Deep Sea Coral Research and Technology Program
Priority Workshop Report for the Northeast Deep-sea Coral Initiative
2023-2026

Workshop Dates: 2-3 May 2023
Marine Biological Laboratory
Woods Hole, MA

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Cover image: Acadian redfish and *Primnoa* corals in the Gulf of Maine.

Executive Summary

The National Oceanic and Atmospheric Administration's Deep Sea Coral Research and Technology Program convened a two-day science priorities workshop on May 2-3, 2023 at the Marine Biological Laboratory in Woods Hole, Massachusetts. Fifty-eight participants representing NOAA offices, other federal agencies, the state of Maine, Fisheries and Oceans Canada, non-governmental organizations, and academic institutions, met to build partnerships and set research priorities for the program's four-year (2023-2026) Northeast Deep-Sea Coral Initiative. The workshop opened by introducing both the Deep Sea Coral Research and Technology Program and the Northeast Deep-Sea Coral Initiative. The purpose, structure, and goals of the initiative were summarized, then other stakeholders active in deep-sea research were invited to present an overview outlining their mission-specific goals and objectives, previous and ongoing deep-sea coral and sponge research efforts, and the tools and technologies available for potential collaborations.

Breakout sessions followed three themes: 1) biological sampling needs; 2) habitat characterization data needs and analysis; and 3) management-driven data product needs. Meeting attendees participated in two breakout sessions, switching between themes for each. These sessions, structured to identify more detailed science strategies that could help develop a cohesive science plan, captured a variety of specific research ideas, which the Steering Committee will summarize. After the breakout sessions, the entire group discussed strategies, ideas, overlaps between the breakout groups, and scientific targets that might have been overlooked in the smaller group discussions.

Overall, research priorities were relevant to wind energy siting, habitat characterization, and modeling efforts within the Gulf of Maine, Hudson Canyon, and the Northeast Canyons and Seamounts Marine National Monument. Additionally, several overarching themes were revealed during group discussions. These themes will, in part, guide planning of regional research activities:

- Continue investigations of deep-sea coral habitats to gain better understanding of habitat characteristics and functional ecology to inform conservation and management objectives.
- Conduct mapping, modeling, and surveys to inform habitat characterization for deep-sea corals and sponges, with particular focus on areas that overlap with offshore wind energy siting in the Gulf of Maine.
- Consider the effects of wind infrastructure on coral habitats and associated species.
- Study the coral ecosystem as a whole to better understand patterns and processes influencing associations between corals and fishes, in particular.
- Examine impacts of climate change in the Gulf of Maine, including potential changes in species distribution.
- Collect physical samples for taxonomy, systematics, aging, population genetics and connectivity, as well as to inform models and environmental DNA sampling.

Based on the results derived from the workshop, the Steering Committee will draft the Science Plan, which will guide research activities in 2024 and 2025, and subsequent data analyses.

Table of Contents

Introduction

Deep-sea corals and sponges (DSCS) create important biogenic habitats and support remarkably complex communities in deep waters around the globe. The National Oceanic and Atmospheric Administration (NOAA) established the Deep Sea Coral Research and Technology Program (DSCRTP) under the authority of the Magnuson-Stevens Fishery Conservation and Management Act, as reauthorized in 2007. The goal of the DSCRTP is to provide scientific information needed to manage, conserve, and protect deep-sea coral and sponge ecosystems throughout the United States. The DSCRTP is guided by the NOAA Strategic Plan for Deep-Sea Coral and Sponge Ecosystems, and aims to (1) support NOAA's role in managing fishing impacts by addressing threats to deep-sea coral ecosystems, (2) aid conservation of deep-sea ecosystems in managed areas such as national marine sanctuaries and marine national monuments, and (3) integrate expertise and resources across NOAA. In collaboration with regional fishery management councils, other NOAA offices and federal agencies, academic partners, industry, and non-government organizations, the DSCRTP supports studies that collect and analyze information on a variety of topics pertaining to deep-sea corals and their role in the ecosystem.

To facilitate this work, the DSCRTP works with partners to support multi-year regional fieldwork initiatives centered on conducting new research, assimilating historic data, and making results public in support of DSCS ecosystem management and conservation. The DSCRTP began operations in 2009, and has funded targeted fieldwork initiatives in the U.S. South Atlantic (2009-2011), West Coast (2010-2012, 2018-2021), Alaska (2012-2014, 2020-2024), Northeast (2013-2015), Pacific Islands (2015-2017), and greater Southeast (2016-2020) regions. The regional initiatives have included mapping, surveys, and research designed to understand the distribution of DSCS; biodiversity, abundance, and life-history information of DSCS and their associated fauna; predict distribution and extent of DSCS habitat using species-distribution modeling; and assess impacts of human activities on DSCS, among other topics. A national-level data management infrastructure underlies the regional initiatives, allowing DSCRTP-supported data to be accessible by the public.

Northeast Deep-Sea Coral Initiative Science Priorities Workshop

In 2023, DSCRTP began a four-year research initiative in the U.S. Northeast region, encompassing jurisdictions of the New England Fishery Management Council (NEFMC) and the Mid-Atlantic Fishery Management Council (MAFMC). The objective of the Northeast Deep-Sea Coral Initiative is to obtain scientific information that will inform management decisions and protection of deep-sea coral and sponge ecosystems throughout the region. Proposed projects should (1) be relevant to management of DSCS ecosystems in the region, (2) address priority research questions identified during this workshop, and (3) be achievable within the budget and support fieldwork and initial data collection within the 2023-2026 timeframe. Similar to previous deep-sea coral research initiatives, supported activities will consist of research expeditions to survey, sample, and map DSCS ecosystems, and data or sample analyses in line with initiative goals. Priority will be placed on activities conducted with partners and that leverage additional resources. During the ramp-up year (2023), research objectives were scoped, prioritized, and planned for the following field-intensive years (2024 and 2025). Activities supported in 2026 will focus on data analyses, database submissions, and publication.

As a first step towards launching this research initiative, the Northeast Fisheries Science Center (NEFSC) led a science priorities workshop in May at the Marine Biological Laboratory in

Woods Hole, Massachusetts. This workshop brought together 58 experts from across NOAA, the regional fishery management councils, the Bureau of Ocean Energy Management (BOEM), U.S. Geological Survey (USGS), Fisheries and Oceans Canada (also known as the Department of Fisheries and Oceans, DFO), the Smithsonian Institution, National Resources Defense Council, The Nature Conservancy, industry, and academia. A list of participants, both in-person and remote, is provided in Appendix A. Discussions at the workshop centered around management issues, geographic priority areas, and research questions relating to deep-sea coral ecosystems along the U.S. northeast coast. Those participating remotely or unable to attend were contacted after the workshop and offered the opportunity to provide further input

Workshop Presentation Summaries

The first day of the workshop began with a welcome and introduction to the DSCRTP followed by a series of overview presentations from various stakeholders that conduct deep-sea research on the East Coast. Presentations covered each institution's general mission; previous, current, and future work related to DSCS; research tools and technology; potential opportunities for collaboration; and goals for the outcome of the workshop or for the Northeast Deep-Sea Coral Initiative overall. This informative session primed small breakout discussions that focused on identifying and prioritizing research needs, as well as brainstorming potential Northeast Deep-Sea Coral Initiative outreach products. The structure of this report follows the general flow of the workshop, and a complete agenda is provided in Appendix B. The included figures (Figures 1-9) were taken directly from the presenter's slides, with presenter permission, and are intended to give a sense of the presenters' content and geographic area of interest.

Overview of Deep-sea Coral Research and Technology Program (DSCRTP)

Heather Coleman, DSCRTP manager, began workshop presentations with an introduction to the program and its operational strategy. The DSCRTP was established in 2009[1] to provide NOAA Fisheries with resources to better understand valuable and vulnerable DSCS habitats. The program coordinates and supports DSCS researchers around the country to conduct peer-reviewed science that informs resource management. Funded research projects are designed in coordination with Regional Fishery Management Councils and other resource managers, and results are reported back to guide fishing and other regulations. Research supported by the program has helped bridge the gap from science to management by informing Council decisions in almost every region, as well as sanctuary expansions, experimental fishing permits, aquaculture siting, and energy infrastructure placement.

DSCRTP heavily relies on partnerships, and owes much of its effectiveness to colleagues in the NOAA Fisheries Science Centers, National Centers for Environmental Information, National Marine Sanctuaries, National Centers for Coastal Ocean Science (NCCOS), and Ocean Exploration, as well as other offices and federal agencies such as BOEM and USGS. This collaborative model allows the program to map, explore, and characterize habitats that are important to multiple federal agencies and interagency partnerships. Together we complement a variety of existing programs and mandates, and integrate vast expertise and resources across and beyond NOAA. These efforts are also in line with the 2021 National Strategy for Ocean Mapping, Exploration, and Characterization (NOMEC) priorities report developed by the Interagency Working Group on Ocean Exploration and Characterization. Program-supported, partnership-based

[1] Magnuson-Stevens Fishery Conservation and Management Act, Section 408.

research includes a range of topics including locating DSCS communities, taxonomic identification, sampling, aging, modeling species distributions, understanding impacts of fishing, assessing the effectiveness of fishing regulations, and creating species guides.

A major operational component of the DSCRTP is organizing and supporting a series of rotating regional research initiatives focused on improving our knowledge of DSCS ecosystems. This investment builds on existing data and partnerships, and complements or leverages a range of partner resources. Guidelines for initiative operation and project components include the need to inform resource management, complement existing programs and mandates, build and strengthen partnerships, conduct systematic survey efforts, contribute to peer-reviewed science, and produce defined data products. Before each four-year initiative begins, researchers and managers from a variety of offices, agencies, institutions, and organizations come together to identify the science and management priorities that shape the initiative's science plan. Results of initiatives, as well as results targeted opportunistic projects in other regions, are brought together by our centralized and publicly accessible national database.

NOAA Office of Habitat Conservation Kick-off Thoughts

Kara Meckley, Office of Habitat Conservation, discussed the office's mission to protect and restore habitat for the purpose of maintaining and rebuilding sustainable fisheries, and recovering protected species. The DSCRTP contributes to the larger mission of habitat conservation by working directly with both scientists and managers at the same time. The last Northeast Deep-Sea Coral Initiative (2013-2015) produced valuable contributions for NOAA Fisheries and the Councils' understanding of habitats and future value for planning. One of the most prominent examples is the establishment of the Lautenberg Deep Sea Coral Protection Area, which came from MAFMC proposals generated during a collaborative workshop hosted just after the initiative concluded. These proposals included spatial information generated during the initiative. The Georges Bank Deep-Sea Coral Protection Area was created in a similar manner in New England by the NEFMC a few years later. The Northeast Canyons and Seamounts Marine National Monument (Monument) designation in 2016 also relied on program data and presents an opportunity for partnership with the US Fish and Wildlife Service (USFWS) as co-managers to explore and characterize this resource. We hope the data and results that come from this initiative will inform planning for other ocean uses like offshore wind and marine aquaculture siting.

This second Northeast Deep-Sea Coral Initiative brings many opportunities. We intend to dramatically expand the amount of information available in the Gulf of Maine, making planning more effective and efficient. The DSCRTP also intends to develop a relationship with USFWS to study and inform successful management of the Monument, and complement information collected by partners like NOAA Ocean Exploration. The Office of National Marine Sanctuaries has the chance to develop management-focused relationships from the beginning of the designation process by partnering to map, explore, and characterize Hudson Canyon. The DSCRTP also plans to analyze information collected before and during this initiative in relevant areas to inform wind energy planning with the NEFSC, NCCOS, and BOEM. Initiative leads also intend to collaborate on important projects with academia, cooperative institutes, industry, USGS, DFO, and the Maine Department of Marine Resources. Gathering scientists and managers to talk before developing the initiative science plan helps to ensure the data we all generate are useful for resource management needs. The DSCRTP could not achieve its mission without leveraging the expertise and resources of all of the partnerships represented at this workshop.

Northeast Fisheries Science Center (NEFSC) Opening Remarks

Nicole Cabana, Deputy Director of the Northeast Fisheries Science Center, began her presentation with acknowledgements for the DSCRTP, Office of Habitat Conservation, Martha

Nizinski, Peter Auster, Greater Atlantic Regional Fisheries Office (GARFO) representatives, the New England and Mid-Atlantic Fishery Management Councils, NOAA Ocean Exploration, National Ocean Service, NCCOS, DFO, academic partners, Woods Hole Oceanographic Institution (WHOI) and others who have previously played roles in deep-sea coral research in the region. The NEFSC looks forward to continuing work with existing partners, as well as the many others in the room who are able to support the upcoming initiative. She emphasized the Center's desire for collaboration and their excitement to work with stakeholders to identify regional priorities.

The main priorities of the NEFSC are to 1) understand the importance of deep-sea coral habitats for fishery management, and 2) understand the likely impacts on these habitats from offshore wind development - the greatest challenge yet faced in the region. The NEFSC's priorities should be considered when determining where to work and what research to conduct over the next few years. Wind energy construction is imminent and will encompass a very large geographical area, impacting every habitat type in the region. Additionally, construction will take place in deeper waters where less is known about habitats, particularly in the Gulf of Maine. This initiative therefore has the potential to improve our understanding of deep-sea corals and habitats in areas under consideration for construction. It will also enable us to provide much needed information to NOAA management on the permitting and approval process. The greatest need is for this research to enhance understanding of the marine environment in and around the potential development areas. Secondly, since coral surveys are resource management driven, we need to follow Council priorities on Essential Fish Habitat. The specific value of deep-sea coral to species and their life stages is not well known, so this initiative has the opportunity to provide needed information on habitat value to managed species.

Ms. Cabana also provided a brief history of deep-sea coral research in the Northeast region, starting in the early 19th century when Addison Emery Veril conducted the first naturalist surveys in deeper waters. Corals have been noted as fisheries bycatch since then. In the 1970s and 1980s, submersible surveys found corals in denser and more diverse populations in canyons offshore. In the 1990s and 2000s, deep-sea coral distribution databases were built. In 2012 the first initiative began and with collaboration from the National Ocean Service, the first regional coral distribution models were created. Additionally, multibeam mapping around deepwater canyons was conducted. The initiative continued from 2013 to 2015, and work extended even beyond that through 2019 by combining resources of partnerships formed during the Initiative.

As a result of the previous Initiative's research, more than 170,000 km^2 of seafloor from Maine to North Carolina was designated for protection, and one dedicated habitat research area was also declared. A major focus of this coming Initiative is to help inform and guide BOEM's wind energy infrastructure development in the region through mapping, modeling, and habitat characterization. It is important to figure out how, why, and how many fish actually use coral habitats. It would also be valuable to quantify effects of fishing and fishing gear on coral habitats, and determine their rates of recovery after impacts, especially in the Jordan Basin. Determining how vulnerable these habitats are to climate change is another critical question for which we need to provide managers information they need and can use.

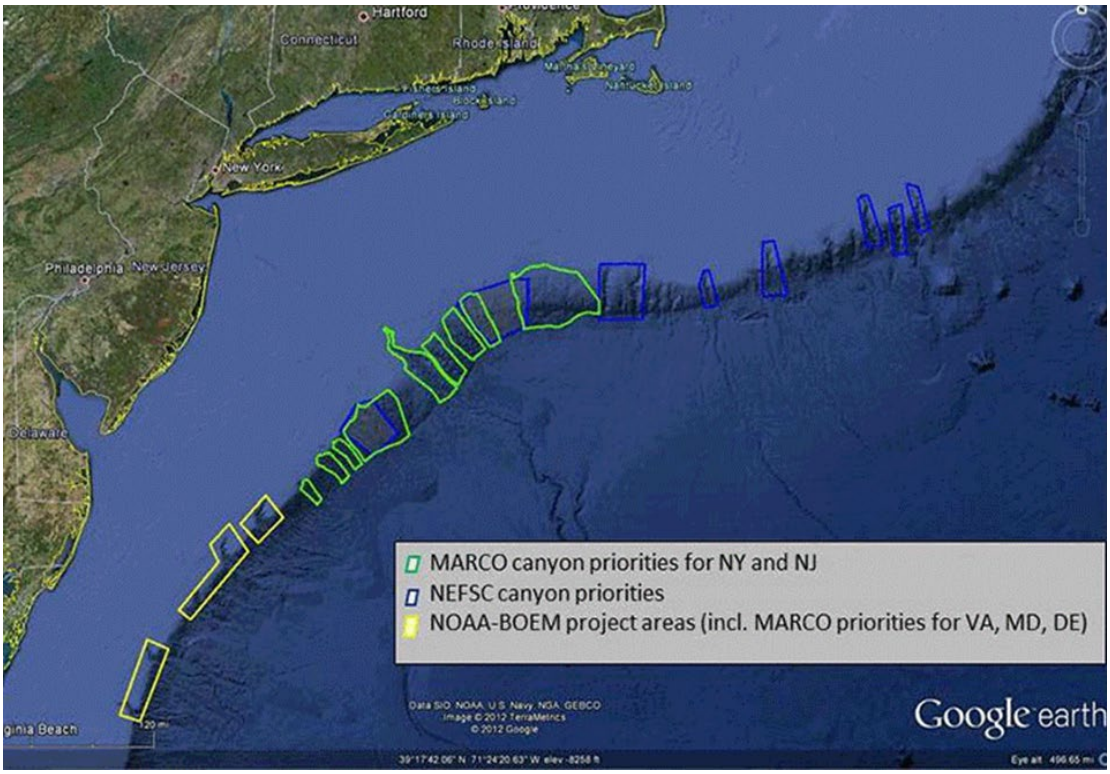
In closing, Ms. Cabana emphasized the importance of partnership as a way to bring additional resources and improve outcomes. Examples include partnering with GARFO, the Office of National Marine Sanctuaries, the Northeast Fisheries Observer Program, USFWS, and DFO.

