2019 Southeastern U.S. Deep-sea Exploration
(EX1906 and EX1907)

NOAA Ship *Okeanos Explorer*
October 5 - November 20, 2019

ASPIRE

Ocean Exploration and Research

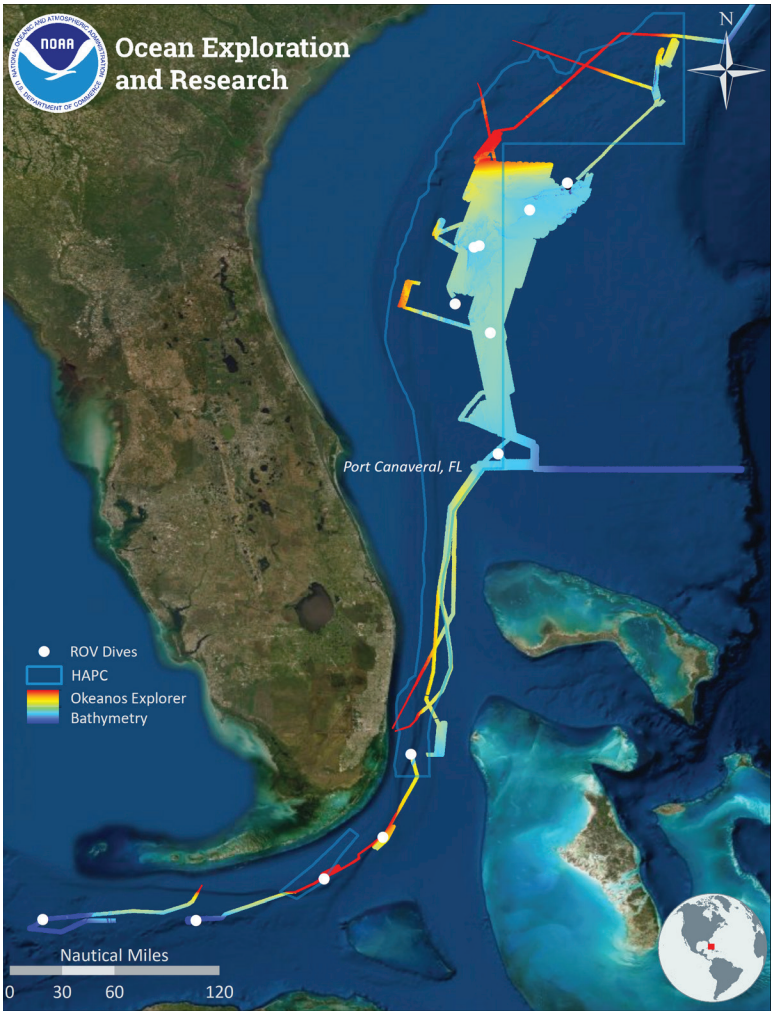
The 2019 Southeastern U.S. Deep-sea Exploration is one of several expeditions led by the NOAA Office of Ocean Exploration and Research (OER) on NOAA Ship *Okeanos Explorer* that contribute to the Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE). ASPIRE is a major multiyear, multinational collaborative field campaign focused on raising collective knowledge and understanding of the North Atlantic Ocean.

Expedition Summary

The 2019 Southeastern U.S. Deep-sea Exploration (EX1906 and EX1907) was a 43-day, two-leg, telepresence-enabled expedition to collect critical baseline information about unknown and poorly understood deepwater areas of the Southeastern U.S. continental margin. It addressed scientific themes and priority areas suggested by scientists and managers from NOAA, management agencies in the region, other federal agencies, and the ocean science community. The expedition entailed mapping and remotely operated vehicle (ROV) operations, filling data gaps in the region toward Seabed 2030 goals for mapping unexplored regions of Earth's ocean and exploring a variety of deep-sea features. Major accomplishments of this expedition are summarized here.

