



## Meeting Summary

### **SUBMARINE CANYONS IN THE MID-ATLANTIC:**

### **CONNECTING SCIENCE TO MANAGEMENT**

**April 7, 2016**

**Wilmington, Delaware**

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### OVERVIEW AND MEETING OBJECTIVES

On April 7, 2016, MARCO convened a one-day meeting of scientific experts and coastal managers to discuss “Submarine Canyons in the Mid-Atlantic: Connecting Science to Management.” The meeting was held at Chase Center Riverfront in Wilmington, Delaware. This workshop built off of an earlier MARCO-hosted workshop in September 2014. Meeting objectives included:

1. To advance the dialogue on submarine canyons in the Mid-Atlantic region and demonstrate MARCO’s work on canyons during 2015.
2. To share scientific knowledge about demonstrated or anticipated effects on canyons from various disturbances.
3. To begin to identify near-term scientific research gaps and research priorities which can inform management discussions.
4. To explore the potential of coordinated interdisciplinary and interagency research programs.
5. To share information from federal agencies on available management programs that have jurisdiction over current and potential uses related to canyons, to understand related data and information requirements.
6. To share information on the recent Mid-Atlantic Fishery Management Council action to protect corals and acknowledge the role of the commercial fishing community in reaching agreement.
7. To identify opportunities to share this information with the Mid-Atlantic regional ocean planning process.

Laura McKay, Chair, MARCO Management Board and Virginia Coastal Zone Management Program, opened the meeting at approximately 9:00 AM with welcoming remarks, followed by an overview of objectives and the agenda by Dr. Chris Kinkade, NOAA, Office for Coastal Management, who served as meeting facilitator.

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## **THE STATE OF THE SCIENCE (Morning Theme)**

The morning discussion focused on State of the Science, and a series of scientific experts presented overviews of research and activities completed to date, followed by Q&A after each presentation.

### **Canyons as a unique ecological system; Dr. Cheryl Morrison, USGS**

Dr. Cheryl Morrison, USGS, presented a broad overview of *“Canyons as a Unique Ecological System”* ([http://midatlanticocean.org/wp-content/uploads/2016/11/CMorrison\\_MARCO\\_canyons\\_April2016\\_Final.pptx.pdf](http://midatlanticocean.org/wp-content/uploads/2016/11/CMorrison_MARCO_canyons_April2016_Final.pptx.pdf)), which emphasized the complexity of the submarine canyon environment, abundance of coral communities, diverse food webs, and complex species interactions. The presentation also noted the importance of considering chemosynthetic habitats and exploring connectivity between individual canyons and the challenge in extrapolating findings from one canyon to other canyons.

In general, a low percentage of the Mid-Atlantic canyons have been explored. Corals are generally slow growers and long-lived. Great physical complexity within and among canyons exists, including tidal flux, eddies and flow. Micro-habitats are abundant. Potential impairments to canyons may include derelict fishing gear, contaminant pollution and ocean acidification.

### **MARCO’s Marine Habitat Priority; Kate Morrison, MARCO**

Kate Morrison, MARCO, presented a summary of *“MARCO’s Marine Habitat Priority”* ([http://midatlanticocean.org/wp-content/uploads/2016/11/KMorrison-MARCO-Presentation\\_Canyons-Meeting\\_-Apr-2016.ppt.pdf](http://midatlanticocean.org/wp-content/uploads/2016/11/KMorrison-MARCO-Presentation_Canyons-Meeting_-Apr-2016.ppt.pdf)) to provide overall context for the meeting. Her overview included: discussion of the workshop goal to understand what types of management programs may be available for canyon ecosystems; MARCO’s *Course of Action for Submarine Canyons*; review of the September 2014 predecessor workshop that focused on understanding science to date; and MARCO’s role in funding a canyons data analysis project with the Woods Hole Oceanographic Institution (described below).