Northeast Retrospective - Look Back at the Previous Initiative

Martha Nizinski (NOAA Fisheries' National Systematics Lab) provided a retrospective on the previous Northeast Deep-Sea Coral Initiative (2013-2015) accomplishments, for which she served as Chief Scientist. Participants attending the priority workshop for this initiative (held in 2011) identified three major priorities. Given that contemporary deep-sea coral information was

extremely limited, the first priority was to locate and characterize deep-sea coral and sponge habitats in the region. The second priority was to obtain basic information on biology, biodiversity, ecology, and connectivity between populations of selected coral species. The third priority was to study natural and human impacts on deep-sea coral and sponge ecosystems to understand disturbance effects and recovery times. Data needs of the Councils were considered a high priority since the Councils were drafting regional deep-sea coral management plans at the time. Also, the NEFSC and GARFO partnered on a proposal to include deep-sea coral habitats as a focal area for NOAA's newly created Habitat Blueprint program. Interest in deep-sea corals and their protection was increasing within NOAA at the time, as well as for Mid-Atlantic Regional Council on the Ocean (MARCO) and other regional stakeholders.

In 2012, a major field campaign, Atlantic Canyons Undersea Mapping Expeditions (ACUMEN), focused on mapping and surveying deepwater canyons along the continental shelf break between Virginia and the Canadian border (Figure 1). A collaboration between NOAA OE, MARCO, NEFSC, and other regional partners, ACUMEN coordinated field efforts to support NOAA Habitat Blueprint projects in the Northeast Region (where canyons were selected as a top priority). It also supported NOAA Integrated Ocean and Coastal Mapping efforts and MARCO's conservation goals. The collaboration capitalized on complementary capabilities of NOAA assets to produce integrated, coherent data sets that were shared across platforms to guide and refine expedition plans in near real-time. ACUMEN was a huge success; all or part of 36 different submarine canyons were mapped adding 10,000 km^2 of multibeam data. This information was used in a variety of ways including directing the Northeast region's 2013-15 deep-sea coral and sponge research planning efforts, revising species distribution models, and guiding the regional fishery management councils in development of deep-sea coral and sponge management zones.



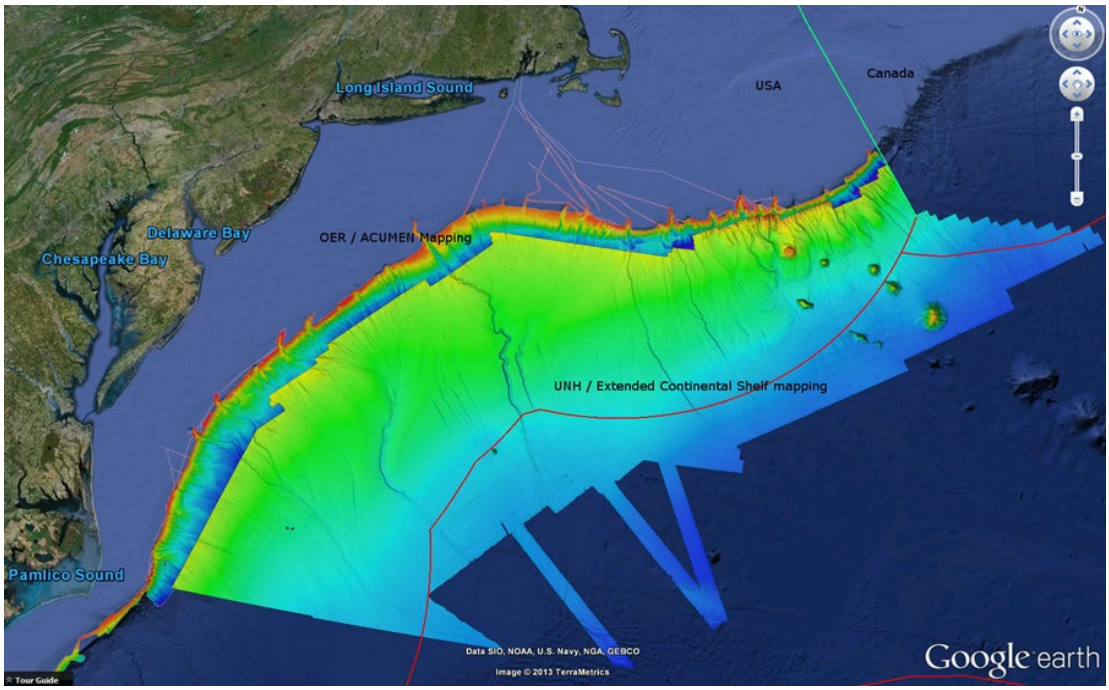


Figure 1: Atlantic Canyons Undersea Mapping Expeditions (ACUMEN) mapped areas. The top image shows survey priorities of the Mid-Atlantic Regional Council on the Ocean (MARCO, outlined in green), Northeast Fisheries Science Center (NEFSC, outlined in blue), and Bureau of Ocean Energy Management (BOEM, outlined in yellow). The bottom image shows bathymetry of the northeast continental slope.

Even with the success of ACUMEN, the first Initiative had some challenges. For example, there was a lack of infrastructure to support coral research and little contemporary data available. Ship time and sampling gear were limited and hard to secure. Therefore, the 3-year plan required built-in flexibility to adapt and respond to council/regional stakeholder priorities and data needs. The three geographic focus areas for the Initiative were prioritized as submarine canyons (cruises led by Martha Nizinski), Gulf of Maine (cruises led by Peter Auster and Dave Packer), and a transboundary collaboration with Canada (cruise led by Martha Nizinski).

With an annual budget ≤ $800,000, the team completed 10 cruises with 151 camera tows, 52 remotely operated vehicle (ROV) dives, 1,002 video hours, 188,579 images, and 250 specimens collected for taxonomy, age/growth, reproduction, and genetics. Additionally, species distribution models were revised and ground-truthed. Three cruises were conducted each year with at least one trip to the canyons and another to the Gulf of Maine. Several vessels including NOAA Ships *Henry Bigelow*, *Okeanos Explorer*, and *Gloria Michelle*, as well as the University of Connecticut (UConn) R/V *Connecticut*, deployed towed-camera systems (WHOI *TowCam*, UConn *ISIS 2)* and ROVs (Canadian ROV *ROPOS*, UConn ROV *Kraken*, and NOAA ROV *Deep Discoverer*).

The combination of towed camera and ROV operations increased the number of surveys at lower costs, which was critical to collecting much needed contemporary data. The majority of projects exceeded expectations in data collection. Coral presence was confirmed in multiple locations throughout the region. Thus, knowledge of deep-sea coral distributions, abundances, and diversity in the region increased exponentially. The valuable information collected was used directly by the MAFMC and NEFMC to inform decision-making. Specimens that were collected have already been used in five other studies designed to better understand the basic biology and ecology of corals. In total, the previous Initiative was the most intensive study of corals, coral habitats, and associated fauna conducted in the Northwest Atlantic region to-date. Additionally, the data collected provided the foundation for future investigations to build upon the knowledge of these critically important organisms and their habitats.

Dr. Nizinski highlighted specific accomplishments from the previous Initiative:

- More than 90,000 km^2 of high resolution multibeam mapping was completed.
- Deep-sea corals are more diverse and abundant than previously thought in the canyons.
- Diversity and abundance of known coral species varies with depth, substrate type, and stability.
- Surveys improved our understanding of the distributions of corals and associated fauna, and showed that no two canyons are alike.
- Dense, extensive coral gardens were discovered in the Gulf of Maine < 200 m. However, there is less coral diversity in the Gulf with 2-3 species of structure-forming alcyonaceans dominating coral communities (primarily *Primnoa* and *Paramuricea*). Many commercially important species of fishes and shellfish occur in and around coral habitats. Evidence of fishing impacts on the habitats was also observed as trawl marks, lost fishing gear, and other anthropogenic debris.
- Transboundary collaborations involved work on both sides of the Canadian/U.S. border to address common goals. Additionally, study areas in the Northeast Channel Coral Conservation Area were revisited to assess coral growth. Coral discoveries in Corsair Canyon resulted in the designation of the Corsair and Georges Canyons Conservation Area.
- Results of the Initiative contributed to the designation of: Frank R. Lautenberg Deep-Sea Coral Protection Area (CPA), Georges Bank CPA, Jordan Basin Dedicated Habitat Research Area (DHRA), Outer Schoodic Ridge CPA, Mount Desert Rock CPA, and the Northeast Canyons and Seamounts Marine National Monument.
- The relationship between Acadian redfish larvae and the common sea pen in the Gulf of Maine was studied to complement Canadian research on fish habitat.

The Initiative also supported two small projects: one focused on species distribution modeling, and the other funded the observer program to include deep-sea corals in their bycatch reporting and share samples with interested researchers. Additionally, an at-sea identification guide was produced to improve data quality.

Other low cost projects were completed in collaboration with the following partners:

- USGS studied squat lobster taxonomy, phylogenetics, and population connectivity.
- USGS studied population genetics and connectivity of *Primnoa resedaeformis* and *Paragorgia arborea*.
- The Smithsonian Institution examined *Paramuricea* samples and studied population connectivity.
- The University of Maine studied coral reproduction.
- NEFSC sponsored a Master's student to study the distribution of octocorals in Jordan Basin.
- UConn sponsored a postdoctoral researcher to perform data mining and assess the use of autonomous underwater vehicles (AUV) versus ROVs.
- WHOI analyzed images.

Finally, the outreach component of the Initiative increased public awareness of deep-sea corals through YouTube videos, blogs, story maps, webstories, newspaper articles, public seminars, documentary content, Capitol Hill briefings, and *Okeanos Explorer* footage.

In conclusion, the first Initiative exceeded expectations and met its primary objective of locating and characterizing coral habitat. There is now a much better understanding of the extent and distribution of deep-sea coral habitats throughout the region that will provide the foundation for future investigations to build upon our knowledge of these critically important organisms and their habitats. Also, 177,076 km^2 were designated as deep-sea coral protection areas based on the new knowledge of regional coral distributions, abundances, and diversity.

New England Fishery Management Council (NEFMC) Overview

Michelle Bachman, Fishery Analyst and Habitat Plan Coordinator with the New England Fishery Management Council, provided an overview of deep-sea coral-related management priorities. The Council's Omnibus Deep-sea Coral Amendment was finalized in 2018, involving collaboration between the NEFMC and the MAFMC. The amendment was put in place to identify and implement measures that reduce the impacts of fishing gear on deep-sea corals in New England. The NEFMC considered a range of management area options and associated fishing gear restrictions that aim to identify and protect concentrations of corals in select areas and restrict the expansion of fishing effort into areas where corals are likely to be present. Geographically, the Amendment covers the entire New England region including the Gulf of Maine, Georges Bank, canyons/slope from Heezen west to Alvin Canyon, and seamounts within the Exclusive Economic Zone (EEZ). It designated two smaller fishery closed areas off the Maine coast (Mt. Desert Rock and Outer Schoodic Ridge CPAs), a dedicated habitat research area in the Jordan Basin, and a large precautionary fishery closure south of the Georges Bank (> 600 m, from the shelf break to the edge of the EEZ). Measures went into effect in July 2021 (Figure 2).

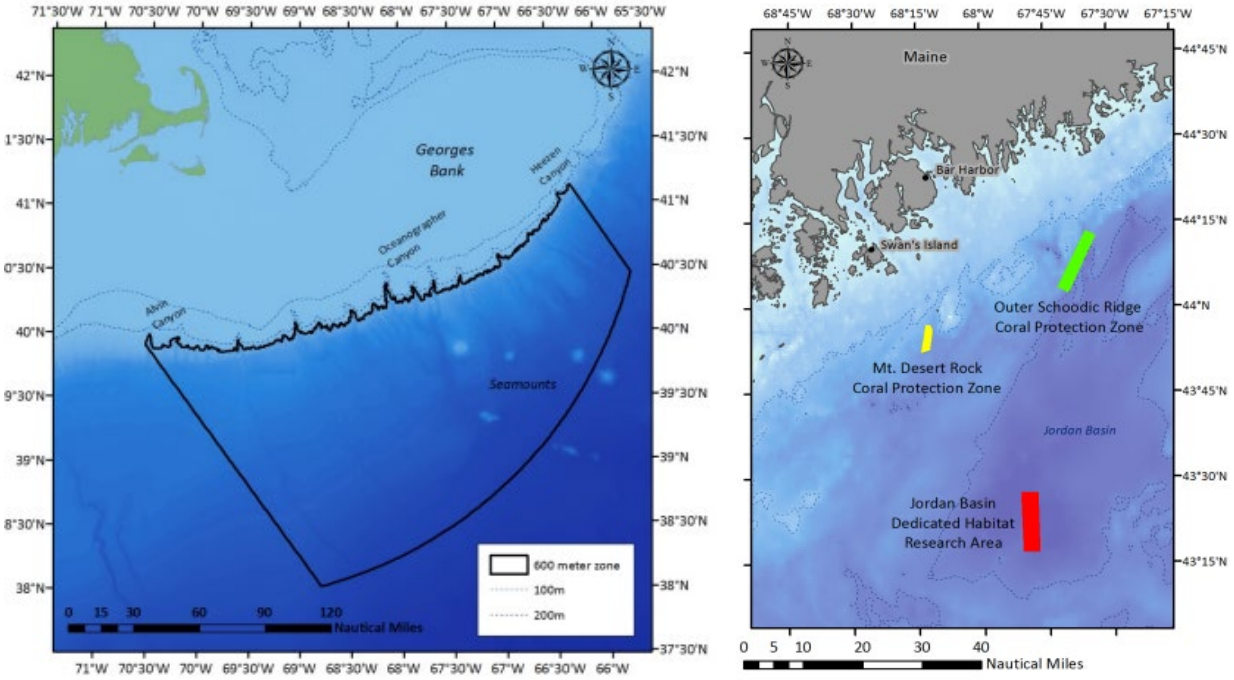


Figure 2: NEFMC Coral Protection Areas. The left image shows boundaries of the Georges Bank Deep-Sea Coral Protection Area, which runs along the outer continental shelf deeper than 600 m and extends to the outer limit of U.S. Exclusive Economic Zone boundary to the east and north, and south to the Mid-Atlantic's Frank R. Lautenberg Deep Sea Coral Protection Area. The right image shows the Mount Desert Rock Coral Protection Area (yellow, 100-200 m depths), and Outer Schoodic Ridge Coral Protection Area (green, 104-248 m depths). Vessels are prohibited from fishing in these areas with most bottom-tending gear.

The NEFMC does not do research, but rather uses data to support development of fishery management plans. Mostly, they consume high-level summaries of research results such as the distribution of corals, relative abundance and suitability, and ecological linkages with managed fish species. Each year they update their list of 5-year research priorities that support fishery management, and share the list with the NEFSC to promote planning and coordination. Current NEFMC priorities relevant for this Initiative follow:

- Investigate the functional ecology of deep-sea corals.
- Estimate anthropogenic impacts, coral recovery rates, and how they relate to intertemporal tradeoffs around fishing and coral protection.
- Targeted studies that focus on defining areas/habitat conditions that support coral and sponge habitats.
- Study growth, reproduction, and population connectivity.
- Develop more sophisticated, higher-resolution models that predict coral presence/absence or relative abundance, not just likelihood of occurrence or habitat suitability.

Locations of interest for Initiative research activities are: 1) shallow parts of slope and canyons (inshore of the Georges Bank CPA) where interactions with fishing are more likely, and 2) the offshore Gulf of Maine, especially Jordan Basin and Georges Basin.