Achieving Goals

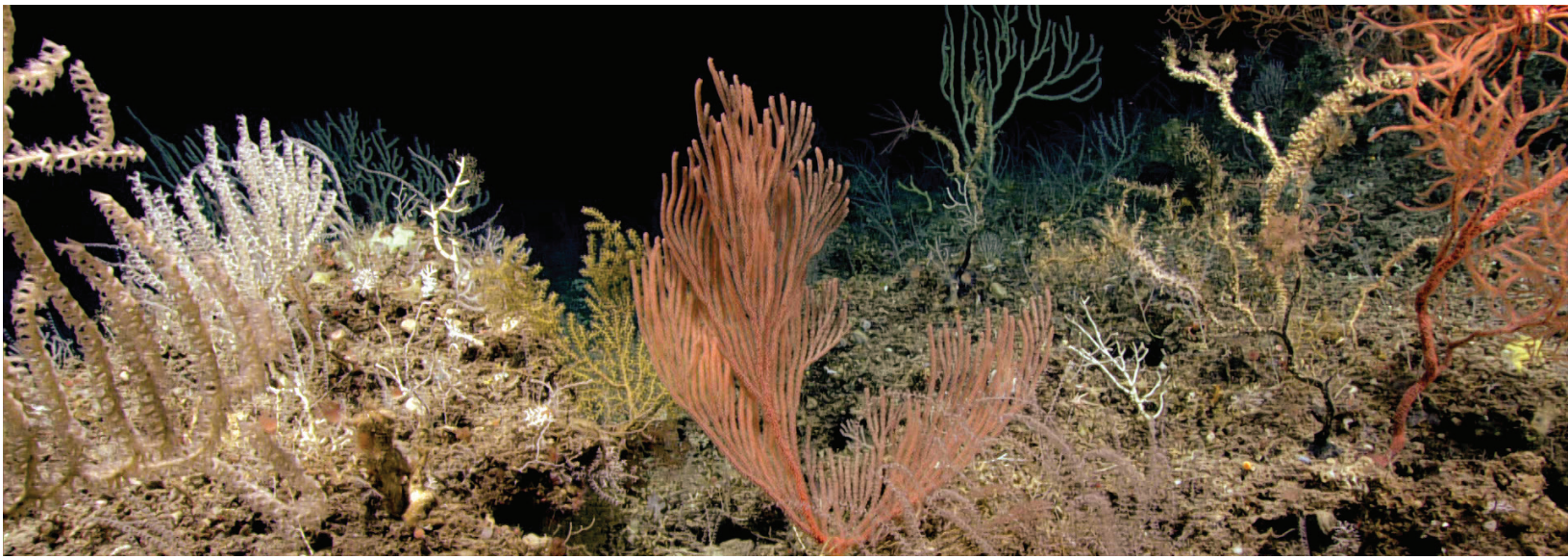
Each ASPIRE expedition has its own objectives that support the goals of the larger campaign. Some of these goals are highlighted here with relevant accomplishments from the 2019 Southeastern U.S. Deep-sea Exploration.



Map of the data collected during the 2019 Southeastern U.S. Deep-sea Exploration (EX1906 and EX1907). *Map courtesy of the NOAA Office of Ocean Exploration and Research.*

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 12 ROV dives, which ranged in depth from 347 to 1,218 meters (1,325 to 3,996 feet). Habitats/features explored included coral mounds, terraces, slopes, escarpments, and boulders.
- Collected 69 biological specimens (40 primary and 29 associates):
    - 50 represent potential new species, range extensions of animals not previously known to occur in the region, dominant species at the site, and/or rare morphotypes.
    - 16 represent ASPIRE target species and will contribute to trans-Atlantic connectivity studies.
- Increased knowledge about the extent, density, morphology, and biological community composition of deep-sea coral (*Lophelia pertusa*) mounds on the central Blake Plateau through mapping and visual surveys.
- Conducted ROV dives in two habitat areas of particular concern (HAPCs) managed by the South Atlantic Fishery Management Council (SAFMC):
    - Stetson-Miami Terrace Deepwater Coral HAPC (6 dives) — Expanded knowledge about the eastern boundary of the Million Mounds region.
    - Pourtalès Terrace Deepwater Coral HAPC (1 dive) — Explored both inside and outside of the protected area.