### **MARCO-sponsored analysis of TowCam data; Dr. Martha Nizinski, NOAA**

Dr. Martha Nizinski, NOAA, NMFS Systematics Laboratory; Smithsonian Institution, discussed the MARCO-sponsored analysis of *“TowCam data: Deep-Water Coral Ecosystem Diversity and Habitat Distribution among Northwestern Atlantic Submarine Canyons”* (<http://midatlanticocean.org/meeting-presentations-submarine-canyons-in-the-mid-atlantic-connecting-science-to-management/>). Dr. Nizinski presented this material on behalf of the broad user research team led by Dr. Tim Shank, Woods

Hole Oceanographic Institution, of which she was a part. MARCO funds were used to supplement data analysis for 11 canyons sampled via *TowCam* technology. Specifically, MARCO funding included analyzing roughly 38,900 images from 19 *TowCam* tows for coral and habitat types, geo-referenced locations for corals, sponges, and fishes. Diversity in bathymetry, topography, geology, species, and the composition of habitats they provide were noted across all canyons. Marine debris, such as plastic bags, was also found in the sampled locations.

### **Mid-Atlantic canyon studies: Norfolk and Baltimore canyons; Dr. Steve Ross, UNCW**

Dr. Steve W. Ross, University of North Carolina- Wilmington, presented information on Norfolk and Baltimore canyons ([http://midatlanticocean.org/wp-content/uploads/2016/11/Ross\\_Mid-Atlantic-canyon-workshop-talk-7Apr2016.pptx.pdf](http://midatlanticocean.org/wp-content/uploads/2016/11/Ross_Mid-Atlantic-canyon-workshop-talk-7Apr2016.pptx.pdf)). Geographically close canyons can be quite different, physically and biologically. For instance, in the Norfolk Canyon, the nepheloid layer (a layer of water in the deep ocean containing significant amounts of suspended sediment) is broken into several pieces, but the Baltimore Canyon has a more uniform nepheloid layer. Sedimentation rates are stronger in Norfolk, possibly linked to the different morphology of the canyons. The physical attributes are different between canyons and between the canyons and the adjacent slope. However, there were also similarities between the two canyons. During the last 2-3 years, about 500 hydrocarbon seeps with likely chemosynthetic communities were found in the mid-Atlantic area. There were no differences between canyons in the bacteria communities found in corals. Canyons harbored different bottom invertebrate communities compared with the slope and the two canyons also differed from each other in these communities. The trophic patterns were similar between canyons, but with some differences likely originating from different organic matter input and processing. Hard bottom habitats showed the impact of anthropogenic input including lost fishing gear and plastic bags, and it is likely microplastics were embedded in the sediment. More research is needed to fill multibeam data gaps (>100m), to study seeps, benthic pelagic coupling, and anthropogenic impacts.

### SCIENTIFIC KNOWLEDGE ABOUT POTENTIAL DISTURBANCES TO CANYONS

Following the introductory presentations on the morning theme “The State of the Knowledge,” a panel discussed Scientific Knowledge about potential disturbances to canyons in the following order:

**“Fish Communities of U.S. Atlantic Submarine Canyons”** ([http://midatlanticocean.org/wp-content/uploads/2016/11/Ross\\_Fish-review-MARCO-meeting-6Apr16.pptx.pdf](http://midatlanticocean.org/wp-content/uploads/2016/11/Ross_Fish-review-MARCO-meeting-6Apr16.pptx.pdf)) - Dr. Steve Ross, University of North Carolina- Wilmington; **“Benthic Communities of Mid-Atlantic Bight Canyons”** (<http://midatlanticocean.org/meeting-presentations-submarine-canyons-in-the-mid-atlantic-connecting-science-to-management/>) - Dr. Sandra Brooke, Florida State University; and **“A Brief Overview of Geologic Processes in U.S. Atlantic Submarine Canyons”** ([http://midatlanticocean.org/wp-content/uploads/2016/11/Chaytor\\_MARCO2016.pptx.pdf](http://midatlanticocean.org/wp-content/uploads/2016/11/Chaytor_MARCO2016.pptx.pdf)) -Dr. Jason Chaytor, USGS.