During the Initiative, the NEFMC plans to share information with constituents on research cruises and findings, as well as provide feedback on how the Council could use resulting data. Additionally, the Council plans to share their annual priority list adjustments and any coral amendment updates with the Northeast Deep-Sea Coral Initiative team. Council members and NEFMC staff are excited about the Initiative and look forward to receiving high-level study results that employ robust scientific methodologies while keeping diverse management applications in mind.

Mid-Atlantic Fishery Management Council (MAFMC) Overview

Kiley Dancy, Mid-Atlantic Fishery Management Council staff, presented an overview of deep-sea coral priorities for the MAFMC. In 2016, the MAFMC passed Amendment 16 to the Mackerel, Squid, Butterfish Fishery Management Plan to reduce impacts of fishing gear on deep-sea corals and their ecosystems in the Mid-Atlantic region, while also considering the operational needs and long-term sustainability of commercial fisheries. The Amendment was made possible by the MAFMC's discretionary authority[2] to designate deep-sea coral zones. As it is currently implemented, there are several discrete zones (canyons and other areas of known or likely coral presence) within a larger broad zone that extends > 450 m to the EEZ boundary, wherein it freezes the footprint of fishing. Within both the broad and discrete zones, there are prohibitions on most mobile and fixed bottom-tending gear, although restrictions do not apply to recreational or lobster gear. There is also an exemption for the red crab fishery indefinitely in the broad zone and minimally for two years in the discrete zones. These boundaries were collaboratively developed during a 2015 workshop, as an option for Council voting (Figure 3). Boundaries relied on coral habitat information such as NOAA's database records, coral species distribution models, and observations from 2012-2014 surveys. The MAFMC's coral regulations have been effective since early 2017 and have not yet been reviewed. This Initiative presents an opportunity to share knowledge that enables the council to initiate a review and consider new data to review the boundaries, enforcement, and exemptions of the coral protection areas.

[2] Magnuson-Stevens Fishery Conservation and Management Act, Section 303.

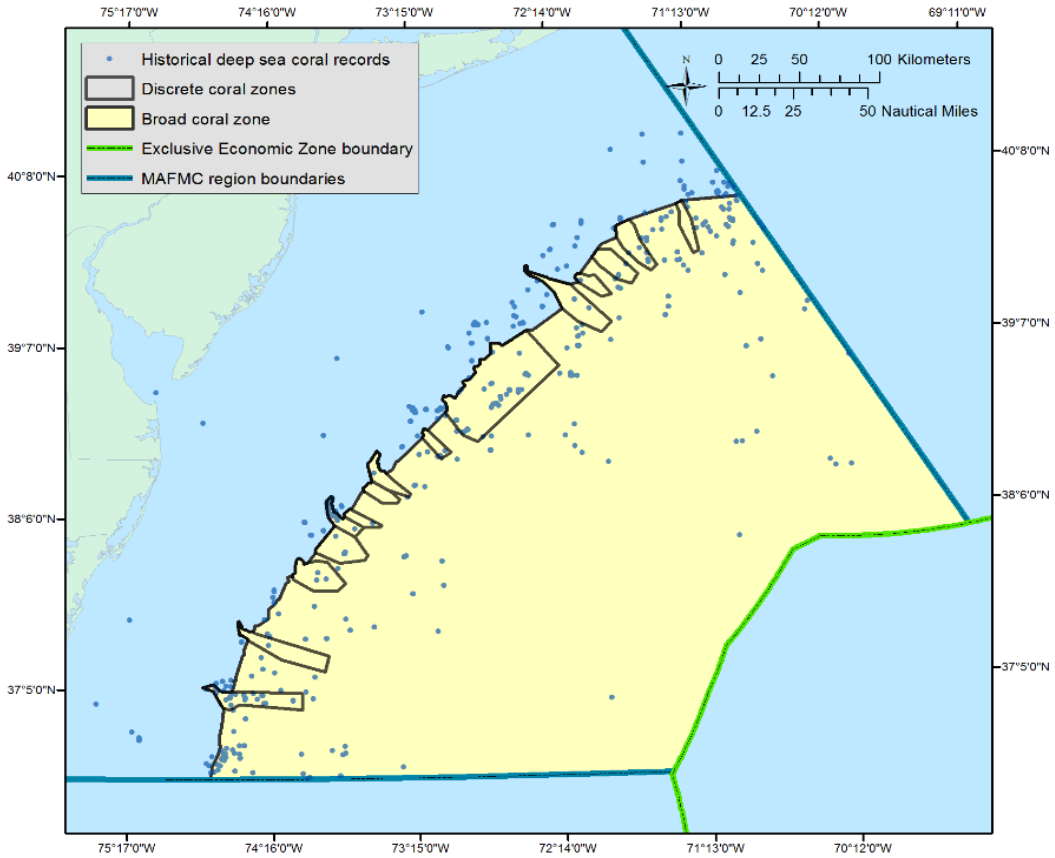


Figure 3: MAFMC's Frank R. Lautenberg Deep Sea Coral Protection Area runs along the Mid-Atlantic canyon heads and outer continental shelf deeper than 450 m. It extends to the outer limit of U.S. Exclusive Economic Zone boundary to the east, and to the Council jurisdiction lines to the north and south. Vessels are prohibited from fishing with most bottom-tending gear.

The MAFMC does not have a specific list of priorities for deep-sea corals; however, their five-year research priorities document covering 2020-2024 has an applicable theme on ecosystem data collection. Research themes of interest to the MAFMC include: 1) deep-sea coral ecological function and habitat value, particularly in relation to MAFMC managed species or habitats, 2) improved understanding of coral distribution and improved species distribution models, 3) deep-sea coral database updates to include all recent survey data, and 4) coral vulnerability to and recovery potential from impacts of fishing gear (potentially even evidence of fishing gear interactions). Locations of interest to the MAFMC include 1) shallower areas in and around the canyons where fishing effort is more likely to overlap with coral habitat (~200-500 m depth range), and 2) canyons with little or no survey effort at all depths (e.g., Block, Emery, Uchupi, Jones, Babylon, Hudson, North Heyes, South Wilmington, South Vries, and Warr-Phoeniz canyons). The MAFMC's position is that wind energy development should be entirely excluded from coral protection zones. Given that, it is unclear if the MAFMC would prioritize surveying in potential wind energy call areas that overlap with coral protection zones, but anything to inform MAFMC comments on proposed wind energy areas and potential coral impacts will be helpful.

Throughout the Initiative, the MAFMC plans to share updates on expeditions and research findings with MAFMC stakeholders, as well as provide the Northeast Deep-Sea Coral Initiative team with locations of interest and plans for coral area review. Lastly, they look forward to routine communication between the NOAA team and the MAFMC, and receipt of preliminary results that expand knowledge of Mid-Atlantic deep-sea habitats and can enhance tools that they will use in future MAFMC reviews.

Bureau of Ocean Energy Management (BOEM) Overview of Atlantic Priorities

Brandon Jensen, Fisheries Biologist, and Mark Mueller, Benthic Ecologist, presented an overview of BOEM priorities related to deep-sea corals. BOEM's mission is to manage the development of almost 2.5 billion acres of U.S. outer continental shelf resources in an environmentally and economically responsible way. The current Administration has plotted a very ambitious course for the nation's energy independence that includes Executive Order 14008, calling for steps to increase responsible renewable energy development on public lands and waters. Additionally, it set the first-ever national offshore wind goal to deploy 30 gigawatts of offshore wind by 2030 and 15 gigawatts of floating offshore wind by 2035.

The BOEM Renewable Energy Program oversees active leases across the Atlantic, and planning processes in the Gulf of Maine and Central Atlantic. There are also active leases in the Gulf of Mexico and off the Pacific coast, with widespread plans including off Hawaii and U.S. territories as part of the recent Inflation Reduction Act.

Brandon provided an overview of the Renewable Energy Program's planning process, which includes more than a year of planning and analysis wherein BOEM initiates the leasing process, identifies wind energy areas, publishes their leasing notices, and conducts environmental reviews of leasing activities. BOEM then holds the lease auction, awards leases, and the lessees have about a year to submit their site assessment plan for BOEM review. Once BOEM approves the plan, the lessee has up to five years to conduct the site assessment and surveys, and then submit their construction and operation plan. BOEM's environmental and technical review of that plan can take up to two years, after which BOEM decides whether to approve, approve with modifications, or disapprove the plan. In the final steps of the process, the lessee submits their facility design and installation reports and then begins installation. Finally, there will be another round of environmental review after 30 years of operation as part of an anticipated decommissioning process.

Currently most offshore wind energy facilities are sited in water depths less than 60 m to allow for fixed bottom foundations. However, more recently BOEM has begun leasing deepwater areas for floating foundations up to 1,300 m in depth. Distance from shore is an important factor for the viability of these floating sites. In September 2022, BOEM partnered with NCCOS to develop a wind energy suitability model, which has enhanced BOEMs ability to identify viable wind call areas.

For the Central Atlantic, BOEM's draft wind energy areas (WEAs) were published in November 2022 and include over 1.7 million acres, with about half of that area in deep water (Figure 4). In regards to deep-sea coral, considerations for the Lautenberg Area and the discrete canyon heads have been made. Observed coral locations (with a 1 km buffer) have been removed from the WEA. The final WEAs are planned for publishing in summer 2023, and will incorporate recently received information from Department of Defense and the National Aeronautics and Space Administration, as well as rescaled suitable DSC habitat data from NOAA Fisheries.

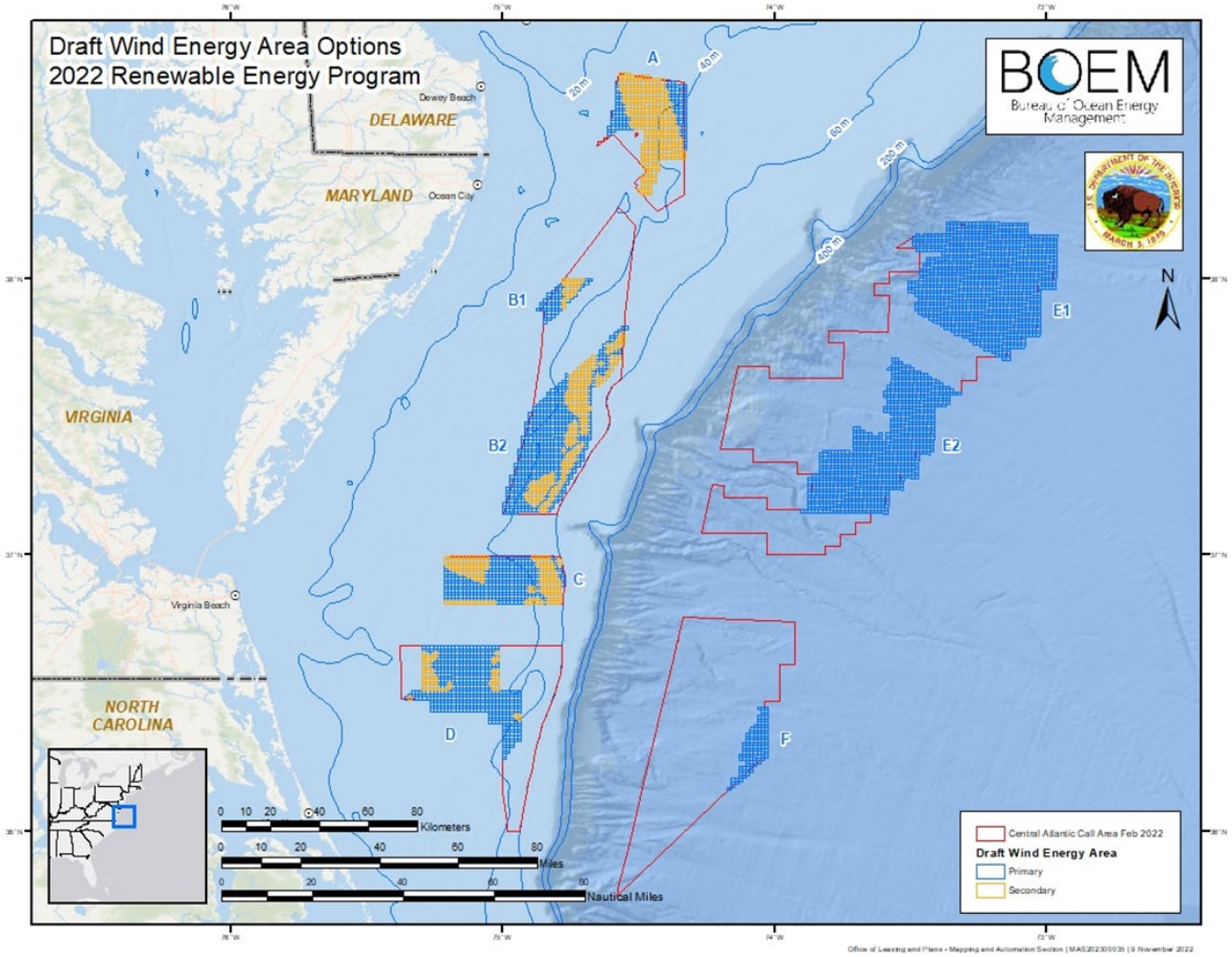


Figure 4: BOEM's Central Atlantic Draft Wind Energy Areas. Note, these maps were current as of the May 2023 Northeast Deep-Sea Coral Initiative Workshop and were included in presentations. For the most current information please refer to the BOEM website.

The recently published call area for the Gulf of Maine encompasses 9.8 million acres (Figure 5). This is a tremendous area that BOEM continues to winnow down in partnership with NCCOS. Some areas currently excluded from the WEA are Mount Desert Rock CPA, Outer Schoodic Ridge CPA, and the Jordan Basin Dedicated Habitat Research Area. The timeline for actual installations into the Gulf of Maine will occur around 2026.

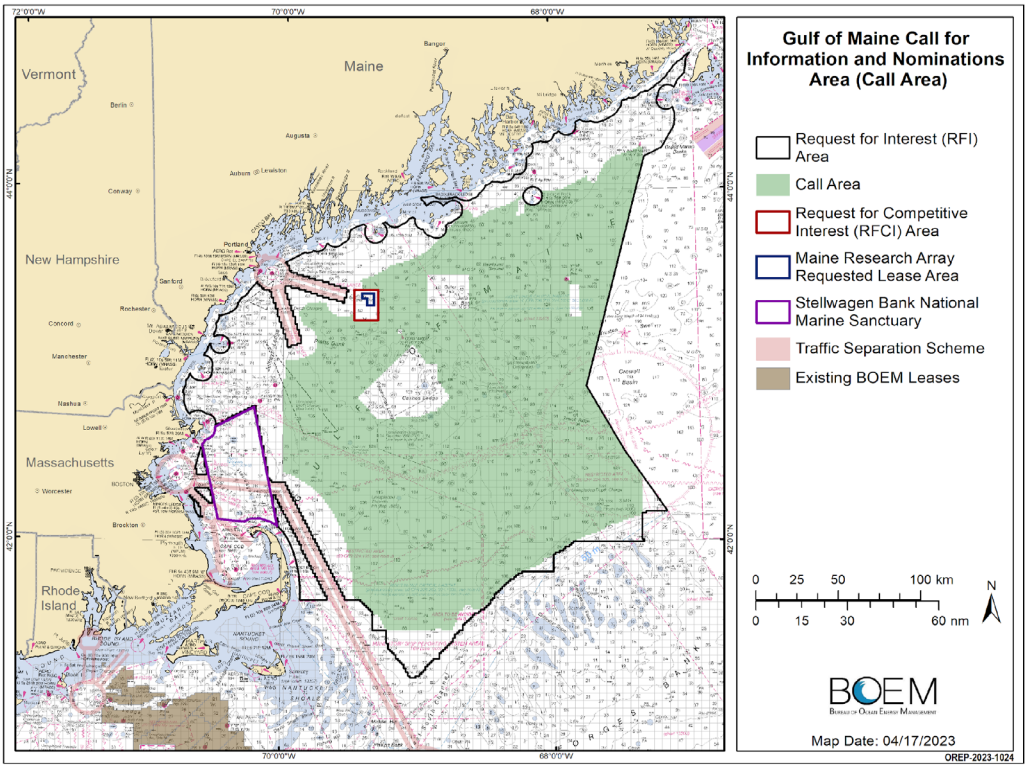


Figure 5: BOEM's Gulf of Maine Draft Wind Energy Areas. Note, these maps were current as of the May 2023 Northeast Deep-Sea Coral Initiative Workshop and were the maps included in presentations. For most current information please refer to the BOEM website.

