oceaneering	ROV Pilot
Branco Castello, Cristiana	Scientist	NMNH	Postdoctoral Researcher
Collins, Allen	Scientist	NOAA Systematics Lab	Director
Cordes, Erik	Co-Chief Sci	Temple	Professor
Evanson, Madeline	Scientist	Temple	Post Bac Researcher
Guzman, Hector	ROV Survey Team	Oceaneering	ROV Survey Tech
Orozco-Juarbe, Jose	Scientist	Univ. PR Mayaguez	Masters Student

Lienesch, Anna	Data Manager	NOAA	Oceanography Faculty Specialist
Mallein, Jack	ROV Team	Oceaneering	ROV Technician
McCartin, Luke	Scientist	Lehigh	PhD Student
Quattrini, Andrea	Chief Sci	NMNH	Research Zoologist
Shomberg, Russel	Scientist	URI	PhD Student
Tripp, Jason	ROV Team	Oceaneering	ROV Supervisor
White, Jason	ROV Team	UNC Wilmington	ROV Pilot

Daily Summaries:

April 5

Arrived at the ship at 1400 UTC for COVID tests. All science and ROV crew arrived throughout the day; all tested negative with a RAPID antigen test. ROV began mobilization around 1600 UTC. Met with Ops Officer. Jason Tripp of Oceaneering is confident in getting ROV mobilization mostly completed today.

April 6

COVID tests were given at 0700-0800 ET. ROV continues mobilization. One of the ROV crew tested positive for COVID and has moved off the vessel and is now in quarantine. One ship's engineer tested inconclusive 3X. Waiting on a PCR confirmation test for the engineer.

Connection with EcoExploratorio. Jose Orozco and I spoke with 15 people from EcoExploratorio about deep-sea corals, bioluminescence, deepwater ecosystems off Puerto Rico.

April 7

Continuing to stay in port as we await results of covid test of ships engineer. Oceaneering will be hiring Jason White (UNCW) as an extra ROV pilot until Oceaneering's ROV crew can come back onboard.

April 8

Safety meeting in the morning at 745. Conducted ROV ballast test. All successful. Routed HDMI cable to feed video into wet and dry labs. Everyone covid tested; two positive covid tests on the rapid molecular test. One of our science crew positive and has had to leave and quarantine.

April 9

Ship's crew prepared for departure and at 0900 pulled away from dock. We transited 15 nautical miles to first station north of Puerto Rico. Planning for midwater dive-North Puerto Rico Midwater. On station at 1700 UTC. ROV in water at 1725 UTC. Dive plan is to dive 100 m above the Deep Scattering Layer (DSL), in the DSL, and 100 m below. The DSL is currently ~550 m (530-580 m) and the bottom depth is 1545. Bottom is flat here, but dive area was chosen as corals were collected here by R/V Pillsbury. A live interaction was conducted with EcoExploratorio at 1800 UTC. Jose Orozco and I answered questions live from about 20 audience members, including students K-12.

Dive GEX-22-01
Site: North Puerto Rico Midwater
Dive target: 18.664000N, -65.966500W
Bottom depth: 1550 m
ROV in water: 18 39.9266°N, 65 57.977°5
Depth Range: 475-900 m
Temperature Range: NA

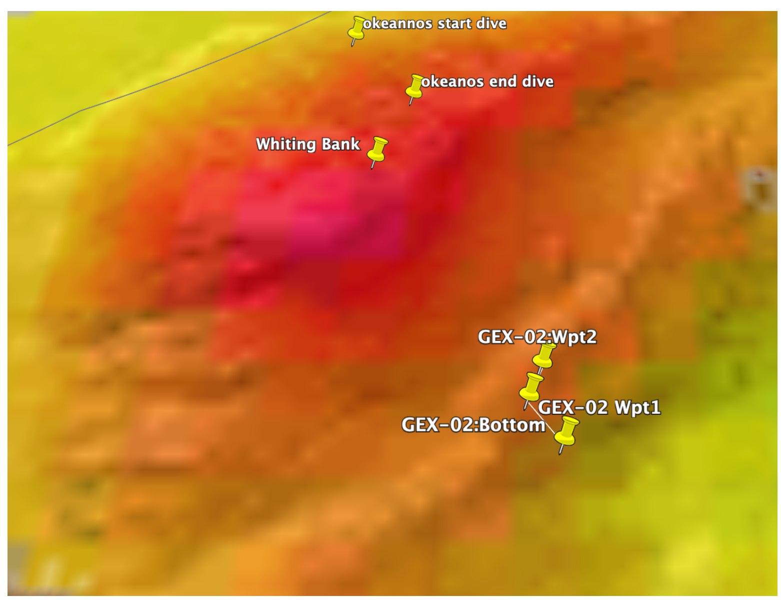
The ROV was deployed at 1726 UTC and reached depth of first transect, 475 m, at 1750 UTC. After some discussion with bridge regarding desired velocity and bearing, the first niskin (N1) was fired for eDNA collection (1804) and the first transect commenced (1807). The ship was moving at 0.2 knots and the ROV was moving quickly through the water column, making it difficult to easily view zooplankton. The ROV tried various strategies, involving going into the current and then dead throttling and drifting. The ability to make out organisms was not great but siphonophores, chaetognaths, a fast moving medusa (potentially a box jelly), and sergestid shrimp were observed. No collections were made by the time the first transect concluded (1837) and the second niskin (N2) was fired. In an attempt to deal with velocity of ROV through the water column, the ship stopped as the ROV descended to 575 m in the heart of the DSL. Niskins were fired at the start and end of a roughly 60 minute transect (N3 at 1849; N6 at 1951). The McLane pump was set to pass 15 l through a filter for eDNA at a 250 ml/minute, which was completed at the end of the transect. A very large siphonophore (likely the physonect *Apolemia*) was encountered during the transect, as were numerous *Cyclothone* (perhaps other species, but small and difficult to see any detail), a cydippid comb jelly, and another siphonophore. Visibility remained a challenge; current was coming from the southwest and it was again a challenge to balance the velocity of ROV through the water column. During this transect, the low light camera was tested between 1927 and 1940. ROV lights were turned off (other than the aft light), Iris and gain were adjusted, and bioluminescence was observed on two occasions. It proved not possible to adjust the low light camera light settings (stayed at 10%). We changed plans and decided to go deeper for the final transect to assess whether visibility would be better at 900 m and another attempt to adjust bearings to best capture images of zooplankton. Transect 3 at 900 m started and ended with Niskin firings (N7 and N8). Visibility and velocity control continued to be challenging, but several foraminifera and a pelagic polychaete were viewed and the low light camera was tested again. We were not able to control the light associated with the low light camera and no bioluminescence was observed. ROV was recovered at 2929 UTC.

April 10

Transited to Whiting Bank on the southeast side of the island. Arrived at 0800 UTC and began multibeam mapping. We filled in holidays and ran a line at the target dive site, a ridge part of Whiting Bank. Safety meeting at 1145 UTC. At 1000 UTC Noticed on the EK60 (split beam) that the DSL was at the surface, but there was still a persistent band at 575 m. At 1230 UTC noticed the DSL band at the surface was gone and the 575 m DSL was thicker than in the early morning.

Continued problems with the survey tracking on the ROV and clump weight. Diving without tracking of the ROV. ROV tracking came on mid dive through help of the ET onboard.

We moved the lights for the lowlight camera before the dive as there are no comms to the lowlight camera lights. Comms to McLane pump working well, and we pumped water throughout the dive, stopping when we sampled and kicked up sediment.



Dive GEX-22-02
Site: Whiting Bank Ridge
Dive target: 17.780518 N, -65.67020W;
Bottom target depth: 1230 m
ROV in water: 18 39.9266°N, 65 57.977°5
Depth Range: 1246-920 m
Temperature Range: 4.5-5.9 °C

The ROV was in the water at 1225 UTC. Upon launch, the ROV hit the side of the ship and one of the niskins was damaged and subsequently lost. A few 100 m down, oceaneering survey alerted that the ROV was not tracking. The ROV team wasn't alerted until the ROV was at 1000 m. Because survey was tracking the clump weight, we proceeded down to a target depth of 1230 m. We landed on bottom at 1326 UTC at a depth of 1243 m. We landed on a relatively steep (30deg) highly-sedimented slope with cobbles and rock outcrops. *Stichopathes (or Aphanostichopathes)* were observed on small outcrops. After we slurped an orange *Stichopathes* colony and rotated the chambers, the chamber jammed and was not operational for the rest of the dive. A large *Saccocalyx*-like (stalked glass sponge of the family Bolosominae) was observed and collected. During collection, an associated polychaete living within the sponge swam away. We continued up slope, slowly, where <10% small rocks covered the bottom. macrourid rattails, cusk eels, halosaurs were common. A dark red cydippid ctenophore was observed – we were able to get great video with HD and lowlight camera of the ctenophore with some persistence over about a 10 minute interval, during which the McLane pump was operating. Red urchins, *Phormosoma placenta,* were common at 1000-1200 m depth. As we moved upslope, we began to see larger outcrops that were more extensive. Bamboo corals (2-3 species) were often observed, but were not common. Several species of sponges dominated the substrate, including several small encrusting forms. Two individuals of predatory tunicate (family Octacnemidae) were observed. We attempted to collect one but it was too large ~15 cm across to fit within a quiver. Without the Biobox on the ROV, collection was abandoned, leaving this family without any specimen records from the entire Caribbean basin. Further upslope, we continued to see larger, more extensive rock outcrops, but most were covered in sediment. Overall, sessile fauna was sparse. Impression was that there was plenty of habitat but not a lot of sessile fauna. Currents were relatively weak at this site and not a lot of particulates in the water column. We approached a depth of 919 m and recovered.

We collected two hexactinellid sponges (*Saccocalyx* or similar *and Hyalonema*), an unknown colonial tunicate, *Stichopathes, Iridogorgia,* and a bamboo coral during the dive. Fishes were diverse but not abundant, and included *Dicrolene, Nezumia, Bathypterois, ?Coloconger, Diplacanthopoma,* and *Aldrovandia.* Amongst the outcrops on the sediments, *Phormosoma* sea urchins and at least 3-4 species of holothurians were observed. A few different shrimp species were common.

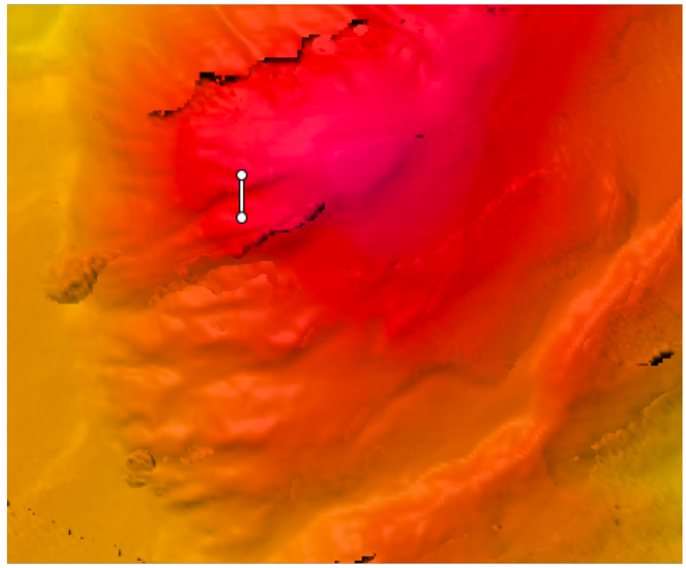
Overall, a successful dive with new discoveries, despite presenting challenges.

CTD cast occurred down to 1200 m and 12 niskins were popped (in sets of 3: 10 m off bottom, 20 m off bottom, 914 m, 555 m, 450 m). DSL was seen at 450-555 m. We noted that the DSL started to separate at dusk as part of it was coming to the surface. All niskins were filtered for eDNA and small samples were taken for pH, salinity, DO, and temperature.

April 11

ROV team worked late in the night swapping out the lowlight camera for the 4K. Dive was delayed in morning due to finalizing some things on the ROV. McLane pump was not put on the ROV because it was on the same channel as 4K. This should be resolved for tomorrow's dive. ROV was deployed at 1325 UTC. It stayed at the surface to check ballast, and came back on deck to fix issue. It was deployed and back in the water at 1356 UTC. It was noted that the ROV clump weight was not tracking bottom.