### **Fish Communities of the U.S. Atlantic Submarine Canyons, Dr. Steve Ross, UNCW**

Two studies have addressed fish communities: one around the shallow shipwrecks near Norfolk Canyon and the other was deeper around Norfolk and Baltimore canyons. In the deep area including the canyons, 123 species were found, and 12(+3) species are range extensions (newly known to this region). There were two clear depth distributions, shallow (200-1400 m) and deep (> 1400 m). Corals were not a significant determinant for species distribution, but it was noted that corals provide important habitat structure. Fish assemblages were similar between the two canyons and the slope but communities in the Mid-Atlantic differed from those in the South Atlantic and Gulf of Mexico regions. Even within regions, fish communities differed between reef and soft bottom habitats. Some differences appear to be driven by depth and some by habitat structure and geography. Studies did not find fishes that were endemic to canyons. There were large quantities of invertebrates, arthropods in particular, that support a complex food web

### **Benthic Communities of Mid-Atlantic Bight Canyons, Dr. Sandra Brooke, FSU**

Octocorals is the largest group of corals found in the Mid-Atlantic Bight Canyons. Scleractinians are less abundant but still present, and more were found in the Norfolk Canyon than in Baltimore Canyon. Corals were found on 83% of dives in Baltimore Canyon (15 of 18 dives), and on 100% of the 12 dives in the Norfolk Canyon. Coral diversity is fairly low. These canyons are extremely diverse in terms of other animals (e.g. echinoderms, decapods, and other crustaceans). Octocoral and hexacoral distributions were significantly influenced by the environment, including temperature at depths, turbidity, pH and oxygen. Morphologies on canyons drive diversity which is important to know in order to predict habitats. Models presently over-predict the presence and abundance of corals. Soft sediment habitats support populations that support a number of fisheries. Red crab was common. Many habitats were found with a small amount of substrate creating complex communities. Baltimore Canyon cold seep (410-450 m) is very patchy with substrate and mussels. Norfolk Canyon Seep (1460-1580 m) is covered in live mussels. There are two seep endemic species. Mussel cover is the driver of the invertebrate communities with a direct relationship: more mussels means there will be more invertebrates. Communities at the two seeps were very different.

Impacts to the canyons include landslides (sediment instability), benthic storms, sediment slumping, and surface storms. Anthropogenic physical impacts to habitat and community results from re-suspension of sediment due to anthropogenic actions, entanglement and suffocation from discarded and lost materials, removal of gas hydrates from methane seeps (in locations where this is happening), and the release of toxic substances. Marine debris was found especially in Norfolk Canyon. Ocean acidification will impact deep water corals. To accurately monitor acidification at canyon depths requires an algorithm specific to the Atlantic that has not yet been created.

### **A Brief Overview of Geologic Processes in U.S. Atlantic Submarine Canyons, Dr. Jason Chaytor, USGS**

Geology is part of a large feedback loop throughout the ocean. The US Mid-Atlantic margin is tectonically passive, but still active in terms of ongoing sedimentary processes. Systems are old and formed 20+ million years ago, transporting material from land to deep water. Modern canyon systems became less active when sea-level began to rise, though they are still active. Every canyon is different

and that is a function of pre-existing geology and modern processes. Terrestrial inputs are episodic and can be a potentially extreme disturbance when they happen. Surface waves (storm induced turbidity currents, sediment mixing and resuspension), are episodic and disturbance is potentially extreme. Wall failure and bioerosion can impact slope stability in canyons at both small and large scales. Biology may play a role in the slope stability. The relationship of biology to disturbance features may help indicate how often disturbances happen.

#### UPDATE FROM NOAA OFFICE OF OCEAN EXPLORATION AND RESEARCH

Dr. John McDonough and Jeremy Potter, NOAA, provided an *“Update from NOAA Office of Ocean Exploration and Research”* ([http://midatlanticocean.org/wp-content/uploads/2016/12/Potter\\_MARCO\\_Canyons\\_OER\\_20160404.pptx.pdf](http://midatlanticocean.org/wp-content/uploads/2016/12/Potter_MARCO_Canyons_OER_20160404.pptx.pdf))

In just 15 years, a collaboration of research efforts has greatly increased knowledge of the Atlantic canyons and has enabled a better demonstration of the value of this research to management. Despite this progress, additional information is needed to fill in the gaps of what is not yet understood. This will happen through an integration of science priorities on the part of NOAA, USGS, BOEM, MAFMC, and the academic community up front so that it results in complementary work. Future research should include international Transatlantic territory, nearshore-to-canyons geology, and information on the larger ecological connections needed for natural resource management. This research should encourage the development of new technologies for the collection of information.