Mark Mueller, a Benthic Ecologist in BOEM's Division of Environmental Sciences, provided an overview of BOEM's long-standing Environmental Studies Program. This program develops, funds, and manages rigorous scientific research to inform policy and management decisions. The top three funded areas within the program are Marine Mammals and Protected Species, Habitat and Ecology, and Fates and Effects. Since 1973, the program has dedicated over $1 billion for management-informing research. There are many existing deep-sea coral studies being funded, as well as interest in the Gulf of Maine region species/habitat information. An example of a recent interagency project with BOEM/NOAA/USGS included baseline seafloor mapping of the Aleutian Islands using the Saildrone *Surveyor* in summer 2022. The mission mapped more than 16,000 km^2 (including difficult to reach areas) over 52 days. Building off the successful proof of concept of that project, BOEM and NOAA are discussing options to partner again to help map priority areas within the Gulf of Maine.

Brandon addressed questions from the group on the structural set-up of floating foundations. The base of the foundation would be floating with some kind of mooring attached to the seafloor. The cables from these floating turbines within the wind farm would come together to a single export cable that would eventually leave the water column and follow the contours of the shelf. Fishermen typically have questions in terms of how all those mooring lines float in the water column and then come together, including specifics on the spacing, as those metrics affect navigation through the wind farm with fishing gear. The cables would have interactions with the bottom during construction, including clearing the bottom of obstructions through trenching that could cause benthic disruption. Brandon is not aware of any chemical anti-fouling treatments for the moorings at this time to prevent corrosion. Lastly, Brandon mentioned that for fixed bottom foundations, there are a lot of European examples that we can learn from, but the floating foundations are a newer technology without much available data.

Overview of Offshore Wind Impacts on Benthos and Fisheries

Elizabeth Methratta (Northeast Fisheries Science Center) presented an overview of 1) offshore wind (OSW) interactions with marine habitats, fish, and fisheries through numerous impact producing factors; 2) evaluation of the risks to corals during siting using enhanced spatial data; and 3) OSW's imminence in the continental shelf, and multiple areas of opportunity to adapt and innovate to overcome challenges.

The industrialization of the ocean is happening now. By 2027, there will be an expected global OSW deployment of 177 GW, of which 8 GW will come from floating foundations. There are currently 123 MW of installed floating offshore wind energy, which is expected to grow by 68 times from current capacity by 2027. Wind development is active and in different phases on all U.S. coasts, with currently 7 fixed turbines installed and operating in the U.S. (5 in RI and 2 in VA). Over the next decade, a rapid development is expected that would cover 2.5 million acres with installation of 3,101 foundations and 10,000 miles of cable.

In the Gulf of Maine, there is still limited coral distribution data to inform the wind call area. At the time of the workshop, draft wind energy areas in the Central Atlantic overlap the Lautenberg CPA, however in the course of drafting the current report the Lautenberg CPA is no longer included in the wind call area. More data on the distribution of corals and other species that use these habitats could inform the wind lease siting process and provide rationale for why they should be excluded from development.

Dr. Methratta then touched on wind infrastructure (including turbines, cables, substations etc.) interactions with the marine ecosystem including habitat, fish, and fisheries. She provided a quick schematic of a general OSW farm with multiple wind turbines connected by array cables that come together at an offshore substation (Figure 6). Here the energy generated flows into one export cable to an onshore substation, and ultimately to the greater electrical grid. In the case of floating foundations, mooring lines, chains, and anchors would also be installed. OSW structures interface with the bottom habitat in different ways. At less than 60 m water depth, fixed foundations can be installed with either monopile or jacket structures. At depths greater than 60 m, floating foundations are needed and can be either spar, semi-submersible, or tension leg design.

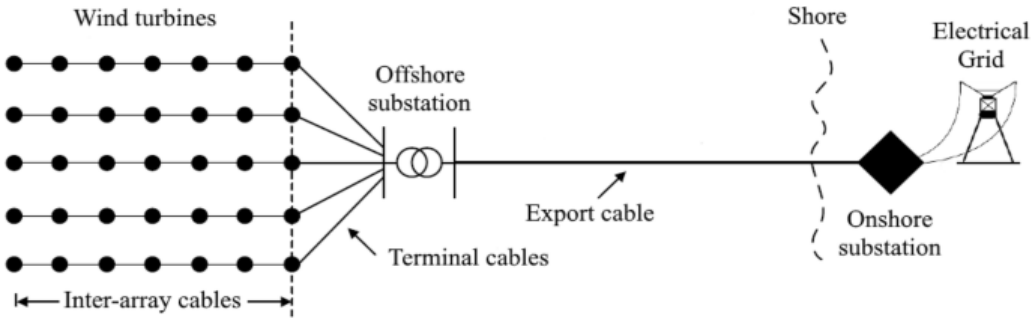


Figure 6: Generalized Schematic of Offshore Wind Infrastructure.

OSW interacts with the marine ecosystem during each phase of development: 1) surveys (2-4 years), 2) construction (2-3 years), 3) operation (30+ years), and 4) decommissioning (2-3 years). There are many factors that can affect the ecosystems including habitat conversion, artificial reef effect, non-native species facilitation, altered hydrodynamics, chemical contaminants, mooring chain interactions, noise, and electromagnetic fields. Although much is still to be learned, particularly in relation to population-level effects, Dr. Methratta provided the following context on each impact producing factor:

- Habitat conversion
    - The addition of hard habitat from underwater foundation structures, scour protection, and rock armoring around cables.
    - Decreased grain size and increased organic matter around structures that result in habitat gain for some species and loss for others.
- Artificial reef effect
    - Turbines support a diverse and abundant artificial reef community that includes epibiota, mobile shellfish, and finfish. Finfish and shellfish, as well as birds and marine mammals also benefit from locally increased food availability and/or shelter, but it could be an ecological trap for some species.
    - Understanding reef effect and its population level implications requires study at broad spatial and temporal scales.
- Facilitation of non-native species
    - Adding hard bottom habitat into otherwise soft bottom environments could facilitate the establishment and range expansion of non-native species. This effect has already been seen with the Rhode Island and south North Sea turbines.
    - Stepping stone effects involve species hopscotching across a water body using manmade structures as habitat, leading to invasions.
- Altered hydrodynamics
    - Local changes include increased turbulence, reduced stratification, increased nutrient flux and chlorophyll. Downstream regional impacts include reduced wind stress and wave energy, wake effect leading to upwelling and downwelling, loss/changes of tidal energy, and reduced mixing rate and shallowing of mixed layer depth.
    - These hydrodynamic effects can span outwards of 65 km from a wind farm, which poses challenges for species that have planktonic larvae.
- Chemical contaminants
    - Anti-corrosives are used to maintain the integrity of structures in salt water, and chemical compounds (such as bisphenol A, aluminum, zinc, and indium) can leach and affect water chemistry and quality, sediments, and biota.
- Interactions with mooring chains: scour, benthic colonization
    - For the floating structures held in place by mooring lines/chains and anchors, there is potential for habitat modification as subsea structures are exposed to strong physical forces. This effect could lead to souring of sediments and liquefaction.
- Electromagnetic fields
    - Existing evidence from field and laboratory studies indicates the potential for electromagnetic fields from cables to affect navigation, predator detection, communication, and finding mates for finfish and shellfish, particularly for electrosensory species.
- Noise
    - Noise disruption occurs during all phases of development and there is evidence of physical injury, mortality, behavior, communication, and movement of species as a result. Sound sensitivity and thresholds for impacts are only known for a few species.

All these impact producing factors are occurring simultaneously and result in spatial and temporal effects in aggregate for the existing ecosystem, in addition to other changes such as warming water, acidification, population shifts, and fishing.

Dr. Methratta described opportunities to innovate monitoring technologies and regional/global collaboration and co-production of knowledge as groups across the country and in Europe rapidly advance OSW. There is also an opportunity to use integrated ecosystem assessments and ecosystem-based management to gauge the status of ecosystems in relation to defined societal goals and objectives. Also, mapping deepwater habitats to inform sitting for floating offshore wind

could provide rationale for excluding sensitive habitats from call areas. The primary challenge to address during this Initiative is determining the sensitivity of corals to OSW impact producing factors and finding ways to mitigate potential impacts.

Questions from the audience included whether she could speak to the impacts on seabirds, and whether there would be situations where overtime decommissioning would be deemphasized as the structures have become artificial reefs and therefore would be beneficial. Dr. Methratta responded that there is a lot of research on the European side that could be reviewed. Another comment was brought forward on the challenge these wind farm structures present for future surveys in the area since they would be hard to navigate for ROVs and AUVs.

US Fish and Wildlife Service (USFWS) Discussion on Monument Planning and Product Needs

Brittany Petersen, Monument Superintendent, presented for the US Fish and Wildlife Service with an overview of the Northeast Canyons and Seamounts Marine National Monument (Figure 7). USFWS is in the process of developing a management plan for the Monument, which is about 130 miles southeast of Cape Cod, Massachusetts and includes two units, one encompassing four seamounts and the other encompassing three canyons along the continental shelf. The Monument was established in 2016 by Presidential Proclamation to protect the canyons and seamounts that showcase unique geological features that anchor vulnerable ecological communities threatened by varied uses, climate change, and related impacts. It also promotes research and scientific exploration designed to further understanding of Monument resources and its educational value.

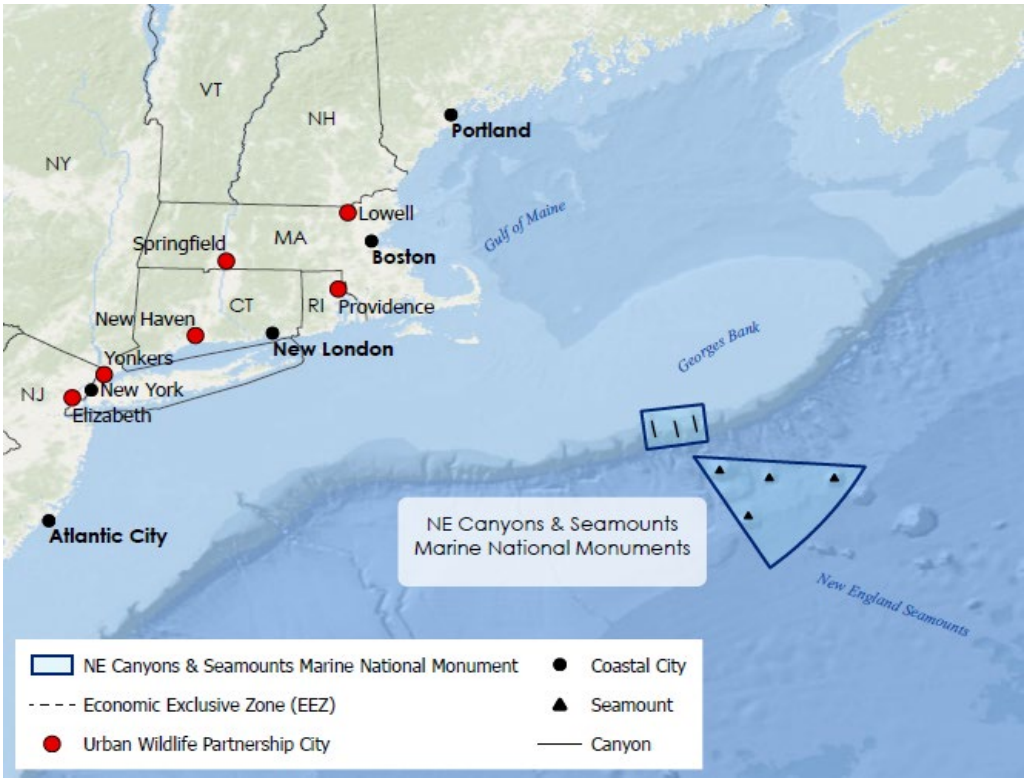


Figure 7: Northeast Canyons and Seamounts Marine National Monument Location.

USFWS recently completed public scoping for the Monument Management Plan, resulting in community-identified research and exploration priorities: 1) developing a comprehensive baseline inventory of the natural, historic, and cultural resources (ecosystem health, biodiversity, species richness, effects of human impacts); 2) surveying and mapping topography and other geological features; 3) climate change (study, mitigate, restore habitat where possible); 4) habitat connectivity and spillover effects; and 5) historical data based time lapse studies. USFWS and NOAA Fisheries are preparing to release a draft Monument Management Plan in fall 2023 for public comment. Key to Initiative success, USFWS looks forward to collaborative multidisciplinary research, translating and communicating the science, and various public engagement opportunities. They plan to support the Initiative through staff time and project funding, and look toward partnerships to assist with outreach and engagement.

Regarding the commercial fishing prohibition for the Monument, NOAA Fisheries will be updating regulations to add Monument boundaries to the definitions section of Magnuson-Stevens Fishery Conservation and Management Act provisions. NOAA Fisheries will then update the prohibitions section of the provisions referencing those boundaries, rather than updating individual fishery management plan provisions to acknowledge the prohibition.

NOAA Sanctuaries Overview of DSC Priorities

Steve Gittings from the NOAA Office of National Marine Sanctuaries provided a brief overview of northeast sanctuaries and proposed sanctuaries. Past sanctuary projects have benefited from DSCRTP support, including mapping and characterization, shipwreck biological surveys, and data to inform sanctuary expansions. Dr. Gittings discussed sanctuary life stages and highlighted the major processes: 1) the designation process (steps from nomination through designation), 2) operations (day-to-day activities to protect resources), 3) evaluation (documenting resource status and trends), and 4) updating the management plan (Figure 8).

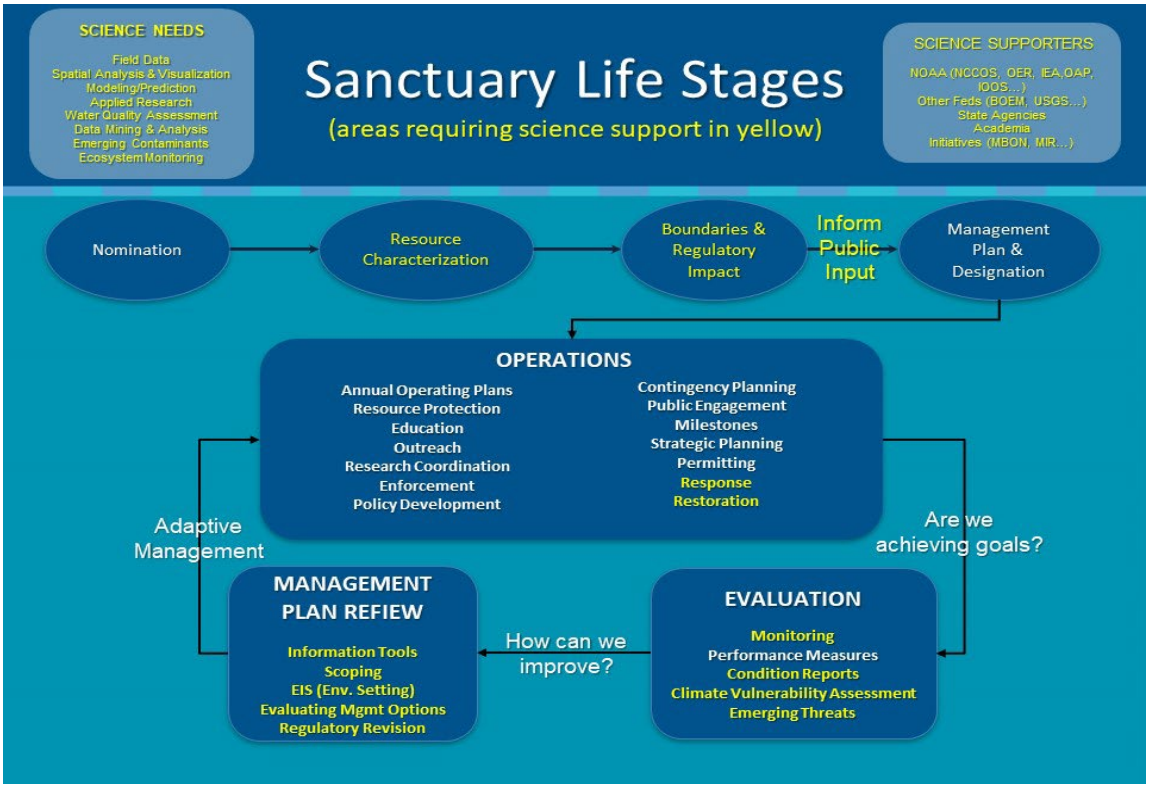


Figure 8: Sanctuary Life Stages.