Dive: GEX-22-03
Site: Whiting Bank
Dive target: 17 48.4350° N, 65 42.8889° W
Bottom Target Depth: 525 m
Wpt1: 17° 48.625'N, 65° 42.908'W, 435 m,
Wpt2: 17° 48.598'N, 65° 42.761'W, 400 m,
Wpt3: 17° 48.674'N, 65° 42.526'W, 275 m,
Wpt4: 17° 48.731'N, 65° 42.331'W, 198 m
Depth Range: 535-310 m
Temperature Range: 11.7-17.8 °C



The top of Whiting bank is known to be a fishing spot for snappers. The goal of the dive was to transit across a ridge at ~500 m, and then work up the ridge to a depth of 200 m. The ROV was on bottom at 1446 UTC and 535 m depth. The ROV landed on a mostly sand bottom, with several cidaroid sea urchins and xenophyophores and occasional outcrops and boulders. Boulders had attached fauna, mostly large flat trumpet-shaped glass sponges (Euretidae) and actiniarian anemones. AT 1510 UTC, the rock bottom was more extensive. Periodically, the ROV had to check its clump weight as it was not tracking bottom. At 1530 UTC, ROV was back on bottom with rock outcrops and boulders covered in hexactinellid, lithistid and other encrusting demosponges. A few fishes and black corals were observed. As the ROV transited, there were patches of sand between rock patches which often contained several urchins, including cidaroids and spatangoids. Rock faces were covered in sponges, generally of two conspicuous species, *Corallistes* and a species in the family Euretidae. A few euretids were colonized by small zoanthids. This sponge had an unusual, ragged form compared to others hinting at the possibility that the zoanthids were interfering with normal growth of the sponge, or perhaps that injury to the sponge allowed for zoanthid colonization. At 1811 UTC we reached a large rock wall and it was noted that these rocks had several striations coming from the east. For the rest of the dive, we tracked the rock ridge and noted a diversity of sessile fauna. Octocorals became more diverse <350 m. Isolated thickets of colonial scleractinians (*Madracis*) were observed at 337 m and again on the top of the ridge at ~310 m. Dive ended at 2045 UTC from a depth of 300 m.

Overall, this area was quite diverse with steep topography and a diversity of sessile fauna. Corals were diverse along dive track, with several octocorals, black corals, and scleractinian species, including: *Madracis, Bathypathes, ?Stauropathes, Scleracis,* Ellisellidae, and *Chrysogorgiiidae.* Sponges were quite abundant throughout the dive, and there were several different anemone species, including a potential *?Telemactis and Liponema.* Fishes were relatively uncommon, however, *Epigonus, Ostichthys* were often seen under ledges. When we reached ~300 m, we began to see silk snappers (*Lutjanus vivanus), Scorpaena* scorpionfishes, and *Antigonia* boarfishes.

Fishing line was observed on the top of the ridge hung up in *Madracis* colonies. Pieces of coral were broken off and damaged, seemingly from the line. We also observed fishing line at a depth of ~400 m. Line was wrapped around a black coral (?*Stauropathes*) colony that measured ~80 cm tall and 70 cm wide. Parts of the colony were damaged from the line, with some portions having been colonized by hydroids and other opportunistic encrusters.

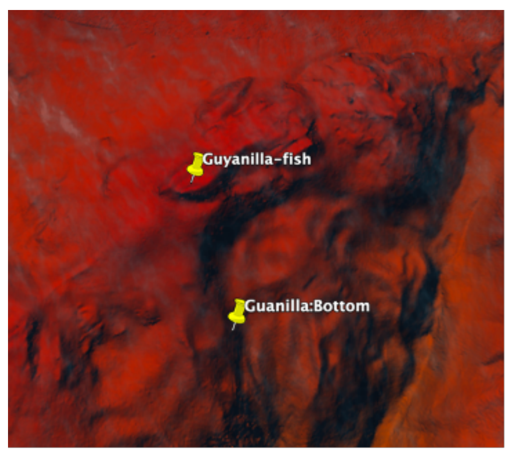
CTD cast occurred down to 1200 m and 12 niskins were popped (3 each depth: 515 m, 420 m, 330 m, 75 m) . Depths corresponded to the niskin samples taken during the ROV and the last depth corresponded to the peak of Whiting bank. We were positioned to the south of the ridge we dove on earlier, as current was moving to the south. All niskins were filtered for eDNA and small samples were taken for pH, salinity, DO, and temperature.

Sample processing went relatively smoothly and took ~4 hours to complete. We noted that the zoanthids that colonized a Euretidae glass sponge turned the ethanol hot pink upon preservation. Several hours later, the ethanol changed to a pale orange color.

Multibeam mapping overnight. We mapped a portion of Grappler Seamount and then transited to the east branch of Guayanilla canyon and ran a line over a potential fault.

April 12

We headed into Ponce harbor to pick up/drop off ROV pilots. Transfer commenced at 0830 with relative ease. We headed back to station, to the head of Guayanilla canyon at a site where fishers fish for snapper. Site location was a target of the Caribbean Fishery Management Council. We noted that the current was moving North-Northwest



Dive: GEX-22-04
Site: Guayanilla Canyon
Dive target: 17° 53.772'N, 66° 43.080'W
Bottom Target Depth: 610 m
Wpt1: 17° 54.288'N, 66° 43.325'W, 410 m
Depth Range: 663-340 m
Temperature Range: 9.2-17.3 dC

The ROV dive began and then aborted due to the carousel not working appropriately. It was fixed and redeployed. ROV landed on bottom at 1600 UTC, 663 m. Bottom was muddy, with several burrows likely from shrimps and other crustaceans. We took one push core at the bottom and the control for the 4K camera broke. Notably, there were several midwater fishes on the bottom; *Chauliodus* was particularly abundant. We continued to move up slope and observed a *Bathynomus* isopod. Benthic fishes over the soft sediment included tripod fish (*Bathypterois bigelowi),* Beardfish (*Polymixia* spp.), and hagfish (?*Eptatrerus).* At 1708 UTC, scattered rocks were observed, and it was noted that a lot of particulate matter was near bottom. A second push core was taken at 1725 and 612 m depth. We continued upslope, which was getting steeper rising 40deg. *Aldrovandia* halosaurs were abundant and synaphobranchid cutthroat eels were common. At 1744 UTC, the slope was mostly rock covered with sediment. Despite the hard substrate, relatively little sessile fauna was observed. However, we did observe ophiuroid brittle stars, including the collection of one (tentatively identified as *Amphiophiura metabula*), several white tube anemones (?*Cerianthiopsis*), and *Aereosoma* urchins were common. Sponges were observed on rocks at ~1820 UTC and 580m; one was observed with a catshark egg case (hatched recently). We collected one of the glass sponges and later recovered several associates (shrimp, amphipods and isopods) living within its body. At 1839 UTC, the bottom flattened again with soft sediment. AT 2002 UTC, marine debris was observed: a sack labeled "cabbage" that was home to several glass sponges. One of the glass sponges (collected for later morphological and genetic characterization) had attained a width of over 10 cm since it had colonized the sack, suggesting a relatively fast rate of growth. A *Neobythites unicolor* fish was also observed, hiding in the bag. We continued on and at 2027 UTC and started observing small scattered rocks with small attached corals (stylasterids), octocorals (*Scleracis)* and sponges (lithistids). At 2100, the bottom became mostly hard pavement covered in a thin veneer of sand. At 375-350 m depth, corals were more diverse, with large whip corals (Ellisellidae), chrysogorgiids, plexaurids, corallids, scleracids, cup corals, black corals, and a small colonial form of scleractinian (*Phyllangia pequegnatae* Cairns, 2000). One chrysogorgiid colony was collected along with a *Uroptychus* squat lobster living within its branches. An unidentified ?*Allopathes* was observed that measured 1 m X 2 m tall. This individual had a very interesting branching pattern, and some branches curled at the ends-reminiscent of *Aphanostichopathes.* A small vase-shaped glass sponge was observed and collected. Near the end of the dive, we noted a school of fish (mackerel). ROV was recovered at 2223

We mapped the heads of Guayanilla Canyon overnight to look for potential signs of earthquake activity that occurred in late 2019 through early 2020.

April 13

We arrived on station at 1100 UTC. We chose a site along a fault line at the head of an eastern branch in Guayanilla Canyon. At 01230 UTC we reassessed the weather and the wind speed came up to 25 sustained winds. We then headed back to the site from 12 April 2022 as it was inshore and seemed to be in a more protected area that perhaps was less windy. We reassessed and determined that it was indeed deployable conditions. The ROV went in the water at 1030. At 200 m, the ROV supervisor noted smoke coming from the transformer outside of the ROV control van and recovered immediately. Upon inspection, it was determined that a wire was damaged and causing the insulation to smolder. After this issue was fixed, it was determined that the conditions were not safe for deployment, with 25 knot sustained winds and gusts up to 28 knots.

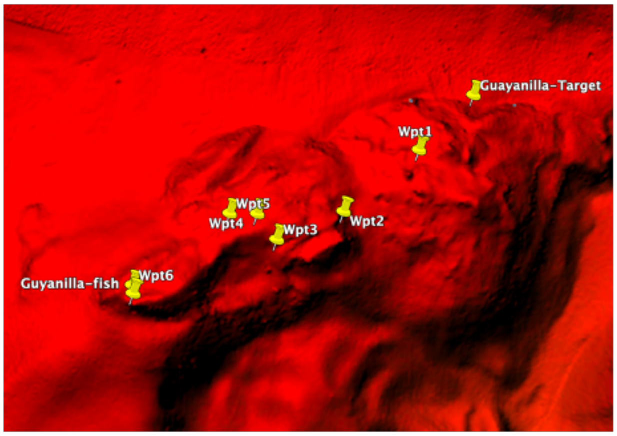
CTD operations began at 1800 UTC. First CTD cast at the top of the feature where we ended dive GEX-22-04. Three niskins were popped at 330 m and at 75 m. A second CTD cast was 1 km southeast of the dive site, down to a depth of 600 m. Niskins were popped at: 3 near bottom, 3 at 415 m in the DSL, 3 more at 335m , and 3 at 75 m depth.

We mapped the western branches of Guyanilla Canyon overnight to look for impacts from the 2019-2020 earthquakes. We mapped a total of 47 nm2 of the Guayanilla canyon region.

April 14

We arrived on station at 1100 UTC at the fishing area on the head of Guyanilla Canyon. Winds were blowing 15 knots from the north-east-east and currents were westerly at 0.2 knots. We launched the ROV at 1215 UTC, and it was noticed that the slurp carousel was not working. We recovered, fixed the issue, and re-deployed the ROV.

Dive: GEX-22-05
Site: Guayanilla Canyon
Dive target: 17° 54.910'N, 66° 42.243'W
Bottom Target Depth: 520 -340 m
Wpt1: 17° 54.734'N, 66° 42.421'W
Wpt2: 17° 54.540'N, 66° 42.663'W
Wpt3: 17° 54.453'N, 66° 42.875'W
Wpt4: 17° 54.533'N, 66° 42.939'W
Wpt5: 17° 54.534'N, 66° 43.028'W
Wpt6: 17° 54.313'N, 66° 43.329'W
Depth Range: 523-422 m
Temperature Range: 12.0-13.8 °C



We landed on the seafloor at 1349 UTC at 523 m depth. Bottom was mostly mud with scattered rock debris and boulders. Stalked crinoids (one species) were common. A few fish were observed, including *Polymixia* and *Synagrops bellus.* Rocks had encrusting sponges, tunicates, and often abundant small coral recruits. *Pseudoanthomastus* was also observed. At 1453 UTC, the ROV began to transit west and a large rock outcrop/ledge was observed. Several large glass sponges, *Dactylocalyx,* were observed along with several coral recruits. A large *Parantipathes* black coral was observed with squat lobsters and ophiuroids. AT 1547 UTC we began moving over pavement with a thin veneer of sediment. AT 1600 UTC, we began to go down slope from 480 to 492 m and the clump weight was often too high and pulled the ROV off bottom, slowing progress. AT 1626 UTC we were back on bottom and took a push core; we noted that we could get 6 inches into sediment. At 1744 UTC we started going up slope again ~25 deg rise and at 1759 UTC and 500 m the ROV was over hard pavement again. AT 1805 UTC we started to observe small, scattered rocks colonized by larger organisms, including a large *Callogorgia* colony with several brittle stars in genera *Ophiacanthus, Asteroschema, Asterogomphus.* At 1843 UTC the ROV came across a large, ascending rock outcrop with tall ledges and walls. These steep outcrops (limestone with mg crusts) were covered with sponges, stylasterids, tunicates, and small corals that appeared to be *Callogorgia* recruits. AT 1916 UTC we popped two niskins for environmental DNA collection. AT 1921 UTC there was a steep slope with boulders topped with a coral garden of young recruits. At this time, and at 454 m depth, we observed a lot of line, likely from drop anchors or fishing pots. AT 1928 UTC we continued up slope over rock outcrops that were in a stepped configuration. We observed white gorgonocephalid basket stars on a ledge, as well as occasional octocoral colonies. Fishing line was observed again. Whereas the basket stars had positioned themselves above the line, coral colonies were sometimes observed to be draped with line but otherwise appeared healthy. At the end of the dive, we observed and attempted to collect a *Holopus* crinoid. The arm malfunctioned, preventing collection, so we recovered the ROV at 422 m and 2014 UTC.

