

October 2021 Open Ocean TIG Script and Q&A Session: Special Mesophotic and Deep Benthic Community Restoration Report

October 28, 2021 Webinar – Presentation Script

Slide 33. Webinar Participation

Speaker: Stephen Heverly

Thank you everyone for joining the Open Ocean Trustee Implementation Group's special session of Mesophotic and Deep Benthic Communities. I'm Stephen Heverly, a contractor with the NOAA's Restoration Center in the Office of Habitat Conservation. I'm helping facilitate the webinar today.

Before we begin the presentation, I'd like to quickly run through some webinar logistics with you. Hopefully everyone's logged in to the webinar by now. You should be able to see the control panel on the right-hand side of your screen – which is shown on this slide.

If you're using a phone for audio, you should all be dialing in using the phone number provided by GoToWebinar—that's the number and access code listed under "Audio" in the control panel. Please note that only presenters will be heard over the phone during the webinar; attendees will be muted.

Please also look at the "Questions" box at the bottom of the control panel – where the green and blue arrow is pointing. If you have questions about the presentation topics along the way, we encourage you to enter those in the "Questions" box at any time. Although, you'll also have an opportunity to submit questions at the end of the presentation, if you plug them in early, it can help us organize them ahead of time.

After our presentation, we'll answer as many questions as we can in the time allotted.

We'll also post the presentation slides and a transcript of the webinar to the GulfSpillRestoration.noaa.gov website in a few days.

Finally, we'll drop a link in the chat for a Mesophotic and Deep Benthic Communities fact sheet to help you follow along.

Now over to Laurie Rounds who will walk us through the agenda.

Links Provided in the Chat:

Mesophotic and Deep Benthic Communities Projects fact sheet:
https://www.gulfspillrestoration.noaa.gov/sites/default/files/2019-05%20OOTIG_DraftRP2EA_MDBC_Overview%20Fact_Sheet.pdf

Slide 34. Special Session Agenda

Speaker: Laurie Rounds

Thank you, Stephen and thank you to everyone for joining today's Open Ocean Trustee Implementation Group webinar. I'm Laurie Rounds with NOAA and serve as NOAA's representative for the Open Ocean Trustee Implementation Group.

Many of you may have joined the webinar for our annual meeting and thank you for staying for this special session. If you are just now joining, welcome and thank you for joining to learn more about our work to restore deep sea communities.

During this special session, we will provide an overview of the Deepwater Horizon projects to restore Mesophotic and Deep Benthic Communities and share progress on the work being conducted during their implementation planning phase. We will also share information about upcoming stakeholder engagement efforts. You'll hear about this work from our project managers that bring a wealth of experience and expertise to the work of restoring deep-sea habitats injured by the Deepwater horizon oil spill. And finally, we will save time for you to ask questions about the work that is underway.

Slide 35. Mesophotic and Deep Benthic Communities Restoration Projects

Speaker: Laurie Rounds

I'd like to start by providing a little more information about how we are defining mesophotic and deep benthic communities for the purposes of these restoration projects. Mesophotic and deep benthic communities are hard and soft habitat on the seafloor that support a variety of fish and invertebrate species. For the purposes of the restoration effort, we are focused on habitats in water depths from 50 meters to over 2,000 meters in the Gulf of Mexico. "Mesophotic" refers to the zone where some sunlight reaches the habitat, whereas the deep-sea environments are devoid of sunlight. Deep sea corals, fish, crabs, and other small animals and microbes live in these habitats and are part of the foundation of life in the northern Gulf of Mexico. In addition, mesophotic reef habitats are important for a variety of fish species of commercial and recreational importance such as snapper, grouper, and amberjack.

The Deepwater Horizon oil spill severely affected mesophotic and deep benthic communities. Because the species that make up these communities can be long-lived and slow growing, their recovery is expected to be slow. Restoration for injuries to these communities from the oil spill is conducted by the Open Ocean Trustee Implementation Group or "TIG". The Open Ocean TIG consists of the four federal trustees: NOAA, the Department of the Interior, U.S. Environmental Protection Agency, and U.S. Department of Agriculture.

In the 2019 Open Ocean Restoration Plan, the TIG selected the four projects shown on this slide to conduct mapping and modelling, habitat characterization, active management and protection, and direct restoration using coral propagation techniques to help restore for the injuries to mesophotic and deep benthic communities. The geographic area for our work focuses on the northern Gulf of Mexico.

Together, the projects comprise an integrated portfolio of restoration activities. They will be implemented over a 7–8-year period that includes an initial 1–2-year implementation planning

phase that has been underway since 2020. The planning phase will be followed by 5-years of implementation and a final year of project evaluation and reporting. The total estimated budget for the portfolio of projects is approximately \$126 million.

