

Windows to the Deep 2021: Southeast U.S. ROV and Mapping (EX-21-07)

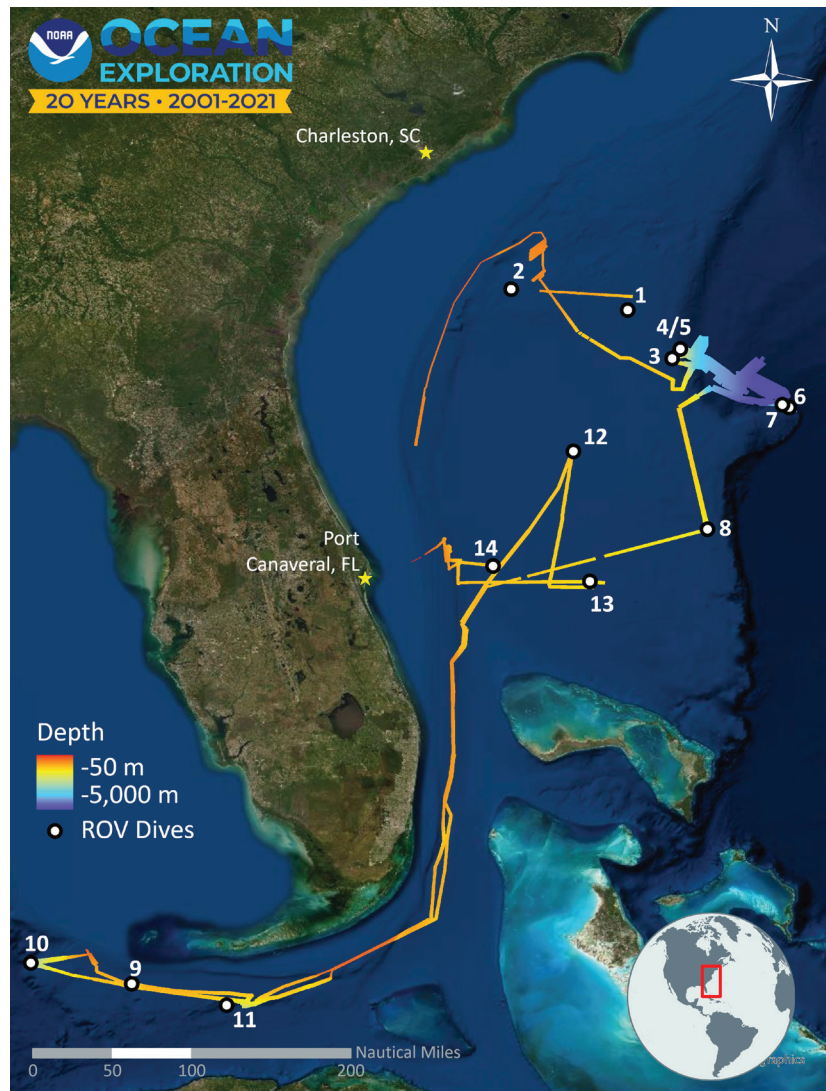


NOAA SHIP *OKEANOS EXPLORER* October 26-November 15, 2021

The Windows to the Deep 2021: U.S. Southeast ROV and Mapping expedition was NOAA Ocean Exploration's last expedition on NOAA Ship *Okeanos Explorer* focused on the Blake Plateau region for the [Atlantic Seafloor Partnership for Integrated Research and Exploration \(ASPIRE\)](#) campaign. ASPIRE is a major multiyear, multinational collaborative field program focused on raising collective knowledge and understanding of the North Atlantic Ocean.

EXPEDITION SUMMARY

[Windows to the Deep 2021](#) was a 21-day telepresence-enabled expedition to collect critical information and acquire data on priority exploration areas identified by the ocean management and scientific communities. This expedition entailed exploration of a diversity of features along the Southeast U.S. continental margin with mapping and remotely operated vehicle (ROV) operations. It targeted areas with the potential to host deep-sea coral and sponge communities and bioherms, maritime heritage sites, and deep-sea escarpments and also featured water column exploration. Mapping data collected during this expedition improved upon previous mapping data and filled major data gaps in the region. During this expedition, NOAA Ocean Exploration also met the milestone of [2 million square kilometers \(772,204 square miles\) mapped](#) using *Okeanos Explorer*. Major accomplishments of this expedition are summarized in the pages that follow.



Windows to the Deep 2021 mapping data collected and dive sites. Mapping data is colored from red (-50 meters/164 feet) to blue (-5,000 meters/16,404 feet). Dive sites are marked by white dots and the respective dive number.

