Turning the lights on for deep-sea ecosystems in the Caribbean, Gulf of Mexico, and US Southeast Atlantic

Amanda N. Netburn[1*], Caitlin Adams[1], Peter Etnoyer[2], James Murphy[3], Kasey Cantwell[4]
[1]NOAA Office of Ocean Exploration and Research
[2]NOAA National Centers for Coastal Ocean Science
[3]University of Hawaii at Manoa
[4]NOAA Office of Ocean Exploration and Research on contract via Maximus

*Corresponding author email: amanda.netburn@noaa.gov

This full-day session of the ASLO 2019 Aquatic Sciences Meeting served as a forum to highlight recent advances in the understanding of deep-sea ecosystems in the western North Atlantic region encompassed by the Caribbean, Gulf of Mexico, and US Southeast Atlantic. Several federal agencies have been supporting ocean exploration initiatives in these regions over the last couple of years, including three National Oceanographic and Atmospheric Administration (NOAA) programs, the Office of Ocean Exploration and Research (OER), National Centers for Coastal Ocean Science (NCCOS), and Deep Sea Coral Research and Technology Program (DSCRTP), as well as the Bureau of Ocean Energy Management (BOEM) and US Geological Survey (USGS). Caitlin Adams opened the session by describing the NOAA OER-led Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE) campaign. She shared the upcoming NOAA Ship *Okeanos Explorer* 2019 field season schedule, and provided information on how to participate in these partnerships. The remainder of the presentations were organized by geography, with the first set of talks focused on the Gulf of Mexico (GoM).

Gulf of Mexico

Peter Etnoyer shared highlights from the DSCRTP-sponsored Southeast Deep Coral Initiative (SEDCI), which conducted 125 remotely operated vehicle dives since 2016 in Flower Garden Banks National Marine Sanctuary and along the West Florida Shelf. These benthic surveys informed the 2018 establishment of new marine protected areas in the Gulf of Mexico (GoM).

Patrick Schwing showed how he and his collaborators used density, diversity, and stable carbonate isotope compositions of benthic foraminifera shells to make inter-regional comparisons for the deep GoM. The data suggested that species composition in these benthic foram communities may be approaching a stable state since the Deepwater Horizon oil spill. Sam Vohsen presented work describing the microbiomes of several different coral species in the GoM. The dominant microbes in a coral species that lives near cold seeps contain genes for sulfur oxidation and carbon fixation, suggesting a chemoautotrophic symbiosis. Jill Bourque described an investigation of community structure and function of seep infaunal communities in the GoM in relation to habitat heterogeneity and sediment geochemistry. She estimated proximity to seeps by modeling seep distribution, finding support for a spatially-extensive sphere of influence of seeps. Rainer Amon provided insights into the deep circulation of the GoM and Northern Caribbean based on modern and historical dissolved inorganic carbon radiocarbon depth profiles, hydrography, and volume transport estimates. Transitioning into the pelagic realm, Trevor McKenzie presented on characterization of mesopelagic organism distributions and patchiness in the North Central GoM using a combination of acoustic and optical techniques to detect organisms from microbes to large nekton.

Caribbean

Steve Auscavitch presented work on distribution patterns of deep-water corals at three seamounts in the Anegada Passage and described how the project contributes toward a better understanding of deep-sea coral biogeography in the Caribbean. Furu Mienis discussed the use of tethered video recordings, sediment samples, dredges, and baited video experiments at the Saba Bank to reveal regional and depth differences of macrobenthic communities and demersal predators between the northern and southern flanks, attributing the differences to different oceanographic conditions. Daniel Wagner shared outcomes of the Océano Profundo 2018 expedition: Exploration of Deep-sea Habitats of Puerto Rico and the U.S. Virgin Islands, an OER expedition that took place aboard NOAA Ship *Okeanos Explorer* to collect data to support the management of deep-dwelling commercial fishery species and unexplored regions of marine protected areas. Data collected from ROV surveys, multibeam seafloor mapping, and CTD casts are publicly available via the NOAA Archives.

US Southeast Atlantic

Charles Messing talked about recent advances in the understanding of deep tropical western Atlantic crinoid fauna, including descriptions of 4 apparent new species. Roger Flood described a recent ROV survey to explore the abyssal furrows on the Blake Bahama outer ridge conducted during the *Okeanos Explorer* expedition Windows to the Deep 2018: Exploration of the Southeast US Continental Margin. The next set of researchers shared their findings from the 2018 NOAA, US Geological Survey, and Bureau of Ocean Energy Management-led DEEP SEARCH expedition. Erik Cordes, DEEP SEARCH program manager, described the characterization of an extensive deepwater coral reef ecosystem off of the U.S. southeast Atlantic coast, identified by *Okeanos Explorer* seafloor mapping and ROV surveys and HOV *Alvin* dives. Cheryl Morrison put this finding into context, using genetic tools to examine connectivity amongst fourteen deep reef and canyon populations of *Lophelia pertusa* in the region. **[insert image 1]**

 Jay Lunden further examined regional oceanographic influences on specialized deep-sea ecosystems along the U.S. Atlantic margin, demonstrating wide variability in both temperature and oxygen throughout the region. Following the DEEP SEARCH focused talks, Mingshun Jiang described modeling and observations of environmental conditions over deep coral reefs in the Florida Straits.
[insert image 2]

The next several talks focused on chemosynthetic communities along the US Atlantic margin. Amanda Demopoulos explained how her USGS team used stable isotopic analysis to gain insights into methane seep-associated mussel *Bathymodiolus childressi* physiology, underlying geochemistry, and food-web linkages at two seeps in the U.S. Atlantic margin. Her results indicate the mussels rely on both methane and phytoplankton-derived organic material for energy. Natasha Vokhshoori determined variability of food resources to chemosymbiotic mussels along environmental gradients at methane seeps using amino acid nitrogen isotopes. These results were confirmed and refined by Hilary Close's use of novel compound-specific

isotopic fingerprints of methane metabolism and dietary relationships in *Bathymodiolus* at seafloor cold seeps.

Finally, Lauren Cook presented a poster comparing sound scattering layers comprised of mesopelagic organisms in three Atlantic locales- the Gulf Stream, the Slope Sea, and the Sargasso Sea.

The session presentations spanned a variety of environments and disciplines, and highlighted numerous discoveries. Ongoing and future exploration will continue to illuminate the deep waters and seafloor of this region, providing continued information to support data-based decision-making in an area with potential growth in the exploitation of resources in deep waters.

Image 1. Large numbers of *Lophelia pertusa*, were found at the top of the crest at ridge feature in the Richardson Hills area during the Windows to the Deep 2018 expedition [EX1805/EX1806]. Surveys by both the DEEP SEARCH project and the Okeanos Explorer have confirmed extensive coral habitat through this region. *Image courtesy of the NOAA Office of Ocean Exploration and Research, Windows to the Deep 2018.*

Image 2. An image of a squat lobster on a bamboo coral observed during a dive in the Richardson Hills area, offshore of South Carolina during the Windows to the Deep 2018 expedition [EX1805/EX1806]. *Image courtesy of the NOAA Office of Ocean Exploration and Research, Windows to the Deep 2018.*