The Hudson Canyon (and potentially other adjacent canyons) area is currently in the beginning stages of a designation process. The sanctuary nomination calls it an ecological hotspot with a rare, sensitive ecosystem. The entire water column is considered as part of the nomination, based on the use of resources by marine mammals, birds, sea turtles, and other transitory species. Of course the economic value of the area from fishing must also be considered, along with the economic impact of sanctuary designation. There are several criteria that all areas under nomination are evaluated against. Five criteria of note are: 1) any nationally significant natural resources, 2) threatened, endangered and protected species in the area, 3) any unique features and highly suitable habitat, 4) coastal community presence, and 5) maritime history and heritage.

As the Hudson Canyon nomination continues, there are both short and long-term needs. Near-term synthesis of information is needed along with input to clarify boundary alternatives for the sanctuary (which includes seaward and landward extent). In the long-term, new observations on habitats, coral, sponges, fish, and human use will be critically important during operations. Additionally, condition reporting on the status and trends in water and habitat quality, living resources, archeological resources, and ecosystem services will be required to maintain the sanctuary. While Hudson Canyon is the largest in the area, it may be relevant and critical to consider including adjacent canyons (such as Jones, Babylon, Emery, Uchupi, Ryan, and McMaster) into the sanctuary for comparative purposes and to enhance protection.

Some of the priority research themes for the Sanctuary team include canyon connectivity, drivers of diversity and development, the role of disturbance, canyon-dependent pelagic species, and pelagic migration patterns. There is also high interest in characterizing benthic and pelagic ecosystems in neighboring canyons and surrounding shelf areas to identify boundary options, and to document and quantify anthropogenic uses and impacts in canyons and surrounding shelf areas. In conclusion, the Sanctuary team hopes the Initiative will assist with objective evaluation of need for and value of the Hudson Canyon designation, as well as foster community engagement and support in the designation process.

NOAA Ocean Exploration Overview

Ashley Marranzino, Benthic Biologist with the University Corporation for Atmospheric Research who supports NOAA Ocean Exploration within the Science and Technology Division, provided an overview of the NOAA Ocean Exploration Program. NOAA Ocean Exploration is dedicated to exploring the unknown ocean (focused on the U.S. EEZ and waters deeper than 200 m) and unlocking its potential through scientific discovery, technological advancements, partnerships, and data delivery. The office supports interagency councils at NOMEC, and strives to meet community needs by sharing discoveries that engage the public. NOAA Ocean Exploration provides a multidisciplinary, initial assessment of unknown and poorly described areas through exploration of the seafloor, the sub-bottom, and the water column. Data collection include high-resolution bathymetry in areas with no (or low-quality) data; identifying, mapping and exploring the diversity and distribution of benthic habitats and resources; investigating deep ocean biogeographic patterns and connectivity; characterizing the water column and fauna; and supporting priority science and management needs. The underpinning of the strategic goals for the 2022-27 period is to “Explore to Discover, Discover to Understand, and Understand to Inform.”

NOAA Ocean Exploration meets their mission goals by using assets including NOAA Ship *Okeanos Explorer,* and ROVs *Deep Discoverer* and *Seirios*. For the next few years the *Okeanos Explorer* will be in the Pacific Ocean completing research expeditions along the West Coast and Alaska, and later into the Pacific Islands. Although NOAA Ocean Exploration and its Cooperative Institute’s assets are not currently in the Northeast, the office and its partners have previously explored areas within the region. Data that may be of interest to the Initiative are accessible

through the NOAA National Centers for Environmental Information's Ocean Exploration Data Atlas and the *Okeanos Explorer* data landing pages.

NOAA Ocean Exploration also runs a competitive grants program, through its annual Notice of Federal Funding Opportunity, which may provide a different avenue for collaboration with the Initiative. This program has funded more than 430 projects worth over $90 million since 2001. There are three areas of interest for proposals: 1) ocean exploration and discovery (with particular interest in water column exploration), 2) technology, and 3) maritime heritage. Award notifications are anticipated to be made in April of 2024 for a September 2024 award start date.

NOAA Ocean Exploration operates significantly in partnership with other offices, agencies, and organizations and looks forward to continuing those collaborations. For example, the Aleutian Islands Saildrone mapping effort (a collaboration between NOAA Ocean Exploration and its cooperative institute, BOEM, DSCRTP, NOAA Office of Coast Survey, the National Oceanographic Partnership Program, and the Monterey Bay Aquarium Research Institute) set the stage for exploration targets that *Okeanos Explorer* will explore this year. Additionally, between 2016-2022, the *Okeanos Explorer* engaged heavily in the Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE) effort, a multi-national campaign coordinated through NOAA Ocean Exploration to meet the science and management needs of multiple U.S. agencies and academia, as well as international and industry partners. ASPIRE included 600 days at sea and resulted in mapping approximately 629,000 km^2. The data synthesis for the ASPIRE campaign is underway, but those data are already available to the Initiative via the NOAA Ocean Exploration Data Atlas.

Fisheries and Oceans Canada (DFO) coral conservation and research efforts and priorities in the Gulf of Maine

Derek Fenton and Javier Murillo, from Fisheries and Oceans Canada (Marine Conservation and Planning Office, and Science Branch) presented Canada's coral conservation and research efforts. Canada has two legislative acts in place to protect corals: 1) The Fisheries Act (Marine Refuges), which restricts access to areas by bottom-contact fisheries through fishery license conditions, and 2) the Oceans Act (Marine Protected Areas) that establishes individual regulations applying to all ocean use activities (Figure 9). The Oceans Act is akin to U.S. Sanctuary designations and has established protected areas such as The Gully (2004) and St. Anns Bank (2017). Two areas of interest were announced in 2018, the Fundian Channel-Browns Bank and Eastern Shore Islands. Also, a Scotian Shelf-Bay of Fundy Bioregional Conservation Network plan is under consultation and expected to be released by 2024 to identify where additional protected areas and refuges will be identified, including coral-focused sites in the Gulf of Maine. The Fundian Channel-Browns Bank area is planned to be established as an Oceans Act Marine Protected Area by 2025, and contains high concentrations of several coral species.

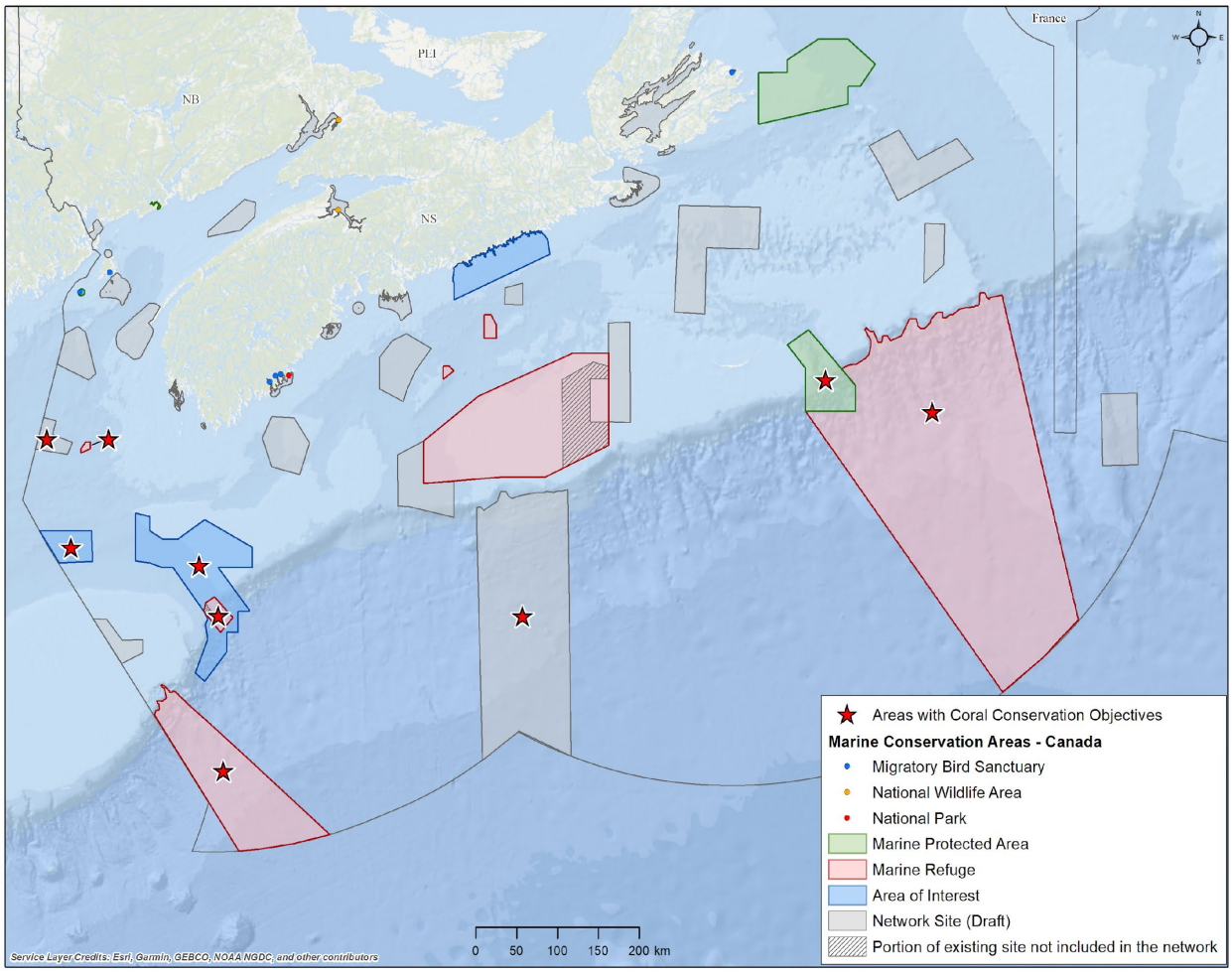


Figure 9: DFO's Bioregional Conservation Networks Maritimes Region Map.

Partnerships are key to Canada's ability to meet conservation commitments. Canada/US collaboration, with a focus on the Gulf of Maine, was identified as key to addressing common coral conservation needs. A primary objective for the country is to improve ongoing management and monitoring of existing protected areas by developing monitoring plans and conducting dedicated surveys. Javier provided a few examples of past deep-sea coral related projects with cross-border collaboration, such as the 2019 NOAA Ocean Exploration Deep Connections and 2021 North Atlantic Stepping Stones expeditions. He reiterated Canada's interest and need to continue monitoring their conservation areas as well as to use species distribution models to predict future coral and sponge locations in relation to climate change. Lastly, Canada's research themes of interest include identification of climate refugia and connectivity patterns, identification of benthic invertebrates from trawl surveys, habitat configuration and fragmentation of vulnerable marine ecosystems, use of sponges as environmental DNA (eDNA) samplers, assessing fish use of vulnerable marine ecosystems (with landers collecting images over a year), characterization of seep fauna, and restoration of damaged reefs with *Lophelia* corals. DFO is interested in potentially collaborating with benthic taxonomy efforts, artificial intelligence / machine learning, and AUV surveys. Additionally, they are able to contribute staff time and expertise to the Initiative as well as possible project co-funding.

Breakout Session Summaries

The workshop included two breakout session periods that were structured to identify more detailed science strategies. Three topics were discussed during each session: 1) Biological Sampling Needs; 2) Habitat Characterization Data Needs and Analysis; and 3) Management Driven Data Product Needs. The breakout sessions captured a variety of specific research ideas summarized below.

Biological Sampling Needs

This session included discussion on biology, biodiversity and ecology, general natural history, genetics, and taxonomy. The second Biological Sampling Needs session also focused on potential new sampling technologies, as participants had varying levels of interest and experience with biological sampling as originally described.

- For selected species with ongoing work (corals *Paramuricea, Paragorgia, Lophelia/Desmophyllum*, and sponge *Vazella pourtalesii*), make sure geographic coverage of sampling is distributed coastwide from Canada to the Gulf of Mexico
    - Cheryl Morrison is working on connectivity in *Paragorgia* and *Primnoa*
    - Identify spatial and temporal coverage of existing samples
        - Overlap with wind call areas
        - Opportunity for prioritization
    - DFO interest in partnerships concerning ongoing work on the sponge *Vazella pourtalesii*, a good opportunity for cross border collaboration and to keep sponges on the radar
- Sample planning
    - Generate a target species lists, including images where possible to maximize collections opportunities.
        - Work with the Smithsonian to find sampling gaps
    - Longline survey could be a source of samples and images
    - OE is in the process of updating the benthic animal guide, which will include images from Northeast EX expeditions
        - How do animal guides and targeted collections lists stay current?
        - Create a hierarchy of known unknowns and identify which species will be the most problematic
        - Especially in canyons, target cryptic species
    - Need for physical sampling that includes corals, sponges, and associated species
        - May need to better understand of fishes in canyons
    - From a planning perspective for "how samples get used," select target species from each major family
        - That technique can help drive connectivity studies by making sure there is enough material in hand from each major group
        - Target associates as well, such as crustaceans, echinoderms, microbes
    - Bioprospecting
        - Possibly target coral injury response
    - Plan sampling to tie circulation models to connectivity
        - There have been changes in circulation over the last few years, which may be important to document now
        - Opportunity to share resources from DFO, since they have a circulation model for the region

    - Connectivity studies need higher sensitivity information (SNPs, UCEs)
        - Interest in connectivity in associates too
    - Growth rates studies need more specimens across depth and species
        - What are settlement cues?
        - Little known about recruitment
        - In the canyons, target areas of suspected recruitment
        - Opportunity to deploy settlement plates
- Sample inventory
    - Need for inventory of materials 'in-hand'
    - ROV *ROPOS* material from the previous initiative is all cataloged
    - There might be materials of interest in MCZ or with partner researchers
    - One product could be an inventory of existing material and data rescue plans
        - Find repositories for material
        - Identify preservation and preservation timeline
    - Inventory can/should incorporate type material
    - Use the Northeast Fisheries Observer Program as source of samples
- Specifically with regard to wind energy plans in the area, plan to study coral response and recovery
    - Another component of offshore wind consideration is the possible introduction of invasive species, and we should be documenting them in coral habitats
        - One tunicate is a particular concern
- eDNA
    - What are the immediate needs to add eDNA to the Initiative?
    - Are there "standard" techniques?
        - Another way to think about standardization is standardization of data structure for eDNA studies
    - Can eDNA be applied for survey mitigation?
    - Gulf of Maine diversity is relatively low, and a good region to apply quantitative polymerase chain reaction (qPCR) to monitor and ask species specific questions
    - With regard to survey mitigation, longline and hook & line surveys may maintain access to areas and may enable sampling within wind energy lease zones for eDNA
    - Find a simple CTD to take water sample on cruises
        - Sample water, including whole water column profiles, to establish a baseline over time
            - Ocean acidification group has samples from the area in hand, and full water column surveys (contact Dwight Gledhill from the Ocean Acidification Program to collaborate)
            - Filter at sea, use metabarcoding for fish and coral
    - MBON projects in area
        - These and other programs are sampling to fill in time series, allowing a longer term perspective
        - IOOS (Integrated Ocean Observing System) has been working in multiple regions including this one for years
    - Possible *in situ* filtration systems through the Ocean Exploration Cooperative Institute, for which Adam Soule and Dwight Gledhill would be contacts
    - Reference databases: Are they representative of species in the region, and is there need for sequencing/collections to fill in species gaps?
    - Make sure samples are linked to good metadata
- Canyons and other geographic areas
    - Shallower than 500 m

        - Think about using vessels of opportunity, such as industry vessels
        - Need to develop better maps (underway)
    - Examine seep/coral interactions because carbonates can provide structure, but is there more than just seeps creating habitat?
- Other uses for biological material
    - Biogeochemical studies examining microchemistry of coral skeletons
        - New technology: laser ablation of skeletons to get concentrations of trace elements
    - Ocean acidification: biogeochemistry and skeletal composition data to inform susceptibility
    - Climate concerns: track species migration, fish migration, track climate impacts and changes
        - If areas are changing quickly, what can we specifically target to document changes?
        - Consider targeting geographic areas that are predicted to be susceptible to warm water incursion
- Sampling should consider ecosystem function
    - Niche specialization
    - Food web
    - Non-neutral associates who are predators
    - Economic ties and fisheries associations
    - Use community rate processes like oxygen flux to measure community metabolism (may be possible to measure with new AUVs)
    - Has water quality been well characterized to support regional modeling?
- What does coral recovery look like after both wind development and fisheries
    - Survey areas where boundaries have changed, and sample what has arrived since boundary changes (as has been done on the WC and AK)
    - Compare fished and non-fished areas

Habitat Characterization

Syntheses/updated information from first initiative:

- Higher resolution seafloor fauna -higher resolution slope data to inform models
    - Re-grid at higher resolution in existing maps
- Story to be told about the outcomes to date (map that was shown on Day 1 with U.S. and Canada protection efforts)