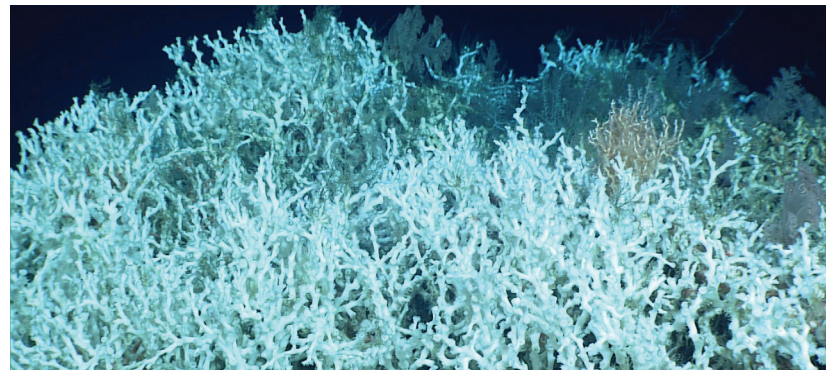
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ACHIEVING ASPIRE GOALS

Each ASPIRE expedition has its own objectives that support the goals of the larger campaign. Some of these goals are highlighted here with relevant accomplishments from Windows to the Deep 2021.

Goal: Improve knowledge of unexplored areas within the U.S. Exclusive Economic Zone (EEZ) and in deep-sea areas that have been mapped for the U.S. Extended Continental Shelf Project to inform management needs for sensitive habitats, geological features, maritime heritage sites, and potential resources.

- Conducted 14 ROV dives ranging in depth from 475 to 3,650 meters (1,558-11,975 feet). Data collected can be used to increase understanding of deep-sea ecosystem connectivity across the Atlantic basin.
- Collected 79 biological samples (45 primary and 34 associates), 4 geological samples, and 57 water samples.
 - Biological samples generally represented new records, potential new species, or dominant fauna.
 - Geological samples will be used to better understand the geological history of this region as well as to characterize habitat substrate.
 - Water samples were collected for environmental DNA (eDNA) processing using ROV *Deep Discoverer* as part of an operational pilot. Samples were collected at standardized waypoints on every dive.
- Completed additional ROV exploration of the largest nearly continuous deep-sea coral mound ecosystem discovered to date. The ROV dives added substantial evidence to the theory that the numerous mounds on the Stetson Mesa offshore of Florida and Georgia are due to the slow accumulation of *Lophelia pertusa* skeletal material over hundreds of thousands of years. This expedition explored three mounds. One was *L. pertusa* rubble, and two were rich with live coral stands at their crests.
- Conducted three ROV dives as well as mapping operations in the Stetson-Miami Terrace Deepwater Coral Habitat Area of Particular Concern (HAPC), which is managed by the South Atlantic Fishery Management Council (SAFMC). Two of the dives revealed high-density/high-diversity coral communities. The third dive targeted a shipwreck that may be a source of oil pollution.

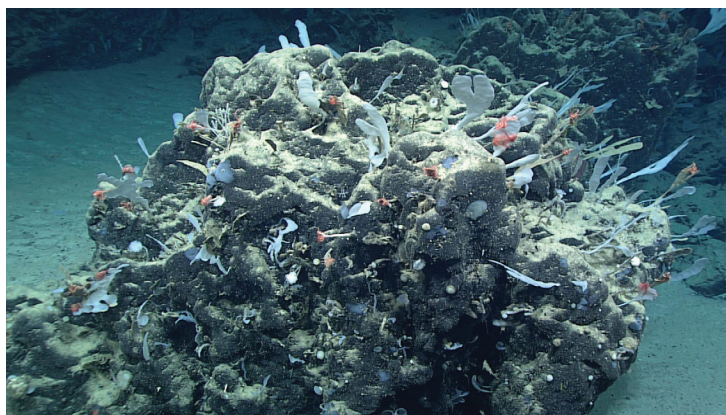


The peak of a *Lophelia pertusa* bioherm seen on Dive 01 of Windows to the Deep 2021.

- Discovered a high diversity of deep-sea corals and sponges on the Blake Spur wall and in the Blake Spur canyon (depths to 3,769 meters/12,365 feet) along the Blake Escarpment in previously unexplored areas.
- Discovered and explored what is likely the wreck of *SS Bloody Marsh* to support the U.S. Coast Guard and NOAA maritime heritage programs.