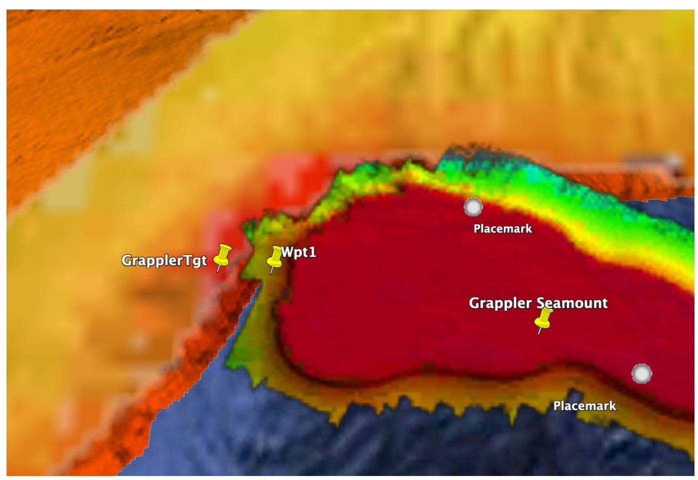
The most common sessile fauna observed across dive included stalked crinoids, *Dactylocalyx, Parantipathes,* and *Acanthogorgia.* One large *Callogorgia* was observed. In patches, we observed cidaroid (C. blakei), echinothuroid, and spatangoid urchins. Fishes observed included *Bembrops, Symphurus* and *Parazen*. *Benthocometes* was consistently observed in close association with large coral colonies and at times sponges. The rarely observed *Hollardia* was seen as well as one *Galeus* catshark. Occasionally, *Xenophora* carrier shells were seen on soft sediments. McClane pump was run throughout most of the dive and a few push cores were taken along with several samples.

Overnight we mapped and filled in holidays along Investigator Canyon and Grappler Bank.

April 15

We arrived on station at 1100 UTC, on the western edge of Grappler Bank (17° 48.447'N, 65° 57.502'W). This bank is a known deepwater fishing area. We deployed the ROV at 1245 UTC and arrived on bottom at 1327 UTC. When we landed on bottom at 1327 UTC, the port thrusters stopped working. We immediately began recovery of ROV at 1337 UTC; it was back on deck at 1447 UTC. As it was being recovered, the ship took a roll that came from a different direction and the ROV banged against the side of the ship. This caused the frame to bend and break in multiple places. No additional dives were possible today.

We put a CTD in the water at 1454, 1 km west-southwest of the bottom target dive site at Grappler, as this was the predominant current direction. We are popping 3 niskins: 660 m, 400 m, 200 m, 75 m.



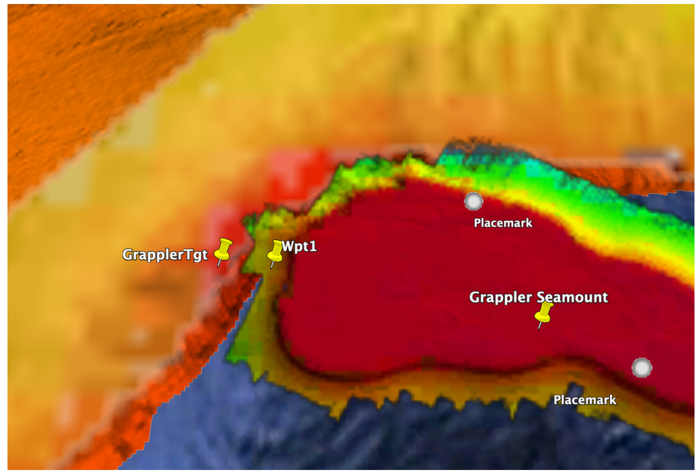
Dive: GEX-22-06
Site: Grappler Bank
Dive target: 17° 48.447'N, 65° 57.502'W
Bottom Target Depth: 700-200 m
Wpt1: 17° 48.434'N, 65° 57.115'W

Overnight, the top of Grappler Bank was mapped in high resolution (16 m).

April 16

We arrived at station at 1100 UTC. We are attempting to dive again at Grappler Seamount, where dive 06 was to take place. It is noted that winds are from the east at 15-20 knots, and there is a slightly stronger surface current at 0.6 knots to the west-southwest.

Dive: GEX-22-07
Site: Grappler Bank
Dive target: 17° 48.447'N, 65° 57.502'W
Bottom Target Depth: 700-200 m
Wpt1: 17° 48.434'N, 65° 57.115'W
Depth Range: 660-210 m
Temperature Range: 9.5-19. °C



ROV was deployed and on bottom at 1309 UTC, 610 m. The ROV then transited to a bottom depth of 660m, moving over pavement with a thin veneer of sand and occasional attached sponges and possible black corals (Small, "stick" morphology). We then moved over soft sediment and attempted a push core, but it was unsuccessful due to the sediment properties. We then moved to a rock outcrop and sampled a *Holopus* crinoid (not present in biobox upon recovery). The ROV was then pulled off bottom as a squall came through. ROV was back on bottom on the same rock feature and made some collections (mostly sponges). AT 620 m depth, bottom temp was 9.5degC. At 1413 UTC, the ROV began to move up slope, over a rock-pavement bottom covered in sessile fauna. The McClane pump was turned on at 1425 UTC. AT1445 UTC we observed several cerianthids as well as many small rosellid glass sponges in the sediment. AT 1452 we came across a large crack in the rock outcrop, with corals, sponges growing on the wall and several carrier crabs along the edge of the crack. At 1506 UTC and 567 m, we came across a large vertical rock wall, again with several sessile organisms including sponges, stylasterid corals, and small white octocorals. In sandy patches, we began to see several bushy bryozoans in the genus *Cornucopina* (likely *C. antillea*, which was described from Puerto Rico and not encountered since the early 1900s). In general, the ROV moved across patches of sediment and hardbottom, with some large outcrops and vertical walls. Deeper (600-500 m), sponges, especially encrusting and lithistid demosponges and hexactinellid glass sponges (including vase-shaped euplectellids; two collected, each with commensal shrimp associates and colonized by hydroids) were seemingly more diverse and then at ~450 m, coral diversity increased. Stalked crinoids were common throughout the dive likely 2-3 different species, as were urchins (especially in the sandy areas). We also observed several coral genera throughout the dive, including Keratoisididae, *Paramuricea, Chrysogorgia, Callogorgia, Acanthoprimnoa, Ellisella, Acanthogorgia,* ?Hemicorallium, *Heteropathes, Stylopathes, Bathypathes,* and *Parantipathes.* Larger coral colonies were consistently associated with squat lobsters and brittle stars. At 1749 UTC, it was noted that all the corals were facing northeast, almost laying down from the current in the area. Fishes were rarely observed, but included *Chlorophthalmus agassizi, Hoplostethus occidentalis, Symphurus, and* an unidentified eel. Near the end of the dive, we lost hydraulics and the manipulator arm was inoperable. We conducted video transects for the last hour of the dive, and reached near the top of the feature at 200 m. Notably, coral rubble and cobbles were observed in large patches near the end of the dive, suggestive of live coral growth on top of Grappler. At 1950 UTC and approx. 220 m, we observed red algae, a telltale sign of the photic zone. We recovered the ROV at 210 m, and transected in the midwater where we captured imagery of a pteropod.

Overnight we finished mapping the top of Grappler Bank at 2 m resolution.

April 17

The ship transited to Investigator Block and arrived on station at 1100 UTC. The conditions were assessed, and it was determined that it was too rough to dive (6 ft confused seas). Winds were 23-25 knots from the east southeast. Surface currents are southwesterly at 0.5-0.6 knots.

We conducted CTD deployments over Investigator Bank, starting at 1300 UTC. The first deployment was to a bottom depth of 285 m, and we popped 6 niskins at 295 m. The second deployment was to a bottom depth of 363 m, and 6 bottles were tripped 300 m and 353 m. The third deployment was to a bottom depth of 525 m, and 3 niskins were each triggered at 300 m, 400 m, and 500 m.

Overnight we finished mapping Investigator Block at 16 m resolution. It took about 8 hours in total

April 18

We arrived on bottom target at 1100 UTC and began assessing conditions. The seas were 3-5 with 6 ft swells. By 1230 UTC, the CO called the dive as conditions were worsening. At 1400 UTC, we began transiting to Whiting Bank. One CTD cast had already been done ~ 1 km from top of mound. We conducted CTD cast at Whiting Bank over a bottom depth of 1150 m. We popped 3 niskins: 515 m, 420 m, 330 m, and 75 m to coincide with ROV dive at Whiting Bank and CTD cast 2 over the bank with 6 bottles popped at 70 m.

Overnight transit into port of San Juan

April 19
Arrive in San Juan, demobilize and depart.

Inventory of Exploration Activities
We conducted seven deployments with the ROV, including one dive in midwater north of San Juan and the rest on the seafloor at four sites south of Puerto Rico (Table 1). One of these lowerings was immediately aborted upon arrival at the seafloor. In total, 34 hours of dive time were completed. We also conducted 13 casts with the CTD Rosette at five sites (Table 2). We also conducted casts at particular distances from each site to detect the signal of eDNA of corals, sponges, and fishes from the site.

Multibeam mapping was conducted to fill in gaps in existing data and gather high resolution surveys of the dive locations. We mapped 180nm^2 at a resolution of 16-24 m (Maps 1-4).

Table 1. Station data for dives with the *ROV Global Explorer*

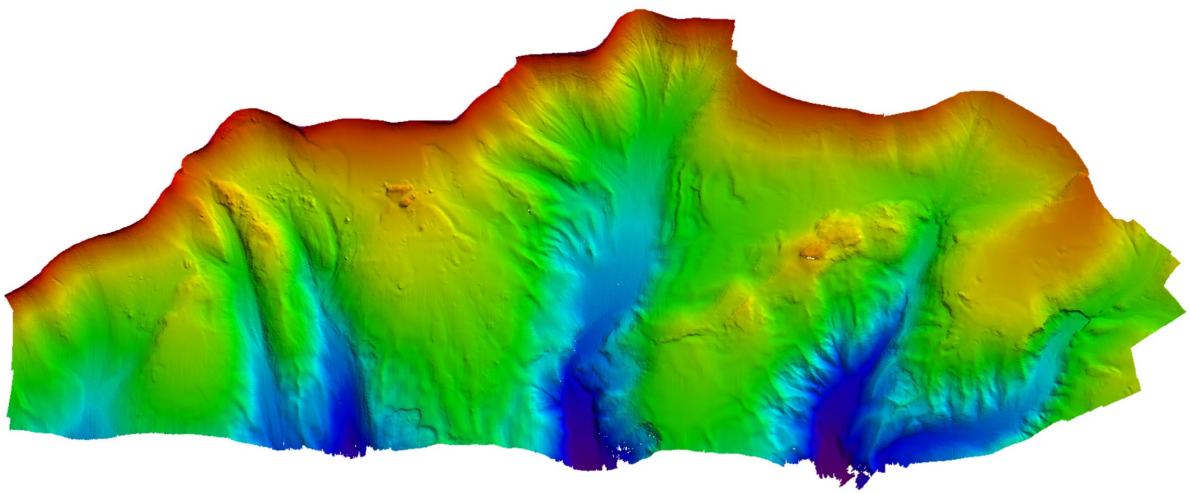
Dive	Site	Date	Start Bottom Lat	Start Bottom Lon	End Bottom Lat	End Bottom Lon	Start Depth (m)	End Depth (m)	Time on Bottom (hr)
GEX-22-01	N. PR Midwater	9-Apr-22	18.6640	-65.9665	NA	NA	450	900	2.65
GEX-22-02	Whiting Bank Ridge	10-Apr-22	17.7833	-65.6720	17.7846	-65.6732	1246	920	5.73
GEX-22-03	Whiting Bank	11-Apr-22	17.8074	-65.7147	17.8113	-65.7108	535	310	6.0
GEX-22-04	Guayanilla Canyon	12-Apr-22	17.8968	-66.7183	17.9049	-66.7215	663	340	6.38
GEX-22-05	Guayanilla Canyon	14-Apr-22	17.9154	-66.7044	17.909	-66.7117	523	422	6.42
GEX-22-06	Grappler Bank	15-Apr-22	17.8075	-65.9585	17.8075	-65.9585	658	658	0.17
GEX-22-07	Grappler Bank	16-Apr-22	17.8077	-65.9586	17.8077	-65.9501	660	210	6.85

Table 2. Station data for CTD casts and the number of eDNA samples collected per cast.