This beautiful coral garden was discovered in the Stetson-Miami Deepwater HAPC during the 2019 Southeastern U.S. Deep-sea Exploration in an area that may mark the eastern extent of the Million Mounds region. *Image courtesy of the NOAA Office of Ocean Exploration and Research, 2019 Southeastern U.S. Deep-sea Exploration.*

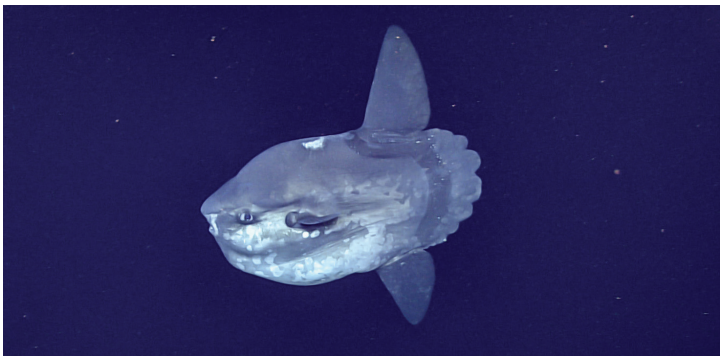
- Explored in and around an area historically subject to the use of experimental deep-sea mining technologies to document signs of disturbance and gather data about the current state of its geology and biology. This dive site was targeted in collaboration with the U.S. Geological Survey (USGS) and the Bureau of Ocean Energy Management (BOEM) and based on mapping data collected during the Windows to the Deep 2019 expedition (EX1903) and historical data from USGS.
- Explored a variety of geological features, including:
    - Terrace-like plateaus on Pourtalès Terrace, which were dominated by eroding limestone encrusted with phosphorite or ferromanganese.
    - Features south of Pourtalès Terrace that were thought to be deep-sea coral mounds based on bathymetry but were actually large boulders that appeared to have originated from the adjacent escarpment.

- Features southwest of the Dry Tortugas that included a plateau surrounded by smaller features resembling pieces of ice calved from an iceberg. The bathymetry suggested these "berg bits" may have been deep-sea coral mounds, but they were actually pieces of the eroded plateau. Some were sedimented, and others were colonized by deep-sea corals and sponges.

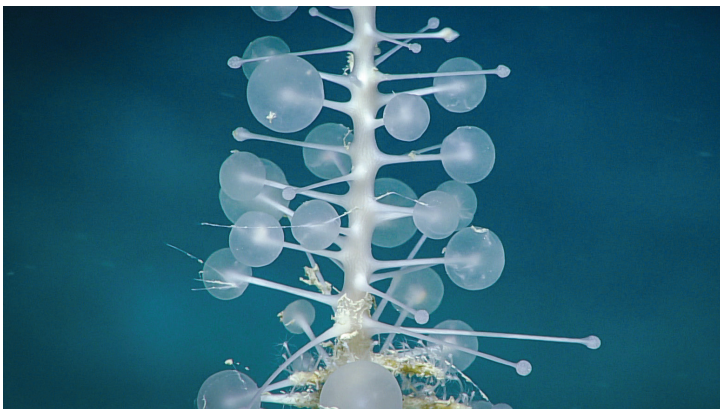
- Collected 6 geological specimens (sediment, ferromanganese-encrusted cobbles, rocks), which will be used to better understand the geological history of the region and to characterize habitat substrate.
- Documented the presence of trash on most dives. Plastic, metal, glass, and fabric debris was noted along with fishing-related debris like ghost nets and fishing line, which was often wrapped around immobile organisms.

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

- Documented deep-sea corals and sponges on all 12 ROV dives.
- Documented high-density communities of deep-sea corals and sponges on 3 ROV dives:
  - Stetson Mesa, Million Mounds East (Dive 02) — Explored a coral garden in an area that may mark the eastern extent of the Million Mounds region.
  - Isolated Mound, Central Blake Plateau (Dive 06) — Discovered and explored two previously unknown *Lophelia pertusa* mounds measuring more than 60 meters (197 feet) tall. These features, which are outside of a HAPC, were targeted for exploration based on mapping data collected during the first leg of the expedition.
  - Pourtalès Terrace (Dive 10) — Explored terrace-like plateaus and overhangs, which harbored life on both the top surfaces and the undersides. Among the many highlights was an abundance of *Gorgonocephalus* sp. (basket stars); 10 were documented.
- Documented new records, both observed and collected:
  - Potential new species collected included:
    - Sponges: *Haplosclerida* sp., *Geodia* sp., *Oceanapia* sp., *Euplectellidae* sp. (same family as *Euplectella aspergillum*), and a number of carnivorous sponges from the Stylocordylidae and Cladorhizidae families, including *Chondrocladia* sp.
    - Corals: *Eunicella* cf. *modesta*, *Enallopsammia* cf. *profunda*, *Lepidisis* sp., and *Plexauridae* sp.
    - Echinoderms: cf. *Floriaster maya*.
    - Bryozoan: cf. *Canda* sp. or cf. *Reteporellina* sp. (yellow mesh fan).
  - Potential new morphotypes included *Zenometra columnaris* (this crinoid is usually purple; these specimens are more tan/cream).
  - Potential geographic range extensions included *Anoxycalyx* (*Scolymastra*) *joubini*, a sponge only documented to date in the Antarctic region.