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#### **TRANSLATING SCIENCE TO MANAGEMENT (Afternoon Theme)**

The afternoon session focused on Translating Science to Management, and began with a lunch keynote by Warren Elliott, Chair, Ecosystem and Ocean Planning Committee, Mid-Atlantic Fishery Management Council (MAFMC). Mr. Elliott described the **Mid-Atlantic Fishery Management Council- Working Collaboratively to Take Action on Corals**

In June 2015, the MAFMC approved the Deep Sea Corals Amendment to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan (FMP). The amendment was designed to identify and implement measures that reduce, to the extent practicable, impacts of fishing gear on deep sea corals in the Mid-Atlantic region. The Council considered measures that would protect known or likely coral habitat while minimizing the associated costs to commercial fisheries operating in or near areas of deep sea coral habitat. The Council recommended several measures to the National Marine Fisheries Service, including the designation of “deep sea coral zones,” within which the use of most types of bottom-tending fishing gear would be prohibited. Mr. Elliott described the workshops at which boundaries were developed through a collaborative process and negotiated in real time. The end result was a set of boundaries developed by workshop participants. The revised boundaries were designed to protect corals while limiting impacts to the fishing industry.

## CURRENT AND POTENTIAL FEDERAL MANAGEMENT

The afternoon panel explored Current and Potential Federal Management, with speakers from a few of the potential management programs including: Bureau of Ocean Energy Management (BOEM), NOAA National Marine Fisheries Service, and NOAA National Marine Sanctuaries Program. The panel did not attempt to provide a comprehensive overview of all potential management programs but was instead intended to highlight a few available programs. Panelists included: Gregory Boland, BOEM, Environmental Studies Program: *BOEM/NOAA OER/USGS study on two Atlantic Canyons* (<http://midatlanticocean.org/wp-content/uploads/2016/11/Boland-MARCO-Canyons-Panel-4-7-2016.pptx.pdf>), Dr. Brad Blythe, BOEM, Environmental Studies Program: *Science Informed Decisions from Use-Inspired Research: BOEM's Environmental Mission* ([http://midatlanticocean.org/wp-content/uploads/2016/11/Blythe\\_MARCO\\_BOEM.pptx.pdf](http://midatlanticocean.org/wp-content/uploads/2016/11/Blythe_MARCO_BOEM.pptx.pdf)) ([http://midatlanticocean.org/wp-content/uploads/2016/11/Stevenson\\_NOAA-Mgmt-Authorities.pptx.pdf](http://midatlanticocean.org/wp-content/uploads/2016/11/Stevenson_NOAA-Mgmt-Authorities.pptx.pdf)), Dr. David Stevenson, NMFS, NOAA, Greater Atlantic Regional Fisheries Office: *NOAA/NMFS Resource Management in Mid-Atlantic Canyons* ([http://midatlanticocean.org/wp-content/uploads/2016/11/Stevenson\\_NOAA-Mgmt-Authorities.pptx.pdf](http://midatlanticocean.org/wp-content/uploads/2016/11/Stevenson_NOAA-Mgmt-Authorities.pptx.pdf)), and Dr. Paul Ticco, NOAA, National Marine Sanctuaries Program.

### **Science Informed Decisions from Use-Inspired Research, Dr. Brad Blythe, BOEM Environmental Studies Program**

BOEM is responsible for managing ocean energy and mineral resources in the Exclusive Economic Zone (EEZ), 3 – 200 nautical miles offshore, in a safe and environmentally sound manner, including oil and gas, renewable energy, and marine minerals. The Environmental Studies Program (ESP) mission is to study and prevent environmental harm from energy development and minerals extraction.