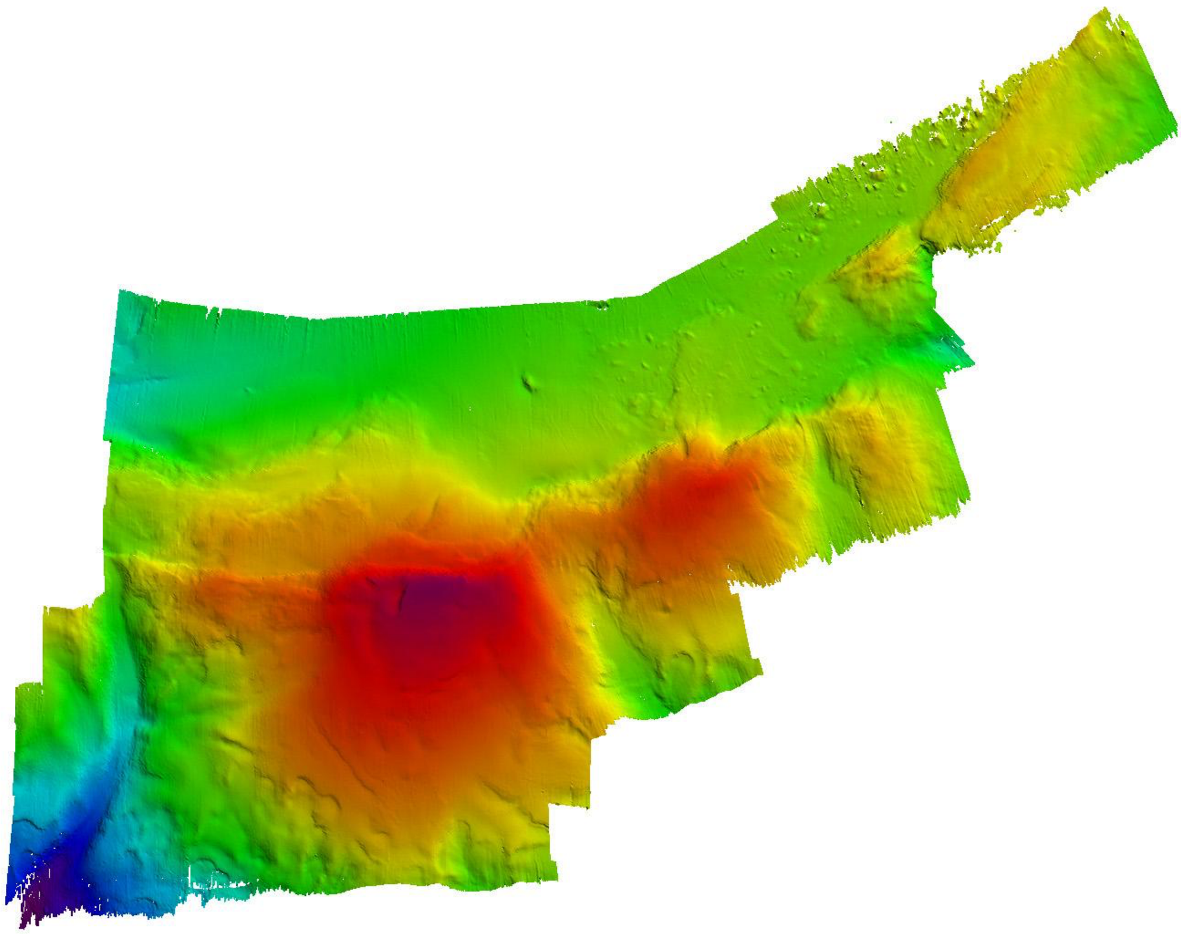
CTD Cast	Site	eDNA samples	Lat	Long	Approximate bottom depth (m)
1	Whiting Bank Ridge	12	17 46.81492N	65 40.19412W	1200
2	Whiting Bank	12	17 48.54218N	65 42.88816W	500
3	Guayanilla Canyon	6	17 54.30966N	66 43.4001W	350
4	Guayanilla Canyon	12	17 53.91632N	66 42.86659W	625
5	1KM SW of Grappler Seamount	12	17 48.13633N	65 57.96195W	950
6	3KM SW of Grappler Seamount	12	17 47.52006N	65 58.90718W	1400
7	6KM SW of Grappler Seamount	12	17 46.59508N	66 00.37171W	1275
8	Investigator Bank	6	17 44.90822N	66 11.1329W	300
9	1KM SW of Investigator Bank	6	17 44.53651N	66 11.53751W	350
10	3KM SW of Investigator Bank	12	17 43.79212N	66 12.33936W	540
11	6KM SW of Investigator Bank	12	17 42.68294N	66 13.5958W	1050
12	~3KM SW of Whiting Bank	12	17 48.27602N	65 43.81482W	1150

13	Whiting Bank (top of feature)	6	17 48.79169N	65 41.96662W	70

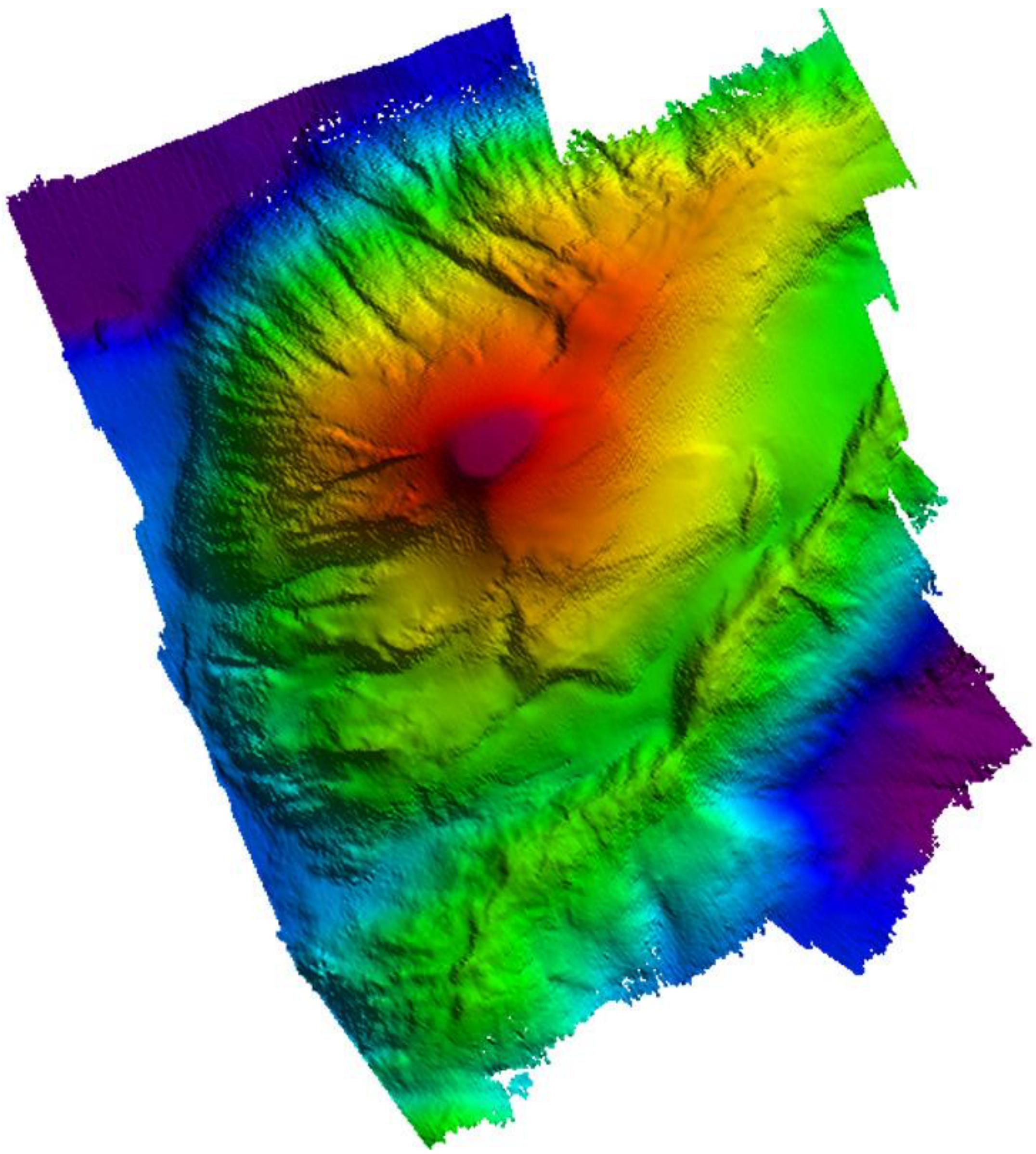
Map 1. Guayanilla Canyon: heads of canyon branches at 24 m resolution, 65 nm2



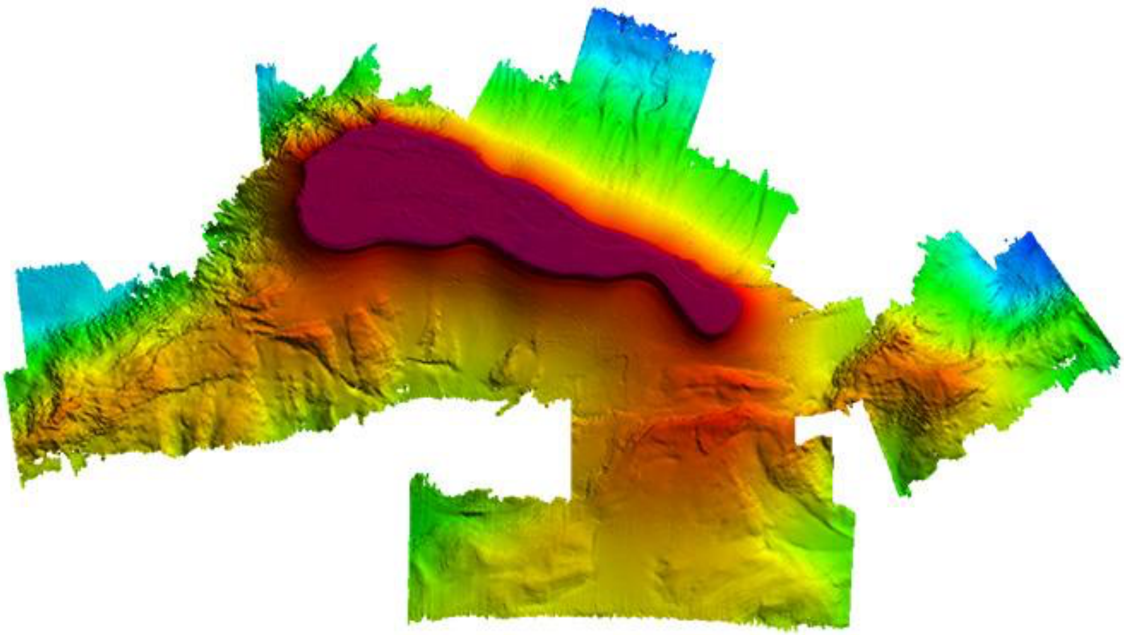
Map 2. Escollo Investigator: 43 nm2, 16 m resolution,



Map 3. Whiting Bank: 30 nm2, 24 m resolution



Map 4. Grappler Bank: 42 nm2, 24 m resolution



Inventory of Samples Collected:
We collected 148 individuals representing 74 taxa (Table 3) from four sites. In addition, we collected a total of 187 eDNA samples using both the ROV and the CTD Rosette (Tables 2, 4).

Table 3. List of all specimens collected during five ROV dives across benthic habitat off the southern coast of Puerto Rico.

Species	Grappler Bank	Guayanilla Canyon	Whiting Bank	Whiting Bank Ridge	Grand Total
Acanthogorgia sp. 1		1			1
Acanthogorgia sp.1		2			2
Acanthogorgia sp.2		1			1
Acanthoprinnoa	1				1
Actiniaria	1	1			2
Amphiophiura metabula		1			1

Amphipoda			3	1	4
Antipatharia	1	3	2		6
Asteroporpa		1			1
Asteroschema		1			1
Astrophorina	1				1
Bathypathes			1		1
Bivalvia	1				1
Callogorgia		1			1
Caridea	1				1
Ceramaster			1		1
Cheiraster mirabilis		1			1
Chironephthya		1			1
Chrysogorgia	1	1			2
Chrysogorgia desbonni		1	2		3
Copepoda		1			1
Coralliidae	1	1			2
Corallistes			2		2
Cornucopina antillea	2				2
Crinoidea		1			1
Crypthelia	1				1
Deltocyanthus italicus	1				1
Demospongiae	2	6			8
Demospongiae ?	1				1
Distichopathes			1		1

Eilisellidae		1			1
Ellisella			1		1
Eucarida			4		4
Euplectellidae	2				2
Euretidae			2		2
Farrea		1			1
Farreidae		1			1
Foraminifera		2			2
Galatheoidea	1				1
Hexactinellida	3	4		1	8
Hydrozoa	2				2
Iridogorgia				1	1
Isopoda		2	3		5
Keratoisididae				1	1
Madracis		1	3		4
Nicella			1		1
Nidaliidae	1				1
Ophidiaster	1				1
Ophiuroidea	3	9	1		13
Paguroidea		1			1
Paramuricea cf. placomus	1				1
Phyllangia pequegnatae		6			6
Plexauridae		1	1		2
Polychaeta			1	1	2

Polynoidae		1			1
Porifera	1				1
Primnoidae		1			1
Protanthea			1		1
Rossellidae	1				1
Saccocalyx				1	1
Savalia			1		1
Scaphopoda		1			1
Scleracis		1	1		1
Scleracis sp.1		1			1
Scleracis sp.2		1			1
Shrimps		2	3		2
Spongicola	3				3
Stichopathes				1	1
Stylopathes	1	1			2
Tetractinellida	1	1			2
Tunicate				1	1
Uroptychus	1	1			2
Xenophora		2			2
Zoanthid			1		1
Grand Total	**37**	**67**	**36**	**8**	**148**

Table 4. eDNA samples collected with the modified McLane pump and the niskins during deployments of the ROV *Global Explorer*.