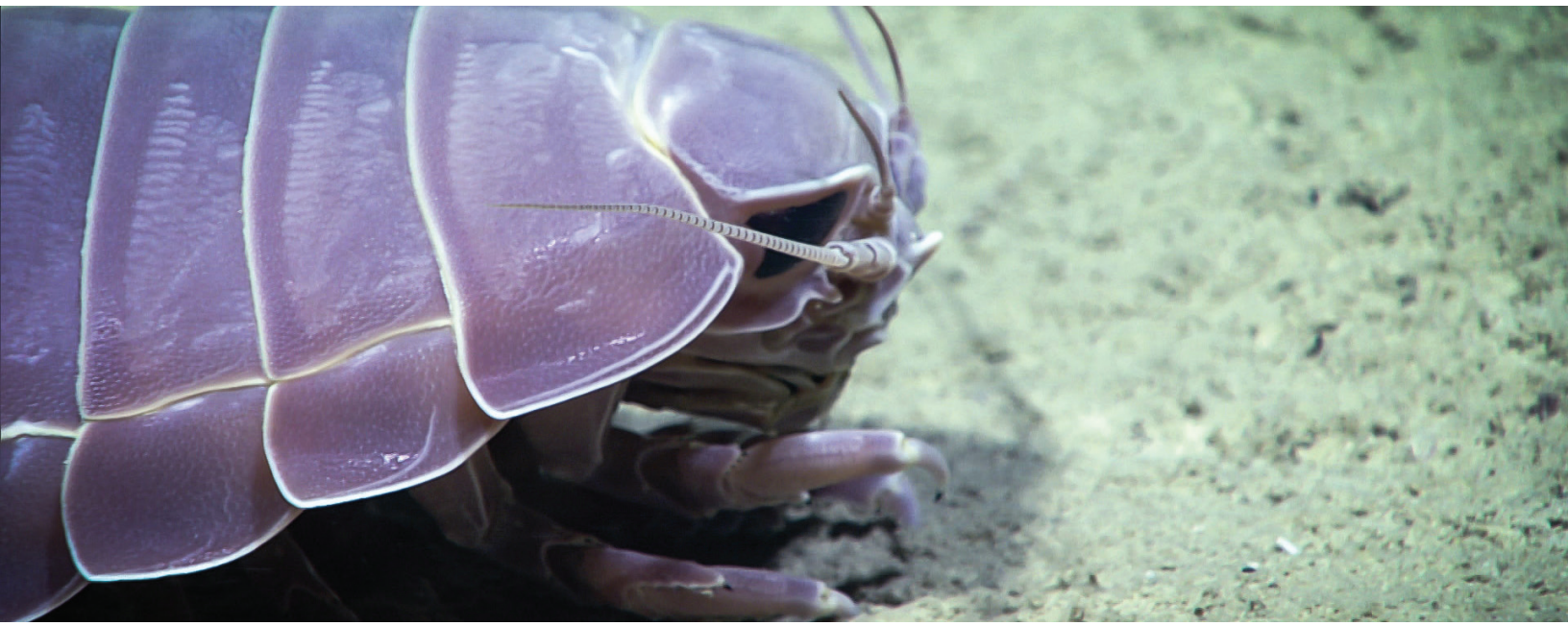


This *Mola mola* (ocean sunfish) seen while exploring the Pourtalès Terrace was a highlight of the 2019 Southeastern U.S. Deep-sea Exploration. *Image courtesy of the NOAA Office of Ocean Exploration and Research, 2019 Southeastern U.S. Deep-sea Exploration.*



This *Chondrocladia* sp. was one of many carnivorous sponges seen during the 2019 Southeastern U.S. Deep-sea Exploration, some of which may be species new to science. *Image courtesy of the NOAA Office of Ocean Exploration and Research, 2019 Southeastern U.S. Deep-sea Exploration.*

- Documented several unfamiliar or rarely seen life history events:
  - A *Pycnogonida* (sea spider) with younglings.
  - An *Acanthacaris caeca* (blind lobster) waving a small piece of organic tissue with its second chelate leg, perhaps fishing for prey.
  - A *Henricia* sp. (sea star) feeding on a carnivorous sponge (both were collected).
  - A *Bathynomus giganticus* (giant isopod) swimming through the water clutching a fish head.
  - A *Calibelemnon* sp. (sea pen) retracting into a burrow in the seafloor when intentionally prodded by the ROV's manipulator arm.