Priorities for the second initiative:

- General
    - Value of partnerships in achieving observing needs – e.g., use of landers or other instruments for long-term data collection (being done in Canada in Gulley Canyon), and bottom sampling to enhance bottom characterization)
    - Need for pelagic information, including links to benthic systems
    - Improved assessments of bottom types (appropriate mapping, bottom sampling, application of classification protocol that builds off the Coastal and Marine Ecological Classification Standard (CMECS))
    - Focus on fish associations with habitat (need protocols that improve our confidence in claiming association)

- Mapping
    - Higher resolution seafloor fauna -higher resolution slope data to inform models
        - Re-classify maps to better reflect habitat characteristics of organisms (corals, fish, etc.) - tops of canyons, slopes, vertical walls
        - Tying maps to observational data and imagery
        - Structure from Motion maps
        - Stratified methodology
            - 25m resolution - general mapping (multibeam)
            - 10m resolution - species distributions - direction of slope (AUV)
            - Sub meter resolution - species scale, species-habitat relationships (imagery) - split beam
    - Model validation
        - ground truthing
- Sampling
    - Samples to ID corals and attached fauna along with associated in situ imagery
    - Increasing use of eDNA during surveys
    - Oceanographic Data to collect/integrate
        - Temperature
        - PH
        - Salinity
        - Acidification
        - Aragonite saturation
        - Oceanography/acoustic doppler current profiler
        - Oxygen saturation
        - Variability in flow/dynamism in habitats
    - Satellite products to overlay onto habitat/mapping products
- Methodology
    - Desire to focus on fewer, particular canyons rather than broadly scattering dives
        - Prioritization of sites
            - Gradient of fishing intensity/effects areas
            - Gulf of Maine = exploratory in nature - basic data collection
            - Canyons = next stage - question based
            - Corsair Canyon as potential priority area due to boundary location
        - Select and apply criteria that prioritize mapping and visits, such as those that we feel would help us best understand connectivity, document changes related to climate, or parameterize models; and apply management criteria (protected areas like Hudson and the Monument, levels of fishing, wind opportunity areas)
        - Possibility of developing typology to do preliminary characterization and then as a selection criterion (e.g., depositional, erosional, shape, incising, slope)
    - Habitat connectivity
        - Samples of key taxa to characterize abundance, distribution, diversity
        - Flow models to estimate propagule distribution
    - Establish a working group to identify selection criteria
- Research Questions
    - What controls the distribution of corals and non-coral habitat forming species?
    - What impacts the recovery of these species?
    - Are we looking to identify reference sites for climate or other impacts?
    - What is the functional ecology of these habitats? How are fish using different habitats?

Management Driven Data Products

The management-focused breakout session included discussion on sanctuaries, the Monument, council actions, economic valuation and quantification of associated fish species, wind energy siting, and other related topics as described below. The group discussed general partner capabilities, interests, and needs:

- BOEM has a small scientific footprint and little capacity to do analysis, making the agency rely on NOAA to produce the data and relevant analysis, especially to inform wind energy siting and impacts.
- The Northeast Fishery Observer Program can contribute samples and location information to the DSCRTP national database, but needs a formal request.
- The Nature Conservancy can be a communications link between those who have information and those who want to use it.
- The NEFMC prioritizes mapping in preparation for the Coral Amendment to be revisited in the future, especially in data poor areas.
- USFWS/NOAA need a better understanding of habitat, species presence, and ecosystem interactions (e.g., whether habitat influences vertical migration) for the forthcoming Monument management efforts.
    - What is the best way to make data accessible to those interested in understanding the Monument?
    - What should go into the plan?
        - Baseline assessments
        - Understanding of how systems work in the Monument
        - Ways to help understand and refine models, and know if there are areas to avoid
        - If corals colonize submarine cables - what does that mean for infrastructure maintenance?
- National Geographic loans the drop camera that is used by E/V *Nautilus*
    - We may be able to borrow it, but it uses a lot of light so not ideal for fish studies
- DFO has landers that we can use
    - Put one/them in the Monument to study interactions over time
    - They have had landers and acoustic instruments in The Gully for a year, and will soon collect them to access the data
- NOMEC strategy alignment
    - Do we want to support and organize a flagship cruise/project of interest to many agencies that is relevant for highlighting through NOMEC?
    - Present activities at NOMEC meetings
    - Go to NOMEC with very specific requests
    - Emerging NOMEC priorities are climate change, biodiversity, and environmental justice
    - Work within the implementation plan milestones

Management-relevant research questions that were highlighted during this breakout session include the following:

- How do we quantify fish usage and/or association with DSC habitats?
    - What are the essential connections?
    - Does being in DSC habitat generate more fish?
    - The University of Maine is studying sea pens and red fish larvae, and could have a student look at samples for larvae
    - Link coral and habitat data to managed species; improve and validate models, then link to fish distributions

        - What role do DSC play (if they do) to sustain fisheries?
        - Reference work by Chris Rooper linking distribution of DSC to fishery independent estimates of biomass of abundance
        - Mark Henderson has done models of both corals and fish
    - Are there West Coast surveys for managed species' prey where feeding happens in coral habitat?
        - We are seeing hints of that within the deep scattering layer
        - We should engage WC and AK colleagues on sampling design and methodology
    - Could we link to Kathryn Ford's splitbeam survey data?
    - Bryan Costa is working on a drop cam system to image as model validation, and may be able to leave it on the seafloor to observe fish too
    - Look into low-light cameras
    - Baited cameras indicate presence (but not abundance)
- A good index of association could be whether people are fishing in areas of interest?
    - This question could be related to the size of patches and distribution since bigger areas are more worth fishing and intensity could correlate with coral abundance
    - Gear interactions also matter
    - Conclusions may come from combining maps of habitat, DSC presence, and fishing
        - For example, fishing is occurring in Jordan Basin and there are hotspots (of fishing and coral)
        - People are fishing on specific features for different reasons
        - Pot, gill net, and trap data exist, and Dave McElroy can survey with a GoPro
        - Note that this would be a challenging project (e.g. redfish don't take the bait for long lines)
- Do we need to monitor all of the protected areas? And do we need to monitor different areas to the same degree?
    - Monitoring information would inform management choices
    - Monitoring can sometimes only be accomplished at the expense of exploration, which can often better help achieve political targets and is generally more attractive
    - Not all sanctuaries collect the same level of info, which is why they have indicators for their condition reports
    - We should try to get Chris Caldow to provide a presentation indicators and the IEA program as a OneNOAA talk
- Can known coral communities grow/expand/recover?
    - Are there places we might expect coral but they are absent?
    - Are there areas we know of historically that could recover?
    - What is the longevity of habitats?
    - Wind development is a 30-50 year planning process, so how can we understand impacts without predictability on such a timescale?
    - Essential Fish Habitat is supposed to cover historical habitat
    - In the past, site clearances were needed for shallow areas before they could be developed, which relied on coral and sensitive habitat absence
        - The question was not asked whether these sites were environments that in the future (or if trawling had not occurred) could support habitat
        - BOEM treats any permanently exposed substrate as possible habitat (at least in the Gulf of Mexico), and needs ROV exploration if there is any exposed habitat
    - BOEM is working on modeling in the Gulf of Maine for whales (not yet corals), adding climate dynamics to predict future conflicts

    - DFO has invested in human activity mapping and early map data mining
        - All Canadian vessels submit VMS (collected 20 years of data) to identify hot spots of activity and help identify places where people should not be
        - Working with industry has been very helpful
    - The state of Maine asks fishermen if they are willing to discuss areas most and least important to constituents
    - One of the biggest data gaps is users and where people are conducting activities
    - Estimate coral and sponge recovery rates from disturbance (not necessarily successional)
- Are there conditions that are more likely to promote corals and succession?
    - It is likely more about currents than habitat preference
- What is anthropogenic influence on the deep sea?
    - In a past BOEM-funded Atlantic Canyons study by Sandra Brooke, differences were observed
    - Public comments in Monument management plan process on PFAS chemical inputs
- For management applications, we should use confidence metrics whenever we can since that consideration is very helpful for managers to use data wisely

Data gaps that we should think about addressing in this Initiative include the following:

- Improve bathymetry (coverage and resolution) and better understand a wider geography of canyons
    - DFO has many samples and data for all of the Canadian canyons, but not much synthesis yet
    - Better understand the seafloor (i.e., CMECS)
    - How well are we really characterizing canyons with spot sampling and dive traps?
        - Is each canyon different because we sampled differently?
        - Should we sample more intensively to understand small discrete areas rather than broader strokes (as we have done in the past)?
    - Collaborative survey design with DFO to understand Corsair Canyon (right on the Hague Line)
        - Would we see more changes in the area after comparing previous results that would give us data related to climate change impacts?
- Are fisheries surveys collecting data that can be used by DSCRTP?
    - Untrawlable long line survey
    - The Observer Program has lots of information
    - Jon Heifetz wrote a paper on distribution of bycatch
    - The state of Maine has an inshore trawl survey that may have observers
- Diel variation of fish association across seasons
    - Use stereo imaging on landers (contact: Rick Starr, MBARI)
- Can we integrate acoustics into our research?
    - Contact Chris Taylor
- How can we better tell the coral story?
    - 360° virtual reality video used in shallow systems
        - See 2019 tech demo cruise report and talk with Katy Croft-Bell or Kakani Katija
    - Ocean Exploration has a deeper 360° camera
    - Set up a fish photo booth
    - BOEM's virtual shipwreck gallery
    - Joint NOAA/USFWS/BOEM/USGS communications
    - USFWS/Mystic Aquarium connection
    - Showcase how to build a deep-sea camera that does not bother fish

Plenary Discussion Summaries

Geographic Priorities

During the first plenary discussion, the group recommended specific areas within the Northeast that could benefit from additional research and resources during the Initiative. Three discrete areas became the focus of conversation: 1) the Gulf of Maine, 2) the Northeast Canyons and Seamounts Marine National Monument, and 3) Mid-Atlantic canyons (including Hudson Canyon, currently proposed as a national marine sanctuary). Maps of these areas were displayed within the conference room and participants were encouraged to place sticker dots on the maps to designate specific areas of interest. Appendix C shows the placement of those dots from in-person attendees.

When selecting geographic sites to study, the group discussed the need to differentiate full surveys from exploratory dive since each yield highly different results. It was noted that more detailed surveys of a smaller area would be more beneficial than exploratory dives that may result in identifying areas where no corals are present. Predictive models were used to guide researchers to areas where corals were likely to occur in past surveys. Therefore, linking new models with improved bathymetry would be useful for selecting Initiative target areas. The group also debated the question of returning to previously sampled sites versus selection of new sites. The need for additional systematic surveys at previous sites and investigation of new sites will be considered further. Decisions will depend on data needs and the timing and validation of new species distribution models and the workflow for validating desired new and improved bathymetric models.

With a renewed emphasis on learning more about sponges, surveys in locations of dense sponge communities should be considered during cruise planning for the Initiative. Historically, research has focused primarily on structure-forming corals. Therefore, identifying data needs for sponge research will be important and require more conversation, especially since dense sponge aggregations are not always associated with coral communities.

Lastly, the group discussed the benefits of conducting additional surveys in the protected areas proposed in 2018 but not selected by the NEFMC. It is challenging to determine whether these sites were not selected due to a lack of data in support of their conservation value versus the practicality of managing those areas. Additional surveys in these areas may not lead to a change in designation status, however, revisiting areas that have been closed for a decade or more to determine the effectiveness of those closures by comparing pre-closure data with the new data could be very beneficial.

Gulf of Maine

The group agreed that the Gulf of Maine is a high priority research area in the Northeast. The forthcoming wind development leasing in the Gulf of Maine creates urgency to expand coral habitat knowledge of the area. The group discussed not just the importance of using data to inform the BOEM wind call and leasing areas, but also to assess potential issues caused by the displacement of fishermen into sensitive coral habitats that have not yet been mapped or characterized. The identification of areas in the Gulf of Maine where that displacement may occur, would allow the effects on sensitive coral habitats to be anticipated and possibly mitigated. Reviewing existing fishery management plans that will require amendments in the near future may be a good way to help determine important areas to survey for coral habitats (e.g., Jonah crab and lobster will require amendments within the next few years).

Surveys of proposed wind farm areas to get baseline data and identify areas that should be avoided (completing comparative inside/outside boundaries surveys) is a priority for the state of Maine. Although it is assumed, whether wind development will indeed have negative impacts on corals and the larger community is unclear, and surveys comparing inside/outside proposed wind

call areas could provide valuable insight. Potential changes to the hydrodynamics and how that might impact communities beyond the footprint of the wind farm (potentially tens of kilometers away) is also a very important consideration.

The development of novel species distribution models for the Gulf of Maine is needed to further management of DSCS habitats in the area. Since the spatial extent of deep-sea coral and sponge occurrence data is limited and existing data were generally collected in an exploratory manner, species distribution models specific to the unique seafloor habitats of the Gulf of Maine have not yet been created. Systematic (i.e., not spatially biased) surveys are needed to support the development of models. Data needed to support model development include new seafloor mapping data from the Gulf of Maine, as well as coral/sponge observations or collections that are accompanied by accurate, fine-scale position data, as well as location information from surveys where corals were not observed.

Several workshop participants made note of potential data sources from the Gulf of Maine that could be included in the DSC Data Portal and possibly contribute to the proposed modeling efforts.

- Peter Auster mentioned that there are data from hundreds of dives, spanning over 30 years of research in the Gulf of Maine, where no corals were observed. These data could potentially be absence points and help with model development.
- Sanctuaries also has some data from places where corals were not found.
    - Whether those data include specific locations that are of sufficient resolution for model development is uncertain.
- The current mapping initiative along the coast of Maine is collecting high-resolution bathymetry, substrate type, backscatter, and fish presence data (mostly in waters under 160 m, but with possible future expansion). Normally these surveys do not identify coral presence, but that can possibly be incorporated more moving forward.
    - These types of data are important for model development. Incorporating data from areas beyond known coral distributions and from shallower depths makes DSCS habitat models stronger.
- Cheryl Morrison is currently analyzing population structure of *Primnoa* and *Paragorgia* in the Gulf of Maine using species specific microsatellites. Her data, which will be published in the near future, could provide the Council with the data necessary to propose additional closure areas. Adding new samples would allow for additional, higher resolution analyses such as Restriction-site Associated DNA sequencing (RAD-Seq) or genome skimming.
- The MAFMC has done some image analysis through Coastal Ocean Vision that may be available to the Initiative.

The group also discussed how high-resolution bathymetry data would help in defining boundaries between coral and non-coral areas, and enable more precise modeling efforts. Additionally, high-resolution bathymetry would provide better information to guide survey priorities. However, NCCOS would need to review the highlighted data from past Gulf of Maine dives (below 160 m, and known to not have corals) to determine whether the location data are of sufficient resolution for modeling applications since absence data are critical to model development. In areas predicted to be unlikely coral habitat, new surveys using equipment other than ROVs (e.g., towed cameras, AUVs, drones) may be more efficient and cost-effect in collection of absence data going forward. Furthermore, comparing areas of known coral presence with results obtained from connectivity models could help narrow selection of sites of interest by highlighting areas of unlikely habitat and providing absence data for species distribution models.

The group then discussed potential sampling sites within the Gulf of Maine. Outer Schoodic Ridge, Jordan Basin, and Georges Basin were identified as priority sites. Additional work in Jordan Basin in general, and near the Canadian border in particular could help define the boundaries of coral areas as well as maintain collaborations with Canadian partners. Surveys at Outer Schoodic

Ridge also present a great opportunity to explore a unique area with walls of *Primnoa* (especially since the last attempt to sample here was unsuccessful due to a high number of lobster pots). Ongoing molecular studies have suggested Outer Schoodic Ridge as having a distinct population of *Primnoa resedaeformis*. Additional samples would allow confirmation of this population structure and potentially strengthen the case to conserve and protect this area. Moreover, additional surveys would provide an opportunity to assess coral condition, presence, and density which could speak to climate change impacts, as well as provide a foundation for future observations. Outer Schoodic Ridge is also a great site to study fish populations and their associations with corals. From a management standpoint, it would be easier to define conservation area boundaries (and be able to present them to the Council) if there were more samples and data along the Hague Line and western part of Jordan basin.

The Gulf of Maine is also of interest to our Canadian partners. For DFO, site selection in the Gulf of Maine is motivated in part by the commitment to achieve 30% seafloor protection by 2030. While Canada has already closed large areas of the seafloor for conservation, new mapping data in combination with existing coral presence and absence data would set the foundation to identify new areas and determine specific targets for surveys in the Gulf of Maine.