Dive	Date	Niskin	Sample ID	Latitude	Longitude	Time fired/pumped
GEX01	4/9/22	Pump	NF22_02_GEX01_pump	18 39.85792N	65 58.02522W	Dive duration
GEX01	4/9/22	1	NF22_02_GEX01_N1	18 39.85792N	65 58.02522W	18:04
GEX01	4/9/22	2	NF22_02_GEX01_N2	18 39.85792N	65 58.02522W	18:39
GEX01	4/9/22	3	NF22_02_GEX01_N3	18 39.85792N	65 58.02522W	18:49
GEX01	4/9/22	6	NF22_02_GEX01_N6	18 39.85792N	65 58.02522W	19:51
GEX01	4/9/22	7	NF22_02_GEX01_N7	18 39.85792N	65 58.02522W	20:10
GEX01	4/9/22	8	NF22_02_GEX01_N8	18 39.85792N	65 58.02522W	20:29
GEX02	4/10/22	2	NF22_02_GEX02_N2	17 46.82703N	65 40.20002W	16:21
GEX02	4/10/22	3	NF22_02_GEX02_N3	17 46.82703N	65 40.20002W	16:22
GEX02	4/10/22	6	NF22_02_GEX02_N6	17 46.82703N	65 40.20002W	19:09
GEX02	4/10/22	7	NF22_02_GEX02_N7	17 46.82703N	65 40.20002W	19:09
GEX02	4/10/22	8	NF22_02_GEX02_N8	17 46.82703N	65 40.20002W	19:09
GEX02	4/10/22	Pump	NF22_02_GEX02_pump	17 46.82703N	65 40.20002W	Dive duration
GEX03	4/11/22	9	NF22_02_GEX03_N9	17 48.43432N	65 42.87284W	12:14
GEX03	4/11/22	2	NF22_02_GEX03_N2	17 48.43432N	65 42.87284W	12:28
GEX03	4/11/22	3	NF22_02_GEX03_N3	17 48.43432N	65 42.87284W	17:46
GEX03	4/11/22	6	NF22_02_GEX03_N6	17 48.43432N	65 42.87284W	17:46
GEX03	4/11/22	7	NF22_02_GEX03_N7	17 48.43432N	65 42.87284W	19:51
GEX03	4/11/22	8	NF22_02_GEX03_N8	17 48.43432N	65 42.87284W	19:52
GEX04	4/12/22	9	NF22_02_GEX04_N9	17 53.76809N	66 43.06703W	20:28
GEX04	4/12/22	2	NF22_02_GEX04_N2	17 53.76809N	66 43.06703W	20:29
GEX04	4/12/22	3	NF22_02_GEX04_N3	17 53.76809N	66 43.06703W	21:30
GEX04	4/12/22	6	NF22_02_GEX04_N6	17 53.76809N	66 43.06703W	21:30
GEX04	4/12/22	7	NF22_02_GEX04_N7	17 53.76809N	66 43.06703W	22:23
GEX04	4/12/22	8	NF22_02_GEX04_N8	17 53.76809N	66 43.06703W	22:23
GEX05	4/14/22	9	NF22_02_GEX05_N9	17 54.92176N	66 42.22984W	16:06
GEX05	4/14/22	2	NF22_02_GEX05_N2	17 54.92176N	66 42.22984W	16:06
GEX05	4/14/22	3	NF22_02_GEX05_N3	17 54.92176N	66 42.22984W	19:17
GEX05	4/14/22	6	NF22_02_GEX05_N4	17 54.92176N	66 42.22984W	19:17
GEX05	4/14/22	Pump	NF22_02_GEX05_pump	17 54.92176N	66 42.22984W	Dive duration
GEX07	4/16/22	9	NF22_02_GEX07_N9	17 48.44645N	65 57.51114W	14:35
GEX07	4/16/22	2	NF22_02_GEX07_N2	17 48.44645N	65 57.51114W	14:35
GEX07	4/16/22	3	NF22_02_GEX07_N3	17 48.44645N	65 57.51114W	18:22
GEX07	4/16/22	6	NF22_02_GEX07_N6	17 48.44645N	65 57.51114W	18:22
GEX07	4/16/22	pump	NF22_02_GEX07_pump	17 48.44645N	65 57.51114W	Dive duration

Scientific Sample Processing:
All samples were preserved for genetic processing. Tissue samples of organisms were preserved in 95% EtOH and stored at -20 degC. Voucher samples were preserved in 95% EtOH or in 10% formalin. All specimens and tissue samples were accessioned at the Smithsonian National Museum of Natural History (NMNH) and are in the process of being catalogued.

Water samples were filtered at sea in Sterevix filters and stored onboard at -80 dC. Filters were accessioned at the NMNH and sent to Lehigh University for analysis. DNA aliquots will be catalogued from the samples.

Preliminary Results

Although only 34 hours of dive time was completed, several interesting observations were completed. Many are noted above in daily activities, but highlighted here as well:

1. Several potential new species, including an unknown black coral (possible new family), a colonial tunicate, a hydrozoa, and a cyclops (i.e., fused eye) isopod
2. A species of Bryozoa, *Cornucopina antillea,* was imaged in its natural habitat for the first time. In fact, it had not been collected since its original discovery in 1933. At that time it was collected via dredge during the Johnson-Smithsonian Expedition to the Puerto Rico Trench.
3. Fishing gear, including monofilament line and anchor/trap lines, was found at all sites visited.
4. A new symbiotic association was documented between a carrier shell and a polynoid scale worm
5. A predatory tunicate in the family Octacnemidae was observed. This family was not previously recorded from the Caribbean Sea
6. We re-mapped a large portion of Guayanilla Canyon, where earthquakes in 2019-2020 could have caused potential landslides.
7. The low-light camera picked up some bioluminescence of midwater organisms. We also observed a strong "siren-light" on a dark red cydippid ctenophore, which was determined to be refraction from the dimmed lights. However, the red light observed was very strong and showed potential for the use of this camera for low-light areas.

   Highlight images below:

Image 1. Predatory Tunicate

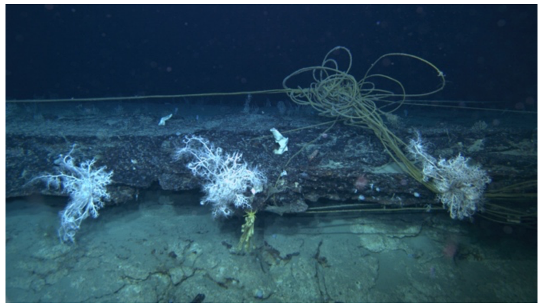


Image 2. Fishing gear on a rocky outcrop


Image 3. Bryozoan observed *in situ* for the first time. It was originally collected in 1933 and described in 1940.

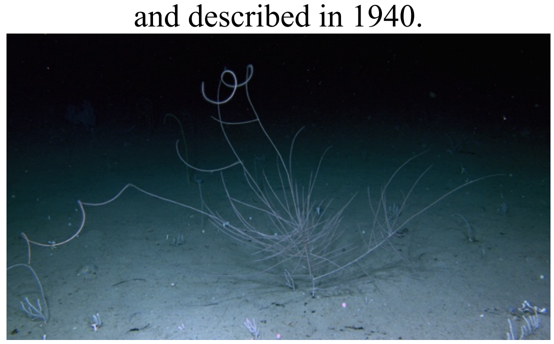


Image 4. A potential new family of black coral.


Image 5. A potential new species of isopod.

Challenges

Several challenges arose during this expedition. The biggest impact was NOAA's COVID protocols. Although highlighted above in daily summaries, the biggest issue pertained to a rapid molecular test given during the day of sailing. This test had a 2% false positive rate, meaning that at least 1-2 people would test positive out of the crew. On our initial sail date (April 6), a critical member of the ROV team tested positive on the rapid molecular test-although he tested negative with the antigen test on April 5 and was asymptomatic. He immediately was put in quarantine in a hotel and tested negative on a PCR lab-based test. However, as per NOAA's protocols, he was not allowed to get a lab-based PCR test to negate this rapid one. On April 6, one of the ship's engineers took 3 molecular tests that were all inconclusive. He was allowed to take a lab-based PCR test, and did get a negative result. This set us back three days as we scrambled to find an ROV pilot who could not only sail, but was also cleared to sail (vaccinations, TB test, medical, etc) on a NOAA vessel. This also hindered the ROV team's ability to have mobilization complete in time for the first dive.

On April 8, the day before we were to set sail, another rapid molecular test was given. A critical member of the bridge department tested positive on this day as well as a critical member of our science team, who was the engineer in charge of running the lowlight camera. Both individuals were put in quarantine and our scientist was not able to rejoin the cruise. Although we did our best to run the low light camera, it was unfortunately not successful as the scientist's knowledge of the camera was instrumental to its success.

Weather impacted the entire expedition. The waves were consistently 4-6 feet with confused seas and swells coming from different directions. Thus, we only completed five successful benthic dives out of 12 planned. On one of the dives, the ROV hit the side of the vessel during recovery and the frame broke in several places. In addition, the sea states knocked the slurp chamber off its rack a few times, and therefore we lost the ability to use those during the cruise.

The ROV also had some navigation issues during the first two dives. They were not resolved until dive 3.

Data Management

Having a NOAA data manager onboard was fantastic. Anna Lienesch managed all data aspects of the project, particularly data coming from the ROV, including the different video types and navigation. All data were put on two hard drives and are currently at URI and NMNH. The data have also been backed up on a OneDrive folder at the Smithsonian Institution NMNH. Data are available to all cruise participants and will be provided to NOAA as per the Data Management plan of the proposal.

All specimens were deposited at the Smithsonian NMNH and are in the process of cataloguing. All eDNA filters were also accessioned at the NMNH, but have been loaned to Lehigh University as a loan for analysis. The DNA aliquots will be retrieved and placed in the Biorepository at the NMNH.

Education and Outreach Activities

We trained a MS student (UPR Mayaguez), an early career researcher (NMNH), a PhD student (Lehigh U.), and a postbac researcher (Temple) at sea; three of whom had never sailed before. Quattrini and Orozco-Juarbe connected with EcoExploratorio in two live interactions; one with ~15 teachers and another with ~30 members of the public (mostly families) at EcoExploratorio. Throughout the cruise we also posted content to the NOAA OER website https://oceanexplorer.noaa.gov/explorations/22puerto-rico-deepwaters/welcome.html, and actively posted on social media (Twitter, #IlluminatingBiodiversity, #Puerto Rico). During #OceanMonth (June 2022), Smithsonian NMNH is planning to highlight several of our findings on Facebook and Instagram.

Two students from the Univ. Of Puerto Rico Mayaguez are spending 8 weeks at the NMNH as interns during the summer of 2022 (May to July). They are both MS students (one sailed with the expedition) and they will be working on the material collected, including DNA extractions and barcoding/genome skimming.

Diversity and Inclusion Activities

Our scientific team consisted of a group of people across diverse career stages, genders, and ethnicities. We brought three people who had never been at sea, and included a Masters student from the Univ. Of Puerto Rico Mayaguez, a NMNH postdoctoral researcher originally from Brazil, and a first-generation, non-traditional recent college graduate. In addition, the chief scientist was a first-generation student and first-time chief scientist. To make our online content more accessible, we created bilingual content on the NOAA OER webpage https://oceanexplorer.noaa.gov/explorations/22puerto-rico-deepwaters/welcome-sp.html.