Goal: Locate and characterize deep-sea coral, sponge, and chemosynthetic communities.

- Documented nine dive sites with high biological diversity.
- Documented deep-sea corals and sponges on every benthic dive.
- Documented new records, both collected and observed:
 - Potential new species collected included two species of sea pen.
 - Potential depth range extensions included:
 - *Paragorgia* sp. (bubblegum coral) seen below 3,000 meters (9,843 feet).
 - *Bythites gerdae* seen 200 meters (656 feet) or more below its known depth range and only seen *in situ* once or twice before.
 - Potential geographic range extensions included several fish:
 - *Deania calcea* (birdbeak dogfish)
 - *Gaidropsarus ensis* (boreal slope fish)
 - *Holcomycteronus* sp. (first *in situ* footage of this rarely observed genus)
- Documented the presence of commercially important species, including *Chaceon quinquedens* (red crab).
- Collected a *Habrocidaris* sp., a rare and unusual echinoid urchin, which will be used to assess its “ancient” looking morphology to determine if it represents an early diverging lineage or a more recent lineage that has converged on its ancient look.
- Collected a striking, blue encrusting hymedesmiid (order Poecilosclerida) demosponge with large oscules with thin membranes. The pigment proved to be ethanol soluble and stable and is therefore of biochemical importance.

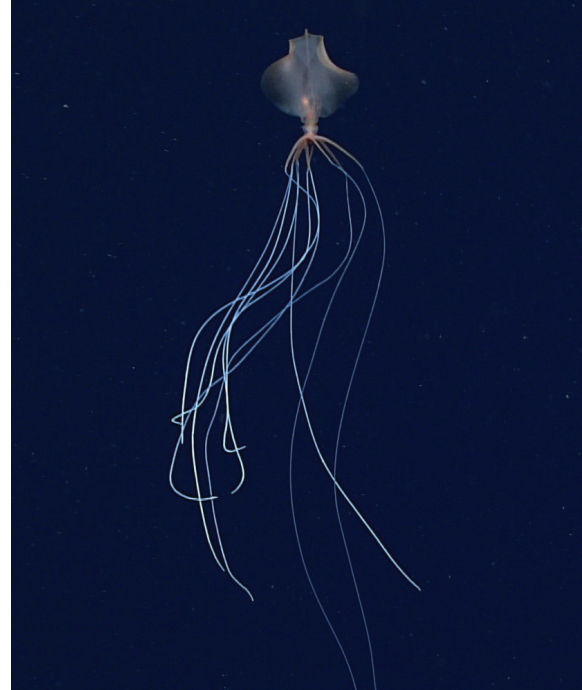


Large boulders with white, flat, lobate hexactinellid (glass) sponges (*Tretopleura* sp.) from Dive 06 of Windows to the Deep 2021, one of which was collected.



A *Bythites gerdae* seen below its known depth range during Dive 11 of Windows to the Deep 2021. This fish may only have been imaged *in situ* once or twice before.

- Documented a rare sighting of a large (approximately 5 meters/16 feet) *Magnapinna* sp. (bigfin squid), which has only been recorded about a dozen times in the literature.
- Documented a homolodromiid crab carrying a sponge over its body using its back legs.
- Documented several rarely observed possible predation events, including:
 - A *Gilbertaster caribaea* (sea star) feeding on a small, delicate coral (possibly a primnoid).
 - A *Circeaster americanus* (sea star) with forked hooks on the tips of its five arms feeding on a small coral (possibly a primnoid or paramuricid).
 - A pycnogonid (sea spider) from the family Colossendeidae feeding on an anemone.
 - A seven-armed solasterid (sun star) feeding on a pterasterid (slime star).



A large (approximately 5 meters/16 feet) big fin squid (*Magnapinna* sp.) seen during Dive 10 of Windows to the Deep 2021. Only about a dozen sightings of a big fin squid are recorded in the literature to date.

Goal: Characterize water column habitats using acoustics, visual observations, and emerging technologies.

- Conducted midwater exploration at depths ranging from 300 to 1,005 meters (984-3,297 feet) during two dives to investigate the diversity and abundance of the midwater's largely unknown pelagic fauna.
- Documented several possibly new species of ctenophore during midwater transects. Two were collected from the waters just above the seafloor. This habitat is extremely difficult to sample with nets, so observations and collection of pelagic animals associated with deep-sea bottom environments, made possible via expeditions such as this, are critical for complete documentation of marine biodiversity, especially when combined with sample collection.
- Collected water samples for eDNA processing at the start of every transect during water column dives and during ROV descent through the deep scattering layer during benthic-focused dives.