You can read more details about each project in the fact sheets developed for the 2019 restoration plan, which Stephen provided a link to in the chat box.

Slide 36. Building a strong foundation for restoration

Speaker: Laurie Rounds

Before we hear from each project, I'd like to provide an update on the work being conducted across the projects as part of the planning and design phase to lay a strong foundation for the 5-year implementation period. Overall, this planning phase was intended to 1) identify and prioritize specific geographic areas to conduct project activities and 2) ensure transparency, public input, stakeholder and partner engagement, and communication of data and results over the life of the projects.

After the projects were approved in December 2019, we formed project teams made up of experts at NOAA and the Department of the Interior. We brought together team members that have many years of experience working to understand, protect, and manage deep-sea resources. These multi-disciplinary teams will help us leverage the experience of programs such as NOAA's Deep Sea Coral Research and Technology Program, the Biogeography Branch and Deep Coral Ecology Lab of the National Centers for Coastal Ocean Science, the Flower Garden Banks National Marine Sanctuary, the Southeast Fisheries Science Center, and the National Centers for Environmental Information. The teams also include biologists, research ecologists, and resource experts from the U.S. Geological Survey, Bureau of Ocean Energy and Management and Bureau of Safety and Environmental Enforcement, which also bring extensive experience and expertise to the projects.

The teams began planning phase work in the summer of 2020 and we anticipate completing that work by next summer. An important task for the teams was a comprehensive inventory of existing geospatial datasets and best available science for mesophotic and deep benthic communities. Many organizations are contributing to the inventory and providing hundreds of datasets for the Gulf of Mexico. One of the first uses of the geospatial inventory has been to engage stakeholders in identifying information gaps and prioritizing geographic areas. We anticipate completing this prioritization process before the end of the year. The project teams are also using this information to identify partners, develop implementation plans, and review environmental compliance requirements to conduct deep-sea expeditions and other project activities in 2022. The Open Ocean Trustees will review the proposed project implementation activities for approval and consistency with the 2019 Open Ocean Restoration Plan. We look forward to sharing information about the initial implementation work in early 2022.

The project teams also continue to establish transparent decision-making practices with a focus on public input, stakeholder engagement, and communication of results. This work has included developing an integrated data management framework that will support our goals for data

sharing and communication. It has also included broad engagement with stakeholders, including several planning workshops. Stephen has provided a link in the chat to a web story that provides more information about these workshops. The teams have also started to explore opportunities to partner with a range of organizations such as the Navy, NOAA cooperative institutes, research institutes, universities, and other private and public organizations with expertise in deep sea field operations.

So, as you are about to hear, there's been a lot of progress by the teams that we are excited to share with you today. We'll begin with Tim Battista and the Mapping, Ground-truthing and Predictive Habitat Modeling project.

Links Provided in the Chat:

MDBC stakeholder engagement: <https://www.gulfspillrestoration.noaa.gov/2021/10/bringing-together-experts-plan-innovative-deep-sea-habitat-restoration?>

Slide 37. Mapping, Ground-truthing, Predictive Habitat Modelling Project Objectives

Speaker: Tim Battista

Thank you, Laurie. Good afternoon everyone. I am Tim Battista with NOAA, and I am one of the co-managers for the Mapping, Ground-truthing, and Predictive habitat Modeling" project, abbreviated as "MGM". This project has an estimated budget of approximately \$35.9 million dollars over a 7 to 8 year duration. The objectives of MGM project are to: 1) document the abundance and distribution of deep and mesophotic benthic communities, 2) provide fundamental information to prioritize and support protection and management activities, and 3) to identify locations for direct restoration. Additionally, MGM will also develop and refine predictive habitat models to improve the effectiveness and cost efficiency of future mapping and ground-truthing efforts, as well as habitat conservation and restoration actions.

Slide 38. Project Implementation Planning Highlights

Speaker: Tim Battista

Today, I would like to share with you three project implementation highlights.

First, we have compiled and internally released, what I believe to be, is the most comprehensive geospatial inventory of existing data within the mesophotic and deep benthic community focus area. This inventory includes, to date, (as represented on the three right panels) over 350 seafloor mapping datasets including acoustic surveys, derived products, and imagery; over 50 ground-truthing datasets including sediment and biological samples as well as photos and videos from various undersea vehicles; and lastly eight predictive habitat modeling datasets including habitat suitability models.

Secondly, we have built and released Web-based tool which we are currently using in a Spatial Prioritization Process. The tool and process are used to identify high-priority areas for upcoming

mapping, ground-truthing, and modelling activities to support MDBC restoration. Essentially to capture the where, what, when, and why priorities.