Planned Reports and Publications

The following are potential publications that will be submitted:

1. Octocoral data will be used in a paper on the biogeography of deepwater octocorals in the North Atlantic (*Deep-Sea Research)*
2. Fish data will be incorporated into a larger paper on biogeography of deepwater fishes in the North Atlantic
3. Carrier shell symbiosis with the scale worm
3. New species descriptions (black coral, tunicate, hydrozoa, isopod)
4. A note on the Bryozoa, *Cornucopina antillea,* with in situ photos

Appendices

Project Instructions

Date Submitted: February 10, 2022

Platform: NOAA Ship *Nancy Foster*

Project Number: NF-22-02

Project Title: Illuminating pelagic and benthic biodiversity in deep waters off Puerto Rico

Project Dates: April 6 2022 to April 19 2022, Transit April 23 to April 29. 2022

Prepared by: Dated: _10 Feb 2022
Andrea Quattrini
Chief Scientist
Smithsonian Institution National Museum of Natural History

Approved by: __________________________ Dated: ___________________
Allen Collins
Director
NOAA Systematics Lab

Approved by: __________________________ Dated: ___________________
Lab Director Name
Title
Affiliation (Program or Lab)

Approved by: __________________________ Dated: ___________________
Captain David J. Zezula, NOAA
Commanding Officer
Marine Operations Center – Atlantic

I. Overview

A. Brief Summary and Project Period

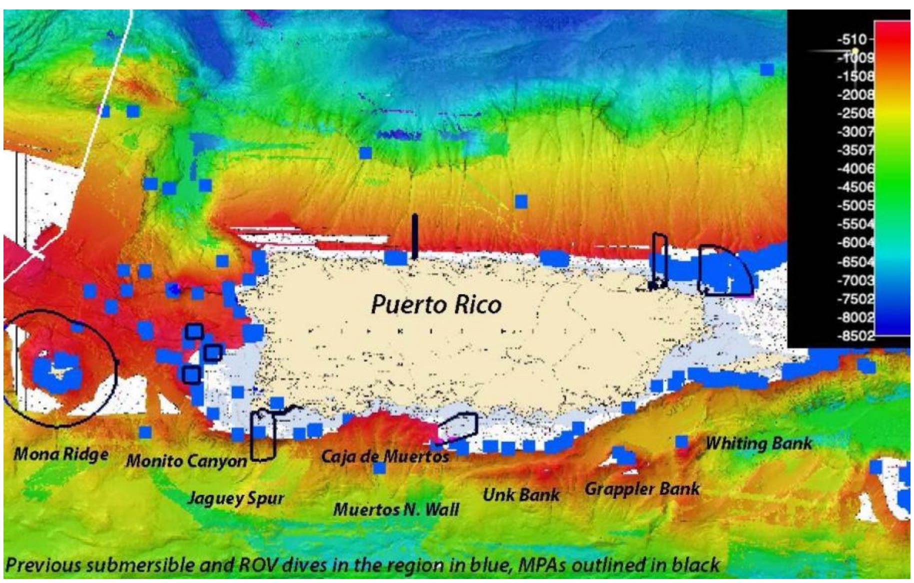
NF-22-02 "Illuminating Biodiversity off Puerto Rico" will set sail from 6-19 April, 2022 aboard the NOAA Ship Nancy Foster. The mobilization of the ROV will occur over Feb 28-March 2 and subsequent demobilization in early May in Charleston SC. ROV crew will begin mobilization in San Juan on April 4 and remaining personnel will load on April 5; all will demobilize on April 19-20. This cruise will sail in and out of San Juan Puerto Rico, followed by a transit back to Charleston, SC. During the cruise we will be using the ROV Global Explorer and the CTD Rosette to survey midwater and benthic communities from 200-2500 m. This project is funded by NOAA OER and NMFS and consists of a collaboration among the Smithsonian National Museum of Natural History, NOAA Systematics Lab, Temple University, University of Rhode Island, University of Puerto Rico Mayaguez, and Lehigh University.

B. Days at Sea (DAS)

Of the _21_ DAS scheduled for this project, _0_ DAS are funded by an OMAO allocation, _21_ DAS are funded by a Line Office Allocation, _0_ DAS are Program Funded, and _0_DAS are Other Agency funded. This project is estimated to exhibit a _24 hr___ Operational Tempo.

C. Operating Area (include optional map/figure showing op area)

Territorial and Federal waters off Puerto Rico. Also See Figure 1 in Appendix



D. Summary of Objectives

We are using a multidisciplinary approach to explore and characterize environmental and biological diversity across pelagic and benthic habitats in deep waters off Puerto Rico in the U.S. EEZ. We will characterize the multiple dimensions of diversity from the surface to the seafloor and improve predictions of where vulnerable marine ecosystems occur are essential for the proper management of resources. Specifically, during this cruise, we will:

1. Conduct 12 hr ROV ops to survey midwater and benthic communities, including canyons and banks, at 200-2500 m
2. Implement new technologies for water sampling and low-light imaging on the ROV
3. Collect specimens via ROV slurp and manipulator and process them in the wet lab for taxonomic and genetic purposes
4. Collect water samples via niskins on the ROV and filter the water at sea for eDNA
5. Collect and process push cores from ROV for diversity and eDNA analyses
6. Conduct CTD Rosette operations if ROV cannot be deployed and/or after each dive
7. Conduct multibeam mapping surveys as needed to help fill in gaps
8. Conduct education and outreach via live 30 min Q and A interactions with EcoExploratorio and the National Museum of Natural History and through website posts

E. Participating Institutions

Smithsonian Institution National Museum of Natural History (NMNH), NOAA Systematics Lab, Temple University, Univ. Rhode Island, Lehigh University, University of Puerto Rico Mayaguez, NOAA OER, Oceaneering

F. Personnel/Science Party: name, title, gender, affiliation, and nationality

Name (Last, First)	**Title**	**Date Aboard**	**Date Disembark**	**Gender**	**Affiliation**	**Nationality**
Bertramson, Jim	ROV Team	4 April	20 April	M	Oceaneering	US
Branco, Cristiana	Scientist	5 April	20 April	F	NMNH	Brazil
Collins, Allen	Scientist	5 April	20 April	M	NOAA	US
Cordes, Erik	Co-Chief Sci	5 April	20 April	M	Temple	US
Evanson, Madeline	Scientist	5 April	20 April	F	Temple	US

Guzman, Hector	ROV Survey Team	4 April	20 April	M	Oceaneering	US
Orozco-Juarbe, Jose	Scientist	5 April	20 April	M	Univ. PR	US
Linesch, Anna	Scientist	5 April	20 April	F	NOAA	US
Mallein, Jack*	ROV Team	4 April	20 April	M	Oceaneering	US
McCartin, Luke	Scientist	5 April	20 April	M	Lehigh	US
Quattrini, Andrea	Chief Sci	5 April	20 April	F	NMNH	US
Schizas, Nikolaos	Scientist	5 April	20 April	M	Univ. PR	US
Shomberg, Russel	Scientist	5 April	20 April	M	URI	US
Tripp, Jason	ROV Team	4 April	20 April	M	Oceaneering	US
Montes, Gonzalez Alejandro	Scientist	5 April	20 April	M	Univ. PR	US

*May be replaced by either Kirk Rogers or Joseph Caba, M, Oceaneering, US

G. Administrative

1. Points of Contacts:

Andrea Quattrini, chief scientist, quattrinia@si.edu, cell: 910-5207264

Erik Cordes, co-chief scientist, ecordes@temple.edu

John Parks, ROV ops manager, JWPArks@oceaneering.com,

Jason Tripp, ROV superintendent, jmtripp@oceaneering.com

Chase Manning, ROV survey lead, cfanning@oceaneering.com

2. Diplomatic Clearances

None Required.

3. Licenses and Permits

A Permit is required to operate at a few of our selected sites off Puerto Rico as they are in territorial waters. We are still waiting to get approved for the permit issued by the Department of Environmental and Natural Resources. If not obtained in time, we will shift our dive locations to other areas outside of the territory.

II. Operations

The Chief Scientist is responsible for ensuring the scientific staff are trained in planned operations and are knowledgeable of project objectives and priorities. The Commanding Officer is responsible for ensuring all operations conform to the ship's accepted practices and procedures.

A. Project Itinerary:

This expedition will focus on conducting ROV operations in midwater and benthic habitats off Puerto Rico (see Figure 1, Table 1). The primary objective for this expedition is to dive using the ROV Global Explorer. We also plan to conduct multibeam mapping operations to fill in bathymetry gaps and conduct CTD casts whenever possible. We will also conduct outreach and education via live interactions from ship to EcoExploratorio and to the NMNH to answer questions with the public in Q and As, however, confirmation is still required because of NMNH closures due to COVID.

Day to day details are as follows. See Table 1 for locations and depths of priority sites

Day	Location	Transit (nm)	Transit time (h)	Comments
28 Feb-2 March	Mobilize the ROV in Charleston SC			also load ship with some science gear (chemicals, a few action packers)
4-Apr	Mobilization			In San Juan
5-Apr	Mobilization			rov and science team to stay aboard vessel
6-Apr	Continue mobilization, Depart	120	12	Interaction with Eco Exploratorio for a live 30 min interaction, time TBD
7-Apr	Whiting Bank			dive at 0700, recover at 1600, CTD casts
8-Apr	Whiting Bank	12	1.5	dive at 0700, recover at 1600, transit to grappler
9-Apr	Grappler Seamount	14	1.5	**in PR territorial waters**, dive at 0700, recover

				at 1600, CTD Casts, transit to un-named ridge
10-Apr	Un-Named Ridge	5	0.5	**in PR territorial waters,** dive at 0700, recover at 1600, CTD Casts, transit to N wall
11-Apr	N Wall Muertos	10	1	dive at 0700, recover at 1600, CTD casts, transit to un-named ridge
12-Apr	Un-Named Ridge	31	3	**in PR territorial waters**, dive at 0700, recover at 1600, transit to Caja
13-Apr	Caja de Muertos	23	2.5	**in PR territorial waters**, dive at 0700, recover at 1600, CTD casts, transit to N Wall
14-Apr	N Wall Muertos	40	4	dive at 0700, recover at 1600,, CTD casts, transit to jaguey
15-Apr	Jaguey Spur	50	5	dive at 0700, recover at 1600,, CTD casts, transit to mona ridge
16-Apr	Mona Ridge	23	2.5	dive at 0700, recover at 1600, CTD casts, multibeam mapping, transit to monito
17-Apr	Monito Canyon			dive at 0700, recover at 1600,, CTD casts, multibeam mapping
18-Apr	Monito Canyon	110	11	dive at 0700, recover at 1600,, transit to san juan
19-Apr	Demobilization			Leave ship
2-May	Demobilization of ROV in Charleston SC			And offload extraneous science gear, and specimens

B. Staging and Destaging:

Staging will begin Feb 28 to March 2 in Charleston SC to load the ROV. A barge will be secured and the ship's crane will be used to load the ROV equipment onto the ship. The ship will then sail to Puerto Rico.

April 4-Mobilization of the ROV will continue in San Juan Puerto Rico. Chief scientists arrive and load science gear.

April 5 Loading of personnel and other science gear will be loaded. ROV mobilization continues.

April 19. Demobilization occurs and science crew departs

C. Operations to be Conducted:

Detailed protocols for each of the operations will be provided to the vessel prior to mobilization. While there are several operations planned for this mission, some adjustments to the day to day operations and sampling locations may be necessary to ensure maximal ROV dive time and efficiency. The cruise operations are summarized as follows.

ROV operations: ROV operations will occur over 12 hours, from ~0800 to 2000. Operations will include midwater and benthic surveys, collecting specimens and recording video. Bottom starting coordinates, waypoints, and dive plans will be provided to the ROV and ship's crew the day before each dive, but priority sites are listed in Table 1. Specific waypoints may be modified while the dive is underway and depending on what is observed on the seafloor. Although currents should be negligible in the region, the chief scientists, ROV superintendent, and CO will discuss alternative plans if sea conditions prohibit diving in a particular location. Scientists will stand ROV dive watches to record data, manage the video, and guide the dive. Depending on the activities planned for a specific dive, different scientists will be involved in leading parts of a dive. Specific collections will include fauna, water, and sediment from the different habitats encountered.

Non-ROV operations: Transit between priority areas will occur following deck operations. Between ROV dives, MB mapping or CTD casts will be conducted. Shipboard operations (mapping, CTDs) will occur mostly between ROV operations, but also if the ROV requires servicing or if weather prohibits ROV dives yet permits other shipboard ops. Mapping operations will focus on previously unmapped areas, particularly in the Mona passage, or potential seep areas along the wall/base of Muertos Trough. Multibeam sonar mapping will occur in selected areas where data are incomplete or absent, at depths ranging from 150-2000m.

Physical oceanographic parameters will be monitored through CTD casts, and the ship's flow-through thermosalinograph and fluorometer instruments. CTD casts will be deployed at selected stations to be determined. Max depth for these operations will be 2500m. The ship will supply DO and turbidity sensors (rated to at least 2000 m) on the CTD. CTD rosette will also collect discrete water samples. The ET/survey technician, with help from the science team, will be responsible for CTD operations.