Goal: Extend bathymetric mapping coverage in the U.S. Exclusive Economic Zone (EEZ) and international waters in support of Seabed 2030.

- Mapped 15,800 square kilometers (6,100 square miles) of seafloor, an area larger than the state of Connecticut.
- Completed mapping of almost all the remaining small gaps in the multibeam sonar bathymetry of the Blake Plateau deeper than 250 meters (820 feet). NOAA Ocean Exploration

has completed the vast majority of multibeam mapping on the plateau through a focused multiyear exploration campaign on *Okeanos Explorer*.

- Mapped gaps in multibeam sonar coverage in the Straits of Florida during strategic ship transits.
- Mapped approximately 150-200 new deep-sea coral mounds, including dense mound aggregations at the western edge of the Blake Plateau within the Stetson-Miami Terrace Deepwater Coral HAPC.
- Improved bathymetric coverage and resolution on and around the international waters of the Blake Spur.

Goal: Enhance predictive capabilities for vulnerable marine habitats and submarine geohazards.

- Discovered numerous areas of deep-sea coral and sponge habitat, which has improved our understanding of this region and has habitat modeling implications that may apply to many other places throughout the ocean.

Goal: Increase understanding of deep-sea ecosystem connectivity across the Atlantic basin.

- Collected two specimens to support trans-Atlantic connectivity studies: *Lophelia pertusa* and *Paramuricia* sp., the latter with an *Asteroschema* sp. (ophiuroid) associate.
- Collected multiple water samples for eDNA processing at standardized waypoints during all dives. Also collected a water sample of a single ASPIRE target species of interest from each dive.

ENGAGING THE SCIENTIFIC COMMUNITY AND THE PUBLIC

Okeanos Explorer is a leading platform for telepresence-enabled exploration, which allows shore-based scientists and managers to fully engage in an expedition and enables members of the public to experience deep-sea exploration and the wonders of science and discovery in real time. Highlights of this engagement during Windows to the Deep 2021 are noted below.

- Engaged more than 127 scientists, resource managers, and students from around the world, including 22 U.S. states, Canada, Mexico, Colombia, Portugal, Italy, the United Kingdom, Malta, Australia, Russia, and Japan.
- Engaged with audiences around the world, opening a window of understanding into the deep sea through live interactions, live-streamed video, expedition web content, and media/web stories, including:
 - Two live interactions, including an interaction sponsored by the White House Office of Science and Technology Policy and the Smithsonian National Museum of Natural History that featured the president's science advisor and director of the White House Office of Science and Technology Policy, the director of the Smithsonian National

Museum of Natural History, and the NOAA administrator. Expedition participants included Science Lead Allen Collins, Mapping Lead Derek Sowers, and Cmdr. Nicole Manning. This virtual interaction had approximately 1,600 views.

- More than 66 news/web stories sharing expedition news, including a story about *SS Bloody Marsh*, which received the most coverage. Outlets included the 28 McClatchy papers (e.g., *Miami Herald*), AccuWeather, *Newsweek*, Live Science, The Weather Channel, and Fox News Weather.
- More than 71,000 live video feed views during the expedition.
- More than 16,000 expedition-specific web content views during the expedition.



Science Lead Allen Collins, Cmdr. Nicole Manning, and Mapping Lead Derek Sowers participate in a live interaction with the White House Office of Science and Technology Policy during Windows to the Deep 2021.

COLLECTING AND SHARING DATA

Data collected during this expedition will inform initial characterization of the areas visited and include multibeam, single beam, sub-bottom, ADCP (acoustic Doppler current profiler), XBT (expendable bathythermograph), CTD (conductivity, temperature, and depth) and dissolved oxygen profiles; surface oceanographic and meteorological sensors; video and imagery; and physical samples. All data from this expedition will be publicly available through national archives. A direct link to the expedition data archive will be provided on the expedition website once the data are available. For questions or inquiries about this expedition, email ex.expeditioncoordinator@noaa.gov.



Atlantic Seafloor Partnership for
Integrated Research and Exploration



By leading national efforts to explore our ocean and making ocean exploration more accessible, NOAA Ocean Exploration is filling gaps in our basic understanding of U.S. deep waters and the seafloor. This work provides critical deep-ocean data, information, and awareness needed to maintain the health of our ocean, sustainably manage our marine resources, accelerate economies, and build a better appreciation of the value and importance of the ocean in our everyday lives.