This is one of a number of giant isopods (*Bathynomous giganteus*) seen during the 2019 Southeastern U.S. Deep-sea Exploration. *Image courtesy of the NOAA Office of Ocean Exploration and Research, 2019 Southeastern U.S. Deep-sea Exploration.*

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

- Conducted 29 days of 24-hour mapping, and overnight mapping during the second leg, in high-priority areas as identified by USGS, BOEM, NOAA, the SAFMC, and the DEEP SEARCH project.
- Mapped more than 33,000 square kilometers (12,741 square miles), an area larger than the states of Maryland, Delaware, and Rhode Island combined, with multibeam sonar, including:
  - 29,939 square kilometers (11,560 square miles) in the U.S. EEZ.
  - 5,129 square kilometers (1,980 square miles) in the two protected areas.
  - 912 square kilometers (352 square miles) in the Bahamas EEZ.
- Added bathymetric coverage to the Blake Plateau, bringing the total mapping in this area by OER on the *Okeanos Explorer* since 2011 to over 76,000 square kilometers (29,344 square miles).
- Connected three separate cruise surveys (EX1903-L1, EX1903-L2, and EX1906) during EX1907.
- Mapped what is potentially the eastern boundary of the Million Mounds region.
- Mapped thousands of new mound features that are likely deep-sea coral mounds.
- Completed mapping near the east-west maritime boundary area between the exclusive economic zones of the United States and the Bahamas.

Goal: Characterize water column habitats throughout the Atlantic basin using acoustics, visual observations, and emerging technologies.

- Collected over 370 gigabytes of EK60 and EK80 split-beam data, over both legs of the expedition, with applications for biomass and seep research.
- Collected over 200 gigabytes of EM 302 water column data.

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

- Discovered areas of deep-sea coral and sponge habitat, which improves our understanding of the region and informs predictive habitat models that may be used in other regions.
- Continued collecting high-resolution bathymetry to better understand past and present submarine geohazards.

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

- Collected 16 biological specimens to support trans-Atlantic connectivity studies, including sponges (*Aphrocallistes beatrix* and *Vazella pourtalesii*) and corals (*Leiopathes* sp., *Bathypathes alternata*, and *Lophelia pertusa*).

Engaging the Scientific Community and the Public

The *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.

- Engaged more than 50 scientists and managers from 30 institutions around the world.
- Supported the exploration command center at Harbor Branch Oceanographic Institute at Florida Atlantic University, from which scientists participated during every dive.
- Conducted a ship tour for partners from the NOAA Atlantic Oceanographic and Meteorological Laboratory, which highlighted the successful integration of the lab's XBT (expendable bathythermograph) autolauncher into OER's mapping operations.
- Engaged the public through live interactions, live streamed video, expedition web content, and media/web stories:
    - 5 live interactions, engaging more than 50 people, including scientists, high school and college students, and the Acting NOAA Administrator.
    - 207,700 views of the live streamed video.
    - 18,350 visits to the expedition web content during the ROV leg of the expedition.
    - 80+ national and local media/web stories.

Collecting and Sharing Data

Data collected during this expedition will inform initial characterization of the areas visited and include multibeam, split-beam, sub-bottom, backscatter, ADCP (acoustic Doppler current profiler), XBT, CTD (conductivity, temperature, and depth), and dissolved oxygen profiles; surface oceanographic and meteorological sensor data; video and still imagery; and physical specimens. This data, along with detailed dive summaries, will be made publicly available through national archives. A direct link to the expedition data archive will be provided on the expedition website when the data become available. Biological specimens will be available from the Smithsonian's National Museum of Natural History. Geological specimens will be available from the Marine and Geology Repository at Oregon State University.