Scientific Computer System (SCS): The Foster's SCS system is a PC-based server, which continuously collects and distributes scientific data from various navigational, oceanographic, meteorological, and sampling sensors throughout the cruise. Date and time for data collections from computers, instrumentation, and log sheet recordings will be synchronized using the vessel's GPS master clock. The *Foster's* Survey Tech is responsible for ensuring data collection.

The ship's Scientific Computer System (SCS) will be required for logging data on a routine basis and data requirements will be coordinated with the Commanding Officer and Electronics Technician at the beginning of the cruise. The bridge officers will be requested to execute "Operations Events" using established software applications to capture SCS data streams during gear deployment and recovery operations. Detailed information on data collection protocols will be supplied to the ship prior to sailing.

Collection of ship sensor data through sampling events is a critical requirement to support this work. It is requested that the time server/time date be embedded into the SCS files. Global Positioning System (DGPS or P-code GPS) provides data on vessel towing speed and direction to be recorded at a frequency of 1 Hz. A It is requested that the sensors be operational, calibrated and that logging capabilities be enabled.

EM710 Multibeam Data Acquisition (MB): To minimize acoustic and electrical interference, whenever possible we request deactivating other sounders on the vessel. The survey technicians will be responsible for MB data acquisition and storage. The science party will provide survey plans to the bridge and survey tech (or appropriate designee) as soon as possible and in the required format prior to the survey start time.

D. Dive Plan

Dives are not planned for this project.

Key Points of Emphasis

1. ROV Ops will occur over 12 hours
2. CTD rosette must be on board, calibrated, with bottles mounted; sensors rated to at least 2000 m
3. CTD Ops will occur if ROV cannot dive, and some evenings (following ROV recovery ~2000 to 2400) will be dedicated to CTD casts
4. ROV will be loaded (28 Feb to 2 March) and offloaded (2 May) in Charleston, SC using a barge and ship's crane
5. Chemicals, and some cruise supplies will be mobilized in Charleston before departure (March 1)
6. Specimens will be offloaded in Charleston following transit back from San Juan (2 May)

E. Applicable Restrictions

Bad weather conditions, high sea states, equipment failure, safety concerns, and unforeseen circumstances can preclude normal operations. The ship's Commanding Officer, ROV superintendent, and chief scientists will assess and address any concerns or issues affecting normal operations.

III. Equipment

A. Equipment and Capabilities provided by the ship (itemized)

CTD rosette with Niskins (12 x 5L) and sufficient weight to conduct CTD casts down to 2500m with DO sensor, turbidity, fluorescence
Fume hood
Multibean sonar equipment necessary to map seafloor
Email and internet services
Networked computers, printer, with SCS

Caris data acquisition and navigation software
Dynamic Positioning (mostly used during ROV and lander ops)
Power to ROV winch and vans
Science refrigerator
Science freezers (-20 and -80)
Seawater available on deck
Wet and dry lab space and storage
Use of all available science berths: 15
Wide-screen video monitor for ROV video feed
Working winches, aframe/jframe
Other deck machinery for deployment and recovery of science gear

B. Equipment and Capabilities provided by the scientists (itemized)

1. ROV Global Explorer: The Global Explorer is rated to 2500 m. It is equipped with two 7 function manipulators, a slurp chamber, cameras, niskin bottles, push cores and quivers. It is operated by Oceaneering, Int. It is a working class ROV, with a weight of 3500 lbs and a length of 110”, 48”, 64”
    a. Control Van, 13000 lbs, 240” long, 96” wide, 99” high
    b. Winch, Clump Weight, Winch tie down, Deck boxes

Qty	Component	Serial #	Asset #	Weight (lbs)	Length	Width	Height
1	Control Van			13,000.00	240"	96"	99"
1	Winch	807002870		14,000.00	90"	80"	101"
1	Vehicle	V004915		3,500.00	110"	48"	64"
1	Clump Weight	CW 01		1,400.00	30"	30"	52"
1	Deck Box	DB 01		1,360.00	42"	48"	78"
1	Deck Box	DB02		1,940.00	50"	40"	70"
1	Deck Box	DB03		1,240.00	41"	49"	83"
3	Winch tie down			1,080.00			
1	Shipping crate 1			1,200.00	40"	48"	43"
	Total Weight			43,280.00			

2. Sheave/Block for the ships wire, large enough to fit the ROV cable
3. Survey Equipment to track the ROV, including a hydrophone to be mounted over the side
4. All chemicals and associated spill kits/containers
5. Computers, including personal laptops
6. Video data/copying equipment

7. Microscope
8. Photo equipment, camera and camera stand

IV. Hazardous Materials

A. Policy and Compliance

The Chief Scientist is responsible for complying with FEC 07 Hazardous Materials and Hazardous Waste Management Requirements for Visiting Scientific Parties (or the OMAO procedure that supersedes it). By Federal regulations and NOAA Marine and Aviation Operations policy, the ship may not sail without a complete inventory of all hazardous materials by name and quantity, MSDS, appropriate spill cleanup materials (neutralizing agents, buffers, or absorbents) in amounts adequate to address spills of a size equal to the amount of chemical brought aboard, and chemical safety and spill response procedures. Documentation regarding those requirements will be provided by the Chief of Operations, Marine Operations Center, upon request.

Per OMAO procedure, the scientific party will include with their project instructions and provide to the CO of the respective ship 30 days before departure:

- List of chemicals by name with anticipated quantity
- List of spill response materials, including neutralizing agents, buffers, and absorbents
- Chemical safety and spill response procedures, such as excerpts of the program's Chemical Hygiene Plan or SOPs relevant for shipboard laboratories
- For bulk quantities of chemicals in excess of 50 gallons total or in containers larger than 10 gallons each, notify ship's Operations Officer regarding quantity, packaging and chemical to verify safe stowage is available as soon as chemical quantities are known.

Upon embarkation and prior to loading hazardous materials aboard the vessel, the scientific party will provide to the CO or their designee:

- An inventory list showing actual amount of hazardous material brought aboard
- An MSDS for each material
- Confirmation that neutralizing agents and spill equipment were brought aboard sufficient to contain and cleanup all of the hazardous material brought aboard by the program
- Confirmation that chemical safety and spill response procedures were brought aboard

Upon departure from the ship, scientific parties will provide the CO or their designee an inventory showing that all chemicals were removed from the vessel. The CO's designee will maintain a log to track scientific party hazardous materials. MSDS will be made available to the ship's complement, in compliance with Hazard Communication Laws.

Scientific parties are expected to manage and respond to spills of scientific hazardous materials. Overboard discharge of hazardous materials is not permitted aboard NOAA ships.

B. Inventory

Common Name of Material	Qty	Notes	Trained Individual	Spill control
Formaldehyde solution (37%)	1 x 500ml	Alkalinity, Stored in ship chemical lkr	Collins/Cordes	F
Ethyl Alcohol (95%)	4 x 5 gallons	Stored in ship chem. lkr or other as directed by ship	Collins/Cordes	E
Mercuric Chloride	3 x 100ml	Very toxic, corrosive, stored in ship chem lkr	Cordes	M

C. Chemical safety and spill response procedures

M: Mercuric Chloride

- Ventilate area of leak or spill.
- Wear appropriate personal protective equipment (impervious material).
- Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover material when possible.
- Use non-metal tools and equipment. Collect material in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place all materials in contact with chemical in a chemical waste container.
- Avoid any transfer into the environment

E: Ethanol

- Ventilate area of leak or spill. Remove all sources of ignition.
- Wear appropriate personal protective equipment.
- Stop the flow of material. Dike the spilled material.
- Carefully cover the area with spill absorbent material.
- Sweep up the residue using spark-proof tools and place the residue into a labeled, plastic, waste container (plastic pail with lid or double heavy-duty plastic bags). Store for disposal as hazardous waste.
- Mop the affected area using detergent and water.

F: Formalin/Formaldehyde

- Ventilate area of leak or spill. Remove all sources of ignition.

- Wear appropriate personal protective equipment.
- Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible.
- Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container.
- Do not use combustible materials, such as saw dust.

D. Radioactive Materials

No Radioactive Isotopes are planned for this project.

E. Inventory (itemized) of Radioactive Materials

None

F. Lithium batteries (beyond everyday household items)

No lithium batteries beyond everyday household items are included.

V. Additional Projects

A. Supplementary ("Piggyback") Projects

No Supplementary Projects are planned.

B. NOAA Fleet Ancillary Projects

No NOAA Fleet Ancillary Projects are planned.

VI. Disposition of Data and Reports

Disposition of data gathered aboard NOAA ships will conform to NAO 216-101 *Ocean Data Acquisitions* and NAO 212-15 *Management of Environmental Data and Information.* To guide the implementation of these NAOs, NOAA's Environmental Data Management Committee (EDMC) provides the *NOAA Data Documentation Procedural Directive* (data documentation) and *NOAA Data Management Planning Procedural Directive* (preparation of Data Management Plans). OMAO is developing procedures and allocating resources to manage OMAO data and Programs are encouraged to do the same for their Project data.

A. Data Classifications: *Under Development*

a. OMAO Data

b. Program Data

B. Responsibilities: *Under Development*

VII. Meetings, Vessel Familiarization, and Project Evaluations

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

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

C. Post-Project Meeting: The Commanding Officer is responsible for conducted a meeting no earlier than 24 hrs before or 7 days after the completion of a project to discuss the overall success and shortcomings of the project. Concerns regarding safety, efficiency, and suggestions for future improvements shall be discussed and mitigations for future projects will be documented for future use. This meeting shall be attended by the ship's officers, applicable crew, the Chief Scientist, and members of the scientific party and is normally arranged by the Operations Officer and Chief Scientist.

D. Project Evaluation Report

Within seven days of the completion of the project, a Customer Satisfaction Survey is to be completed by the Chief Scientist or Principal Investigator, as appropriate. The form is available at https://sites.google.com/a/noaa.gov/omao-intranet-dev/operations/marine/customer-satisfaction-survey and provides a "Submit" button at the end of the form. It is also located at https://docs.google.com/a/noaa.gov/forms/d/1a5hCCkgIwaSII4DmrHPudAehQ9HqhRqY3J_FXqbJp9g/viewform. Submitted form data is deposited into a spreadsheet used by OMAO management to analyze the information. Though the complete form is not shared with the ships, specific concerns and praises are followed up on while not divulging the identity of the evaluator.

VIII. Miscellaneous

A. Meals and Berthing

The ship will provide meals for the scientists listed above. Meals will be served 3 times daily beginning one hour before scheduled departure, extending throughout the project, and ending two hours after the termination of the project. Since the watch schedule is split between day and night, the night watch may often miss daytime meals and will require adequate food and beverages (for example a variety of sandwich items, cheeses, fruit, milk, juices) during what are not typically meal hours. Special dietary requirements for scientific participants will be made available to the ship's command at least seven days prior to the project.

Berthing requirements, including number and gender of the scientific party, will be provided to the ship by the Chief Scientist. The Chief Scientist and Commanding Officer will work together on a detailed berthing plan to accommodate the gender mix of the scientific party taking into consideration the current makeup of the ship's complement. The Chief Scientist is responsible for ensuring the scientific berthing spaces are left in the condition in which they were received; for stripping bedding and linen return; and for the return of any room keys which were issued. Unless prior arrangements are made, the science party may move aboard the night before scheduled departure and must move off the ship the day after scheduled arrival (at the end of project). The Chief Scientist/Principal Investigator is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the project and at its conclusion prior to departing the ship.

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

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy dated May 17, 2000 which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels.

B. Medical Forms and Emergency Contacts

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

NHSQs must be submitted every 2 years for individuals under the age of 50 and every 1 year for ages 50 and above. NHSQs must be accompanied by NOAA Form (NF) 57-10-02 - Tuberculosis Screening Document in compliance with OMAO Policy 1008 (Tuberculosis Protection Program, which requires a yearly PPD or TB exam).

The completed forms should be sent to Marine Health Services at the applicable Marine Operations Center. The NHSQ and Tuberculosis Screening Document should reach the Health Services Office no later than 4 weeks prior to the start of the project to allow time for the participant to obtain and submit additional information should health services require it, before clearance to sail can be granted. Please contact MOC Health Services with any questions regarding eligibility or completion of either form. Ensure to fully complete each form and indicate the ship or ships the participant will be sailing on. The participant will receive an email notice when medically cleared to sail if a legible email address is provided on the NHSQ.

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

The only secure submission process approved by NOAA is kiteworks by Accellion Secure File Transfer, which requires the sender to set up an account using a valid NOAA email address and password. User accounts may expire after 30 days of inactivity. Simply re-register to send and receive files.

Persons without a NOAA email account must fax or mail their forms.

Contact information: Include only the Pacific OR Atlantic Office as applicable.