The ESP reviews proposed activities and highlights further scientific research needs. Environmental research provides the environmental information which forms the basis of the environmental assessment. An environmental analysis and the supporting documents are fed into program decisions. The process may require multiple environmental reviews. Research findings inform regulatory enforcement, consisting of environmental safety and compliance, permitting, monitoring, and mitigation. The ESP Study Development Plan allows ideas for potential future proposals to be studied.

### **Study on two Atlantic Canyons, Gregory Boland, BOEM Environmental Studies Program**

Mr. Boland presented a history of deep water studies of the Atlantic Continental Shelf break from the 1970's through the multi-agency BOEM/NOAA OER/USGS study of Norfolk and Baltimore Canyon between 2011 and 2013 highlighting the discovery of deep-sea corals, gas seeps, and chemosynthetic communities. A final technical report is nearing completion, and is expected to be released to the public in late 2017. BOEM is considering the development of a new study for deep water exploration and research on the Mid- and South Atlantic Ocean.

### **NOAA NMFS Resource Management in the Mid-Atlantic Canyons, Dr. David Stevenson, NOAA NMFS Greater Atlantic Regional Fisheries Office**

Dr. David Stevenson, NOAA NMFS Greater Atlantic Regional Fisheries Office, reviewed NOAA NMFS resource management in the Mid-Atlantic Canyons which are in federal waters. Three laws that affect resources in federal waters were explained, including the Endangered Species Act, the Marine Mammal Protection Act, and the Magnuson-Stevens Fisheries Conservation and Management Act. Fishery Management Councils (FMCs) are charged with describing and identifying Essential Fish Habitat (EFH) for managed species, minimizing to the extent practicable adverse effects on EFH caused by fishing, and identifying other actions to encourage the conservation and enhancement of EFH. The 1996 amendment to the Magnuson-Stevens Act gave the FMCs the discretionary authority to designate zones where and periods when fishing may be restricted to protect deep-sea corals. Better information is needed on species distribution and abundance, seasonality, habitat requirements (pelagic and benthic), effects of climate change, impacts of fishing and non-fishing activities, and better maps of bottom habitat types in the canyons.

### **The National Marine Sanctuaries as a Management Tool, Dr. Paul Ticco, NOAA National Marine Sanctuaries Program**

Dr. Paul Ticco, NOAA National Marine Sanctuaries Program, presented a history of national sanctuary nominations and the 2014 Site Nomination Process (SNP) which formally considers a request from communities. The SNP steps include nomination, evaluation, criteria, consideration, evaluation, and addition to the inventory of potential sanctuaries. The Management Review and Designation process follows the nomination. Offshore Canyons and Seamounts could be considered for Offshore National Marine Sanctuaries. In order to designate a canyon as a Marine National Sanctuary, the best quantitative data and scientific information from continued exploration of these vast areas would aid decision-making.

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### **OPEN DISCUSSION**

Dr. Chris Kinkade, NOAA, Office for Coastal Management, facilitated the afternoon discussion following the panel. The discussion revealed that there are a variety of scientific data gaps in the Mid-Atlantic Submarine Canyons including: bathymetric mapping (esp. <500m), multibeam gaps <100m; validation and refinement of habitat prediction models and moving beyond presence to abundance and diversity of faunal communities; more observations and physical samples; ocean acidification impacts; among others.

There is a need to expand knowledge of and access to scientific information on canyons. This can be done through better connecting various portals. It is also helpful to work with industry and expand data sources. Forums that connect science and management are also helpful. There is a need for public education to tell the story of the canyons.

### **NEXT STEPS**

Laura McKay, Chair, MARCO Management Board, Virginia Department of Environmental Quality, concluded the meeting with some highlights of next steps including: (1) the need to share the regional research priorities discussion with the Mid-Atlantic Regional Planning Body, (2) continued coordination and communications between meeting participants about their research, (3) participation in BOEM's annual call for research priorities, and (4) discussions on pelagic communities and shelf interconnectivity.

NOAA was thanked for funding the workshop.

The meeting adjourned at approximately 4:45 pm