Northeast Canyons and Seamounts

Another primary area of interest for the group was the Northeast Canyons and Seamounts Marine National Monument specifically and other Northeast canyons in general. Corsair Canyon, Bear Seamount, and Oceanographer Canyon were noted specifically, as well as the potential to survey additional canyons throughout the region to increase geographic coverage and sampling for connectivity. The group favored studying representative canyons, particularly those that would aid population connectivity research or occur in areas of potential or known biogeographic breaks. Additionally, sampling at shallower depths within the canyon heads (< 400 m) would provide information to fishery management councils on potential impacts within these habitats. There was also interest in including canyons for studying potential climate change impacts, including potential changes in ocean acidification if climate change impacts the water flow through canyon habitats.

Within the canyons, priorities for consideration include the following:

- Improve species distribution models using existing data from Martha Nizinski's work in alignment with NCCOS' planned new model development for the northeast canyons within the next year and a half.
- Potentially partnering with BOEM to explore areas of high seep concentrations and determine their possible linkage to coral habitats.
- Conduct quantitative surveys of corals in fishing areas to assess fishing pressure and effects on coral, as well as expand knowledge of fish associations.
- Conduct surveys in the Northeast Canyons and Seamounts Marine National Monument to assess recovery potential of corals after fishing closures were enacted.
- Identify sets of canyons/canyon heads, including those within the Monument, that would cover a broad geographic range and enable connectivity studies on a variety of species.

Resources, Collaboration, & Implementation

NOAA 2024 Ship Time Requests

The workshop included a brief overview of three shiptime requests that had been submitted in early 2023 to support fieldwork in 2024. They include 1) Gulf of Maine mapping with NOAA Ship *Hassler*, submitted jointly with the Office of Coast Survey, 2) ROV work with NOAA Ships *Bigelow* or *Pisces* in the Gulf of Maine, and 3) ROV work with the *Bigelow* in both the Gulf of Maine and Northeast Canyons and Seamounts Marine National Monument in collaboration with

Dalhousie University and Fisheries and Oceans Canada colleagues. At the time of the workshop ship time decisions were still outstanding, and additional requests will be submitted in 2024 to support fieldwork in 2025. The steering committee is seeking partnerships in the region to further leverage resources for these surveys.

Gulf of Maine Mapping Effort

The NOAA Office of Marine and Aviation Operations is funding a proposal submitted by the NEFSC, NCCOS, and DSCRTP to deploy two Voyager class Saildrone vehicles to map the Gulf of Maine. The currently proposed zones for mapping include portions of the wind call area designated by BOEM and the mapping will begin in the fall of 2023, and be continued during the summer of 2024. Data derived from this mission will fill in some of the bathymetry gaps within the Jordan and Georges Basins with plans to use the data to direct survey efforts later in the Initiative The Initiative will also seek partnerships that could leverage additional resources for further mapping efforts going forward.

Fishery Management Council Deep-sea Coral Related Priorities

As the Initiative aims to support the mission and goals of the Mid-Atlantic and New England Fishery Management Councils, a quick discussion highlighted their priorities which are listed below.

MAFMC priorities

- General 5.5: evaluate the potential impacts of offshore wind development on habitats and productivity, larval distribution, and changing community structure of council-managed stocks.
- General 9: monitor changes in distribution and habitat use for all Mid-Atlantic species and evaluate implications for stock productivity.

NEFMC priorities

- 79: investigate the functional ecology of deep-sea corals.
- 80: quantify the degree of seabed contact for fishing gears and their component parts, particularly groundfish trawls.
- 82: evaluate habitat recovery following impact by fishing gear.
- 86: geological and biological sampling using acoustic, video, and grab sampling in the Gulf of Maine and Southern New England region to improve spatial resolution of habitat distributions and characterize temporal variability.

Proposed Technologies

Group discussion considered potential new technologies that could be incorporated into the Initiative. To employ the appropriate technologies and make sure resources are available to collect necessary metadata for models, it will be important for the team to specify exactly what they hope to measure.

One proposal was to increase visual observation data to be incorporated into models. Model validation has been successful through the use of single point dropcams paired with high resolution spatial data that can increase sample sizes, and therefore it could be helpful to try to attach a camera onto anything headed to the seafloor (i.e. CTD casts).

Application of biogeochemistry-linked ocean models that include bottom temperature could also be useful in understanding DSCS habitats, and many more of them will be available soon after the completion of the first phase of the NOAA Climate Ecosystems Fisheries Initiative.

Another topic of high interest was artificial intelligence (AI) and its potential application to image annotation. Incorporation AI into annotation pipelines could greatly assist with video annotation workload. There are already algorithms in use to detect presence and absence of an organism within videos that can potentially be used for deep-sea coral applications. Additionally,

NOAA has an agreement with FathomNet (a private company) to ingest AUV imagery and improve identification of family-level species through AI annotation. Inclusion of deep-sea coral captured data files to their system could help develop that AI identification capability.

The group also discussed incorporating AUV surveys, which could be less expensive or more flexible than traditional ROV. AUVs do not require a tether system, can be launched from smaller platforms, can be used to ground truth multibeam bathymetry, can support a variety of environmental sensors, and can be paired with sampling tools such as CTD casts for eDNA sampling, possibly allowing flexibility in survey planning. The group also discussed the benefits of pairing AUV and ROV surveys to enable AUVs for better special coverage to find sample targets.

In combination with several different types of resources, the importance of eDNA and water sampling garnered significant conversation during the workshop. Determinations on presence and absence of corals may be possible by reviewing existing eDNA water samples. Furthermore, historic records with eDNA might improve models, reduce ship time, and prioritize areas to survey more thoroughly. The Ocean Acidification Program group has existing water column samples that include eDNA (from the East Coast Ocean Acidification cruise and Ecosystem Monitoring surveys that were working 5 m above the seafloor), which may be valuable to the Initiative. Additionally, if samples are available, the NEFSC has existing water sample data taken with their Habitat Mapping Camera System (HabCam) that could be leveraged for inclusion in model development. Whether the Initiative should move forward with mining eDNA samples available from the Ocean Acidification Program or NEFSC will be considered by the Steering Committee.

On the topic of eDNA and water sampling, the following takeaways for future cruise consideration were highlighted.

- Unless within a high current area, water samples up to 10-20 m off the bottom can still detect the benthic signal and are acceptable for coral surveys.
- As little as one liter of water needs to be collected to conduct eDNA analysis, although more is better.
- Spatial resolution for eDNA samples is still hard to confirm. Typically, vertically 10-20 m off-bottom is about the furthest possible.
- Signals are localized, but for sampling design should include some areas where there are known corals, some that are random, and also some where there are no corals. This plan would help ground truth and determine if the camera was missing corals.
- There remain questions on whether eDNA signals travel further than current thinking (different species shed differently and can travel 1.5 nautical miles), and more work is needed before eDNA can be used as a localization framework.
    - qPCR is better for determining localized source than metabarcoding, so if we have some specific species of interest, we can develop specific information.
    - In general with 18s or 16s, species level biodiversity markers are limited via eDNA, especially for corals.

Other ideas brought forward to the group on technologies to consider for the research initiative included the following.

- Full ocean sampling can be useful as eDNA and surface samples could potentially detect coral larvae.
- Split beam sonar (not necessarily the split bean elements, but the ability for software to split the data afterwards) could be used to parse out in greater resolution animals by size, as well as distinguish between those that are close and those on the seafloor.
- Acoustics assessment tools could help select sites to assess the quantity of fish.
- Stereo imaging to look at colony, morphology, and size could enable linking survey data to potential reproduction and recovery models.

- Adding pH sensors to gear can measure environmental variables like dissolved oxygen. Previous cruises did not have capabilities to measure these types of things, just temperatures.
    - Measures like pH, without distribution, are tricky for spatial predictive models. The Aleutian Saildrone mission had the MBARI Environmental Sample Processor eDNA sampler on it as another good pairing of technology.
- Kathryn Ford's HabCam program is working to develop autonomous camera systems with image annotation capabilities that would not need to be towed (especially in more challenging wind turbine environments).
    - Synthetic Aperture Sonar Systems are great, but the challenge is with the high cost of data storage and archival, as well as how to deliver data to the community, especially as file sizes increase exponentially with 4K-type functionality.
- Sample collection of species types that could be processed for microchemistry of coral skeletons where there is potential to use the results to reconstruct their environments.
- Additional resources of interest include DFO dropcams or ROV *ROPOS*, micro AUVs and portable ROVs being developed by NCCOS, reconstituted versions of the UConn towed system, and Saab SeaEye ROVs for visual surveys.

Potential Collaboration

As part of this session, the group also discussed access to certain assets and technologies needed to accomplish the proposed field work. For example, fishing industry vessels were considered as an alternative platform for field work since these ships may be more readily available and easier to schedule than NOAA ships. NOAA has the ability to acquire sea days on these vessels through flexible contracts, and depending on the type of ships available different research operations could be accommodated. These fishing vessels could be beneficial for small-scale projects and could potentially deploy and retrieve landers and AUVs more efficiently than NOAA vessels. Alternatively, conversations with the University of Connecticut are underway to inquire about use of one of their vessels, especially if NOAA vessels are not available. Finally, the National Observer Program may also have options for vessel contracts and sea days that could be used for smaller scale data collection such as to collect eDNA samples or deploy smaller visual survey devices such as tow cams, drift cams, landers or AUVs. Observers are typically very excited about working with environmental groups and could provide a resource to the program by collecting samples opportunistically and using identification guides to provide initial taxonomic identifications of bycatch collected.

Collaboration with DFO has been mutually beneficial in previous years and could continue and expand in this Initiative. DFO has three benthic landers currently on the Scotian Shelf that will be recovered in during the Initiative. They are equipped with both camera systems that fire every thirty minutes as well as environmental sampling and monitoring equipment. DFO would be open to collaborating with the Initiative on using the landers if there is mutual interest.

The Woods Hole Oceanographic Institution (WHOI) would be another potential collaborator and has various resources that could be available to the Initiative. They have imaging systems for almost every platform, including a new small-sized ROV currently in development that is expected to be ready within 2-3 years. Additionally, they have several large multicorers with cameras that may be available for research on sediments or carbon sequestration in the canyons. If the Initiative engages in multi-agency cruises, such as with USGS, these multicorer systems could be an important resource. Lastly, WHOI also has two landers that could potentially be made available to the Initiative.

Small Project Brainstorming

In this session, the focus shifted to a brainstorming discussion on ideas for specific small projects (i.e., low cost, high return) to consider for funding in 2024. The project ideas discussed with the group are summarized below.

Fish associations

Holding a cross-regional workshop focused on discussing the best approach for quantifying coral and fish associations was discussed. Coral/fish associations could also be better understood through further studies:

- Exploring fishery dependent data sources for additional information that includes broader seasonal coverage.
- Re-analyzing data from *Okeanos Explorer* cruises to study abundances and associations within those annotations.
- Linking smaller scale coral/fish associations to fishery independent data sources may provide data necessary to assess the role corals play in variations in biomass and abundance indices over a larger geographic scale.
- Determining the relationship between these two disparate types of data could be useful in development of models.

There was also a discussion of continuing analysis of existing data for fish and invertebrate associations and submitting these data to the national database.

Red crab survey

In alignment with the NEFMC priority to conduct deepwater surveys for red crab, a project to further annotate existing *TowCam* and ROV *ROPOS* images was proposed. Red crab presence, distribution, and abundance data, as well as their associations with coral would be analyzed. Currently red crabs are considered data poor, especially since their distribution does not intersect with the NEFSC's fishery independent surveys. Useful information would include a better understanding of their depth distribution and habitat use. Information gleaned from these images would provide a better understanding of depth distribution and habitat use as well as highlight data gaps that could potentially be addressed on cruises during the Initiative. Data from historical surveys (e.g., R. Walley, V. Guida) may be available that could be incorporated into this project.

Split-beam sonar imaging of demersal fishes in coral/non-coral landscapes

The primary objective of this project is to better understand the links between coral habitats and managed species, particularly fishes. Imagery does not provide adequate information on how fishes utilize coral habitats. Split-beam sonar would provide additional information including but not limited to temporal (seasonal/diel) distributions and size classes. While an AUV could be used, surveys using shipboard split-beam sonar at one or two targeted coral areas would be beneficial to determine the quality and usefulness of the data before employing the approach more widely.

Split-beam sonar would need to be paired with drop camera imagery to verify fish identifications. This project could potentially be added to existing mapping cruises to reduce costs. NOAA ships already have these systems on board and they could be used concurrently with multibeam without degrading resolution.

Develop guidelines for offshore wind developers to identify DSC in their habitat geophysical and geotechnical surveys

Organizations involved in deploying undersea cable and Stellwagen Bank National Marine Sanctuary may have some baseline guidelines related to habitat characterization. However, there may be a need to further refine sampling strategies and recommendations related to benthic fauna. Also, DSCRTP is working on a related project with BOEM to develop a guide that identifies

sensitive and important benthic habitats with an emphasis on the coral/sponge/seep species found within them. Additionally, the Regional Wildlife Science Collaborative for Offshore Wind has established a Habitat and Ecosystems subcommittee (including development stakeholders) that is working on a science plan that includes standards and protocols for characterizing benthic habitats. The scope of this proposed project could be customized to fit stakeholder priorities and available funding. For example, a smaller subset of species with high quality imagery available could be highlighted in the BOEM benthic guide currently under development.

Develop survey recommendations for offshore wind developers

Setting standards now for wind companies could be really important. This project would provide guidance to developers on what types of surveys should be conducted to determine the suitability of the leasing areas. In collaboration with BOEM, recommendations on protocols for approving specific lease sites and requirements for monitoring programs by vendors could be drafted. Topics for consideration include: requiring developers to provide a mitigation plan to reduce negative impacts on deep-sea corals if these habitats are encountered; recommending size and proximity of spatial buffers around sensitive habitats; and determining impacts (both direct and indirect) on deep-sea corals at local and regional scales.

Publish a paper focused on policy needed for coral habitat recovery from disturbance

This publication would focus on the importance of protecting sensitive deep-sea coral habitats. Peter Auster volunteered to write a section on coral recovery in light of climate change and distribution shifts, based on work from the west coast which discussed changes in habitats 10-years after being closed to trawling. A statement of what DSCRTP defines as "recovery" would be needed as well as distinguishing between an ecosystem versus a single species. Lastly, synthesis of biodiversity of the associated fauna, across depths, in each canyon could potentially show the potential of corals acting as indicator species.

Recover/analyze historic video/imagery from National Undersea Research Center archives

There is a significant amount of data from previous dives in the Northeast region that have not yet been annotated. While the general location of the dives are known, there may not be specific GPS coordinates associated with these data, and therefore these data may not be particularly useful for model development. However, the imagery would be worth reviewing if only to provide absence data, and could inform exploratory field efforts in the future.

Data Management

As a government agency, NOAA is required to archive all management-relevant data produced and make these data publically available. To accomplish that, the DSCRTP created and maintains the NOAA Deep-Sea Coral and Sponge Data Portal, within which all Initiative data must be included. To ensure raw data captured at sea (including images, video, environmental, etc.) are properly archived, the DSCRTP and National Centers for Environmental Information send hard drives with the research teams, and data are backed up directly on the ship. There is a proposed folder structure for organizing the data, although the research teams are able to adjust as necessary. Once annotations of the data are complete, the information is submitted for input into the national database. The database is set up to accept any record of corals or sponges that have locality data. This includes, but is not limited to records obtained from eDNA, physical samples, videos, and images. All data within the portal are also linked to other data sources such the Ocean Biodiversity Information System (OBIS). For those interested in individual datasets on a specific project, cruise, or effort, the portal is structured with data pages that allow querying data specific to those efforts. To assist the PIs with data submission, customized forms are created for data entry.

During the workshop the group agreed that a priority of the Initiative should be to produce communication products, catered to various community audiences, for distribution at the end of the Initiative, thus ensuring the data are accessible and available. Beyond the data that can be used in scientific investigations such as model development, specific outreach products should be created for educational groups, Fishery Managers, and the general public. For example, Fishery Managers would likely appreciate spatial data analyses and pre-packaged data summaries that are condensed, easily digestible, and highlight new information about particular places studied (e.g., new information from Jordan Basin that discusses where corals are, how they are distributed, etc.). These updated summaries of knowledge could then be leveraged when revisiting the management councils coral amendment.

Data requirements for the next version of species distribution models include both presence and absence data. Having both available in the portal is essential to new model development. Additionally, standardizing collection of abundance data, including their spatial scale is very important.