Marine Health Services
Marine Operations Center – Atlantic
439 W. York Street
Norfolk, VA 23510
Telephone 757-441-6320
Fax 757-441-3760
Email MOA.Health.Services@noaa.gov

Marine Health Services
Marine Operations Center – Pacific
2002 SE Marine Science Dr.
Newport, OR 97365
Telephone 541-867-8822
Fax 541-867-8856
Email MOP.Health-Services@noaa.gov

Prior to departure, the Chief Scientist must provide an electronic listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: contact name, address, relationship to member, and telephone number.

C. Shipboard Safety

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

Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. At the discretion of the ship CO, safety shoes (i.e. steel or composite toe protection) may be required to participate in any work dealing with suspended loads, including CTD deployment and recovery. The ship does not provide safety-toed shoes/boots. The ship's Operations Officer should be consulted by the Chief Scientist to ensure members of the scientific party report aboard with the proper attire.

D. Communications

A progress report on operations prepared by the Chief Scientist may be relayed to the program office. Sometimes it is necessary for the Chief Scientist to communicate with another vessel, aircraft, or shore facility. Through various means of communications, the ship can usually accommodate the Chief Scientist. Special radio voice communications requirements should be listed in the project instructions. The ship's primary means of communication with the Marine Operations Center is via email and the Very Small Aperture Terminal (VSAT) link. Standard VSAT bandwidth has increased, on average per ship, to 768 kbs and is shared by all vessel's staff and the science team at no charge to sailing personnel. Increased bandwidth in 7 day increments is available on the VSAT systems at increased cost to the scientific party. If increased bandwidth is being considered, program accounting is required and it must be arranged through the ship's Commanding Officer at least 30 days in advance.

E. IT Security

Any computer that will be hooked into the ship's network must comply with the *OMAO Fleet IT Security Policy* 1.1 (November 4, 2005) prior to establishing a direct connection to the NOAA WAN. Requirements include, but are not limited to:

(1) Installation of the latest virus definition (.DAT) file on all systems and performance of a virus scan on each system.

(2) Installation of the latest critical operating system security patches.

(3) No external public Internet Service Provider (ISP) connections.

Completion of the above requirements prior to boarding the ship is required.

Computer Operating Systems that the support vendor has identified as reaching "End of Life" for support will not be allowed on the shipboard network. Examples include Microsoft Windows XP and Vista as well as Windows Server 2003.

Non-NOAA personnel using the ship's computers or connecting their own computers to the ship's network must complete NOAA's IT Security Awareness Course within 3 days of embarking.

F. Foreign National Guests Access to OMAO Facilities and Platforms

All foreign national access to the vessel shall be in accordance with NAO 207-12 and RADM De Bow's March 16, 2006 memo (http://deemedexports.noaa.gov). National Marine Fisheries Service personnel will use the Foreign National Registration System (FNRS) to submit requests for access to NOAA facilities and ships. The Departmental Sponsor/NOAA (DSN) is responsible for obtaining clearances and export licenses and for providing escorts required by the NAO. DSNs should consult with their designated Line Office Deemed Export point of contact to assist with the process.

Full compliance with NAO 207-12 is required.

Responsibilities of the Chief Scientist:

1. Provide the Commanding Officer with the email generated by the Servicing Security Office granting approval for the foreign national guest's visit. (For NMFS-sponsored guests, this email will be transmitted by FNRS.) This email will identify the guest's DSN

and Designated Escorts (if any) and will serve as evidence that the requirements of NAO 207-12 have been complied with.

2. Escorts – The Chief Scientist is responsible to provide escorts to comply with NAO 207-12 Section 5.10, or as required by the vessel's DOC/OSY Regional Security Officer.
3. Ensure all non-foreign national members of the scientific party receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the Servicing Security Office.
4. Export Control - Ensure that approved controls are in place for any technologies subject to Export Administration Regulations (EAR) that will be brought aboard the ship.

The Commanding Officer and the Chief Scientist will keep each other informed of controlled technologies belonging to the ship and to the scientific party and will work together to implement any access controls necessary to ensure no unlicensed export occurs.

Responsibilities of the Commanding Officer:

1. Ensure only those foreign nationals with DOC/OSY clearance are granted access.
2. Deny access to OMAO platforms and facilities by foreign nationals from countries controlled for anti-terrorism (AT) reasons and individuals from Cuba or Iran without written approval from the Director of the Office of Marine and Aviation Operations and compliance with export and sanction regulations.
3. Ensure foreign national access is permitted only if unlicensed deemed export is not likely to occur.
4. Ensure receipt from the Chief Scientist or the DSN of the FNRS or Servicing Security Office email granting approval for the foreign national guest's visit.
5. Ensure Foreign Port Officials, e.g., Pilots, immigration officials, receive escorted access in accordance with maritime custom to facilitate the vessel's visit to foreign ports.
6. Ensure all OMAO personnel onboard receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the Servicing Security Office.

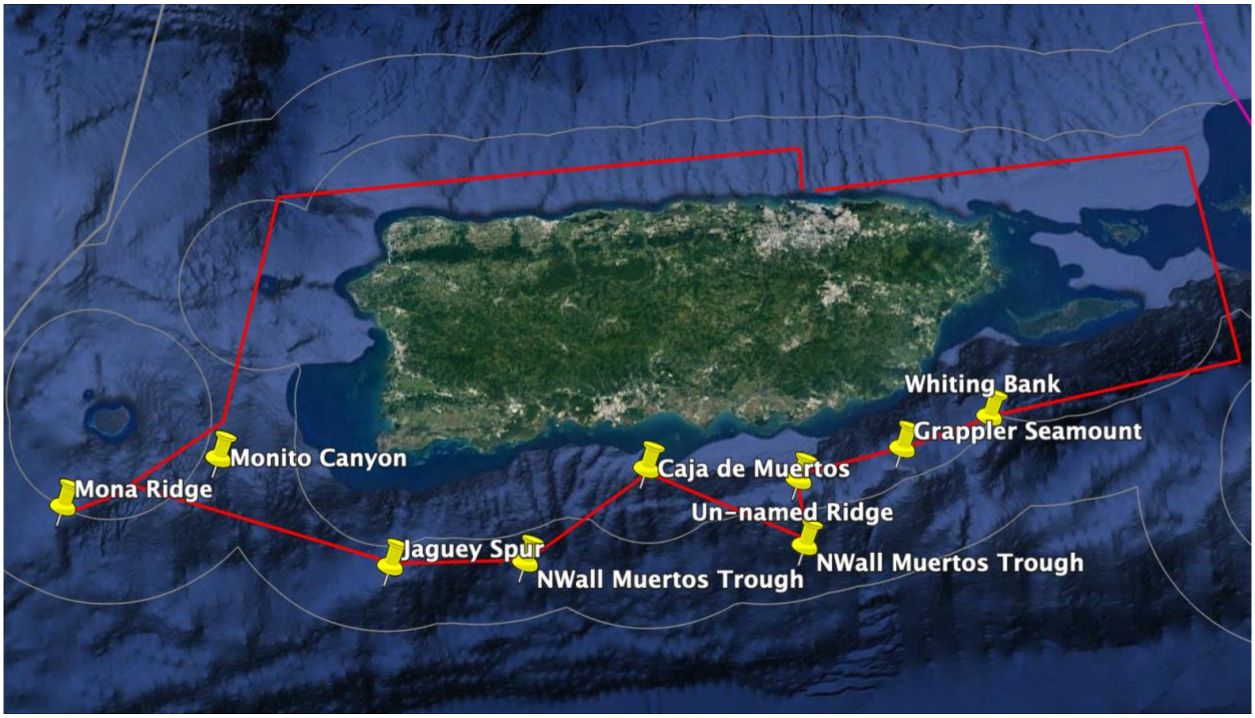
Responsibilities of the Foreign National Sponsor:

1. Export Control - The DSN is responsible for obtaining any required export licenses and complying with any conditions of those licenses prior to the foreign national being provided access to the controlled technology onboard regardless of the technology's ownership.
2. The DSN, if not sailing for the project,shall assign an on-board Program individual, who will be responsible for the foreign national while on board. The identified individual must be a U.S. citizen and a NOAA or DOC employee. According to DOC/OSY, this requirement cannot be altered.

3. Ensure completion and submission of 207-12 Appendix C (Certification of Conditions and Responsibilities for a Foreign National) within three days of the FN's arrival onboard the ship.

IX. Appendices

1. Figure 1. Map of the survey area with target ROV dive locations (yellow pins). Cruise track is also indicated in red.



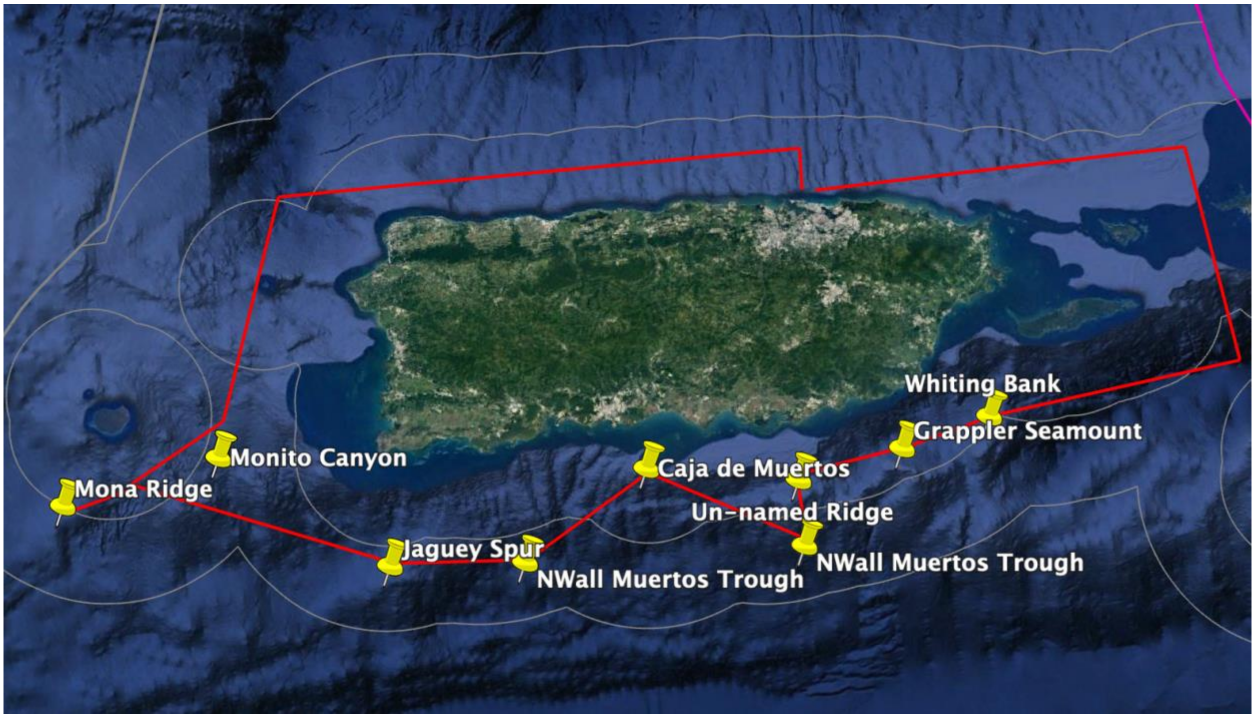
2. Table 1. Priority dive targets

Location	Longitude	Latitude	Depth (m)
Whiting Bank	-65.69454	17.85539	900
Whiting Bank	-65.69454	17.85539	900
Grappler Seamount	-65.91998	17.79999	500
N Wall Muertos	-66.19491	17.65648	1500

Un-Named Ridge	-66.18553	17.74847	350
Un-Named Ridge	-66.33373	17.74607	900
Caja de Muertos	-66.56299	17.80899	883
N Wall Muertos	-66.97633	17.69745	2000
Jaguey Spur	-67.22296	17.63399	2100
Mona Ridge	-68.04512	17.84414	1900
Monito Canyon	-67.65610	17.87560	1000
Monito Canyon, Depart SanJuan	-67.64099	17.99317	1300

Appendix B

1. Figure 1. Map of the survey area with target ROV dive locations (yellow pins). Cruise track is also indicated in red.



2. Table 1. Priority dive targets

Location	Longitude	Latitude	Depth (m)
Whiting Bank	-65.69454	17.85539	900
Whiting Bank	-65.69454	17.85539	900
Grappler Seamount	-65.91998	17.79999	500
N Wall Muertos	-66.19491	17.65648	1500
Un-Named Ridge	-66.18553	17.74847	350
Un-Named Ridge	-66.33373	17.74607	900

Caja de Muertos	-66.56299	17.80899	883
N Wall Muertos	-66.97633	17.69745	2000
Jaguey Spur	-67.22296	17.63399	2100
Mona Ridge	-68.04512	17.84414	1900
Monito Canyon	-67.65610	17.87560	1000
Monito Canyon, Depart SanJuan	-67.64099	17.99317	1300