Conclusions from the Workshop

Contributions from this diverse group of experts resulted in a compilation of broad ideas, opportunities, and paths forward to advance our understanding of deep-sea coral and sponges in the Northeast Region. Throughout the discussions, three geographic locations were consistently identified as high priority areas for study in the upcoming effort:

1. The Gulf of Maine
2. Northeast Canyons and Seamounts Marine National Monument
3. Hudson Canyon (proposed National Marine Sanctuary)

Over the course of development of the Science Plan, and with new mapping data obtained from the Saildrone and other mapping surveys, the Steering committee will remain engaged with local stakeholders and identify specific priority regions for survey within these broader geographic areas.

The participants agreed that the Northeast Deep-Sea Coral Initiative should consider how corals fit into the larger ecosystem, and place less emphasis on exploration and discovery. Focus areas should include the following:

1. Continue investigations of deep-sea coral habitats to gain better understanding of habitat characteristics and functional ecology to inform conservation and management objectives.
2. Conduct mapping, modeling, and surveys to inform siting of OSW in the Gulf of Maine.
3. Consider the impact/recovery/effect of wind infrastructure on coral habitats.
4. Incorporate ecosystem context on how coral interacts with fish populations and how the wind impacts on corals could then impact the fish.
5. Study climate change impacts to the Gulf of Maine, including species displacement
4. Sample for connectivity and species identification, and include absence data from surveys to inform models.

These priorities will drive specific surveys, projects and deliverables to be identified in the Science plan, and will be revisited over time to be sure we are meeting management driven goals.

Finally, the success of the Northeast Deep-Sea Coral Initiative will depend upon strong collaborations and partnerships to leverage resources, share ideas, and contribute to data collection. Many partners and potential collaborators were represented at the workshop. NOAA is committed to strengthening these partnerships as the Initiative moves forward.

Acknowledgements

We thank the Northeast Deep-Sea Coral Initiative steering committee for their input during the planning and execution of this workshop, making it a productive event. In addition to all the participants, both remote and in person, we also acknowledge and thank the people who played supportive roles: Kat McDonald for facilitating and supporting workshop logistics, Meredith Everett for facilitating and creating informative materials for the breakout session notes, Michael Rhode for creating an interactive map displaying data from the DSCRTP national database, and Heather Coleman who also helped plan, facilitate and prepare thoughtful materials. We also thank the presenters at the workshop for preparing material to share with the attendees about their respective agencies or institutions, as well as all the virtual attendees for participating remotely and contributing to the workshop. A special thanks to the NOAA DSCRTP for funding the workshop which allowed all of the thoughtful, cross-cutting discussions to take place to help prepare the steering committee for science plan development. And a special thanks to the Marine Biological Laboratory for the use of their high-tech conference space that ensured a smooth workshop for all.

Appendix A - Workshop participants

Name	Affiliation	Participation
Adam Soule	University of Rhode Island, Graduate School of Oceanography	In-person
Adrian Castillo	SUNY College of Environmental Science and Forestry	Virtual
Alice Stratton	NOAA Office of National Marine Sanctuaries	Virtual
Andrea Quatrinni	Smithsonian Natural History Museum	Virtual
Anne Simpson	Maine Department of Marine Resources	In-person
Ashley Chappell	Integrated Ocean and Coastal Mapping, NOAA Office of Coast Survey	Virtual
Ashley Marranzino	University Corporation for Atmospheric Research, NOAA Ocean Exploration	In-person
Brandon Jensen	Bureau of Ocean Energy Management, Office of Renewable Energy	Virtual
Brittany Petersen	U.S. Fish and Wildlife Service, Northeast Canyons and Seamounts Monument	In-person
Cheryl Morrison	U.S. Geological Survey, Eastern Ecological Science Center	Virtual
Corinne Kane	NOAA Greater Atlantic Regional Fisheries Office	In-person
Dave Packer	NOAA Northeast Fisheries Science Center, Habitat Ecology Branch	In-person
David McElroy	NOAA Northeast Fisheries Science Center, Cooperative Research Branch	In-person
Derek Fenton	Fisheries and Oceans Canada	In-person
Dwight Gledhill	NOAA Ocean Acidification Program	Virtual
Ellen Kenchington	Fisheries and Oceans Canada	Virtual
Gilbert (Gib) Brogan	Oceana	In-person
Heather Coleman	NOAA Fisheries, Deep Sea Coral Research and Technology Program	In-person
James Vasslides	NOAA Northeast Fisheries Science Center	In-person
Jason Chaytor	U.S. Geological Survey, Woods Hole Coastal and Marine Science Center	In-person
Javier Murillo-Perez	Fisheries and Oceans Canada	In-person
Jennifer Le	Bureau of Ocean Energy Management, Office of Environmental Programs	In-person
Julia Beaty	Mid-Atlantic Fishery Management Council	Virtual
Kara Meckley	NOAA Fisheries, Office of Habitat Conservation	In-person
Kathryn McDonald	NOAA Fisheries, Deep Sea Coral Research and Technology Program	In-person
Kathryn Ford	NOAA Northeast Fisheries Science Center, Population Ecosystems Monitoring and Analysis Division	In-person
Kiley Dancy	Mid-Atlantic Fishery Management Council	Virtual
Kirstin Meyer-Kaiser	Woods Hole Oceanographic Institution	Virtual
LeAnn Hogan	NOAA Office of National Marine Sanctuaries	Virtual
Libby Jewett	NOAA Ocean Acidification Program	Virtual
Lindsey Nelson	NOAA Northeast Fisheries Science Center, Cooperative Research Branch	Virtual
Lisa Methratta	NOAA Northeast Fisheries Science Center, Offshore Wind Team	In-person
Lisa Milke	NOAA Northeast Fisheries Science Center, Ecosystems and Aquaculture Division	In-person
Marianne Randall	NOAA Greater Atlantic Regional Fisheries Office	Virtual
Mark Finkbeiner	NOAA Office for Coastal Management	Virtual
Mark Mueller	Bureau of Ocean Energy Management, Environmental Studies Program	In-person
Marta Ribera	The Nature Conservancy	In-person
Martha Nizinski	NOAA Fisheries, National Systematics Laboratory	In-person
Matthew Poti	NOAA National Centers for Coastal Ocean Science	In-person
Melissa Smith	Maine Department of Marine Resources	In-person
Meme Lobecker	Kongsberg Underwater Technology	In-person
Meredith Everett	NOAA Fisheries, Deep Sea Coral Research and Technology Program	In-person

Merry Camhi	Wildlife Conservation Society	Virtual
Michael Rhode	Lynker, NOAA Northeast Fisheries Science Center	In-person
Michelle Bachman	New England Fishery Management Council	In-person
Nicole Cabana	NOAA Northeast Fisheries Science Center	In-person
Nina Yang	Woods Hole Oceanographic Institute	In-person
Pace Wilber	NOAA Southeast Regional Office, Offshore Wind Team	Virtual
Pam Goddard	Lynker, NOAA Alaska Fisheries Science Center	In-person
Peter Auster	Mystic Aquarium, University of Connecticut	In-person
Sam Candio	NOAA Ocean Exploration	Virtual
Sarah Rieter	New England Aquarium	Virtual
Stephanie Sharuga	Bureau of Ocean Energy Management, Office of Environmental Programs	Virtual
Steve Auscavitch	Boston University	In-person
Steve Brodet	Kongsberg Underwater Technology	In-person
Steve Gittings	NOAA Office of National Marine Sanctuaries	In-person
Tania Lewandowski	NOAA Northeast Fisheries Science Center, Observer Program	In-person
Tim Shank	Woods Hole Oceanographic Institution	In-person
Tori Kentner	Mid-Atlantic Fishery Management Council	In-person

Appendix B - Workshop Agenda

Northeast Deep-Sea Coral Initiative - Priorities Workshop Agenda

DAY 1: May 2, 2023 - Marine Biological Laboratory, Woods Hole, MA - Meigs Conference Room		
Time	**Topic**	**Presenter**
8:30-9:00	Arrival and Mingling (Icebreaker BINGO!)	NA
9:00-9:05	Welcome and Logistics	Kat McDonald
9:05-9:20	Overview of Deep-sea Coral Research and Technology Program	Heather Coleman
9:20-9:30	NOAA Office of Habitat Conservation Kick-off Thoughts	Kara Meckley
9:30-9:45	Northeast Fisheries Science Center Opening Remarks	Nicole Cabana
9:45-10:30	Northeast Retrospective - Look back at the previous Initiative	Martha Nizinski
10:30-10:45	**—---------- 15-MINUTE BREAK ----------**	**NA**
10:45-11:00	New England Fishery Management Council Overview	Michelle Bachman
11:00-11:15	Mid-Atlantic Fishery Management Council Overview	Kiley Dancy
11:15-11:45	Bureau of Ocean Energy Management Overview of Atlantic Priorities	Brandon Jensen
11:45-12:15	Overview of Offshore Wind Impacts on Benthos and Fisheries	Lisa Methratta
12:15-1:30	**—---------- LUNCH ----------**	**N/A**
1:30-1:45	U.S Fish and Wildlife Service Discussion on Monument Planning and Product Needs	Brittany Petersen
1:45-2:00	NOAA Sanctuaries Overview of DSC Priorities	Steve Gittings
2:00-2:15	NOAA Ocean Exploration Overview	Ashley Marranzino
2:15-2:30	Fisheries and Oceans Canada coral conservation and research efforts and priorities in the Gulf of Maine	Derek Fenton/ Javier Murillo-Perez
2:30-2:45	Break Out Session Introduction - Structure	Meredith Everett
2:45-3:00	**—---------- 15-MINUTE BREAK ----------**	**N/A**
3:00-3:45	Break Out Session #1	Breakout Facilitators
3:45-4:15	Break Out Session Debrief	Spokespersons
4:15-4:30	Daily Wrap-up	Kat McDonald

DAY 2: May 3, 2023 - Marine Biological Laboratory, Woods Hole, MA - Meigs Conference Room		
Time	**Topic**	**Presenter**
8:30-9:00	Arrival and Mingling	NA
9:00-9:15	Welcome and Logistics	Kat McDonald
9:15-10:00	Break Out Session #2: New Groups	Breakout Facilitators
10:00-10:30	Break Out Session Debrief	Group Spokespersons
10:30-10:45	**—---------- 15-MINUTE BREAK ----------**	**NA**
10:45-12:00	Summary of Breakout Session Outcomes ● Discussion on geographic priorities and map review ● Other topics of interest	Meredith Everett
12:00-1:15	**—---------- LUNCH —----------**	**NA**
1:15-1:30	Resources, Assets, and Collaboration ● Ship time planned for 2024 (and possibly 2025) ● ROV ideas and input ● Collaborative research discussion and expedition leveraging	Meredith Everett
1:30-2:45	Group Discussion #2: How the work gets done ● Research strategies, participants, framework for accomplishing tasks ● New technologies that may apply, could be tested	Meredith Everett
2:45-3:00	**—----------15-MINUTE BREAK—----------**	**NA**
3:00-3:30	Data Product Requirements ● Overview of what is expected by the Initiative and data collection tracking mechanisms. ● Deep-sea coral database overview and example of data collection to publishing process	Meredith Everett
3:30-4:00	Small Project Possibilities ● Overview of what is defined as a small project ● Discussion of possible project ideas	Heather Coleman
4:15-4:30	Wrap-up ● Highlights from the two days ● Next Step Discussion ● Review of Action or Parking Lot Items	Kat McDonald

Appendix C - Geographic Map of Priorities

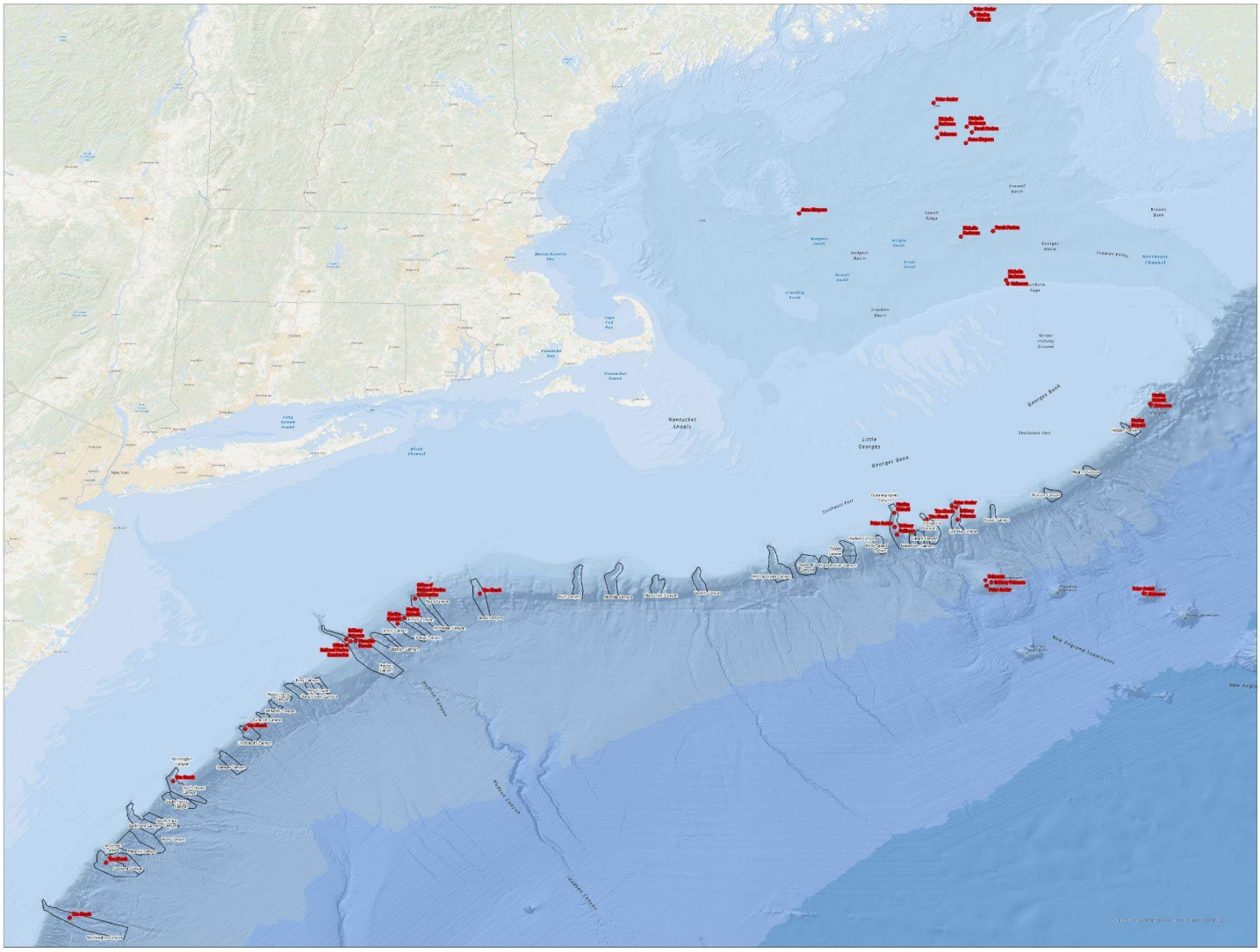


Figure 10: Map of the Gulf of Maine, New England and Mid-Atlantic canyons, and New England seamounts on the continental slope. Red dots indicate priorities chosen by workshop participants.

Appendix D - Acronyms

Acronym	Definition
ACUMEN	Atlantic Canyons Undersea Mapping Expeditions
AI	artificial intelligence
ASPIRE	Atlantic Seafloor Partnership for Integrated Research and Exploration
AUV	autonomous underwater vehicle
BOEM	Bureau of Ocean Energy Management
CMECS	Coastal and Marine Ecological Classification Standard
CPA	Coral Protection Area
DFO	Fisheries and Oceans Canada
DSCRTP	Deep Sea Coral Research and Technology Program
DSCS	deep-sea coral and sponge
eDNA	environmental DNA
EEZ	exclusive economic zone
GARFO	Greater Atlantic Regional Fisheries Office
GPS	Global Positioning System
HabCam	Habitat Mapping Camera System
MAFMC	Mid-Atlantic Fishery Management Council
MARCO	Mid-Atlantic Regional Council on the Ocean
NCCOS	National Centers for Coastal Ocean Science
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NOAA	National Oceanic and Atmospheric Administration
NOMEC	National Strategy for Ocean Mapping, Exploration, and Characterization
OSW	offshore wind
qPCR	quantitative polymerase chain reaction
R/V	research vehicle
ROPOS	Remotely Operated Platform for Ocean Sciences
ROV	remotely operated vehicle
UConn	University of Connecticut

USFWS	US Fish and Wildlife Service
USGS	United States Geological Survey
WEA	wind energy areas
WHOI	Woods Hole Oceanographic Institution