And lastly, we have developed a robust MGM Operational plan for 2022, which for MGM includes three cruises planned on the NOAA fleet and one through contracted services. These cruise efforts span the full mesophotic and deep depth regimes, and include hydrographic mapping, imaging with ROV's, deployment of AUVs, and incorporate partnerships with many internal and external partners.

Slide 39. Upcoming Stakeholder Engagement

Speaker: Tim Battista

Now we will touch on stakeholder engagement.

As I mentioned previously, the spatial prioritization exercise is underway now and we have several preliminary workshops. The exercise includes over 90 subject matter experts as participants. The tool will be close tomorrow and results will be made public January of 2022.

We are conducting a summit in late October and have invited several mappings, ground-truthing, and modelling technical experts. This summit and experts' group will help us identify and define Best Practices and Approaches MGM for implementation.

Also, we will be releasing four Tech Memo reports between the end of this month and March 2022, and these will be capturing key findings, analyses, and recommendations.

And lastly, we will be leading a town hall and presenting several talks at the Ocean Sciences meeting in March 2022

With that, I'll turn it over to Randy Clark to provide an overview of the Habitat Assessment and Evaluation Project.

Slide 40. Habitat Assessment and Evaluation Project Objectives

Speaker: Randy Clark

Hello, my name is Randy Clark, I'm a marine biologist with NOAA's National Center for Coastal Ocean Science's Marine Spatial Ecology Division. I'm a co-manager for the Habitat Assessment and Evaluation. Our internal team consists of 23 mesophotic and deep benthic community experts from NOAA, USGS, and BOEM.

The "habitat assessment and evaluation" project has an estimated budget of \$52.6 million dollars over 7 to 8 years. The project will fill critical data gaps and evaluate sites for potential direct restoration and protection activities, at both injured and reference sites; document ongoing injury to MDBC's from natural and anthropogenic threats; provide background data needed to assess success of restoration efforts with respect to recovery, natural mortality, and

growth rates; and establish a baseline for health and condition to guide direct restoration and protection.

Specific project activities also include establishing and maintaining long-term monitoring and sentinel sites; conducting field data collection and analysis; supporting development and application of image analysis/species recognition tools; and assessing the effectiveness of existing spatial management frameworks for addressing key threats to MDBC.

Slide 41. Project Implementation Planning Highlights

Speaker: Randy Clark

We've been very busy over the last 18 months. Before we set out to sea, we need to discover what we know about these communities, where they are, and subsequently what we don't know. Our team has tackled this objective with two activities. First, we've assembled a comprehensive bibliography of relevant literature as it relates to best practices for sampling and characterizing biological communities, oceanographic parameters, and fish and coral genetic information. Second, we are currently searching for existing accessible data, evaluating them as we get them, and requesting data that may be less accessible or not processed for our utility (such as ROV video data that has not been annotated for taxonomic metrics). We will put these two activities together and develop a gap analysis that will help us plan and execute field work over the next 5 or 6 years.

Slide 42 Stakeholder Engagement

Speaker: Randy Clark

We've held some initial meetings with groups we know we'd like to establish formal relationships with. For example, we have communicated with experts at the Smithsonian about their expertise in community characterization, biodiversity, taxonomy, genetics, existing collections, eDNA and Education and Outreach. We've recently communicated with experts at USM about their holdings to build landers for our project and work with an existing graduate student who is doing research on a bank within our study area.

The Habitat Assessment team developed a poster for the DSBS virtual poster session.

We are hosting two important workshops in fiscal year 22. As a result of our inventory and bibliography that I mentioned earlier, we have had our internal experts put together some topical summaries around some key project objectives. These summaries are our first attempt to identify best practices for data collection or analysis. The workshops will be a forum for external SMEs to provide feedback on information we may have missed or promote alternative recommendations than those that we have developed. One workshop will be co-hosted by another NRDA project called Habitat for fish. We have overlapping objectives and thought a joint forum would be beneficial and easier on our subject matter experts. The workshop will focus on fish and mobile macroinvertebrates.

The other workshop will be hosted solely by the HAE team and focus on the benthic invertebrates.

We plan on submitting a joint cross project town hall session at the Ocean Sciences conference and will submit an abstract to the Gulf of Mexico Conference that will provide the participants a summary of HAE and our objectives.

Slide 43. Active Management & Protection Project Objectives

Speaker: G.P. Schmahl

Thank you, Randy. I am G.P. Schmahl, the acting project lead for the active management and protection project. The initial phase of this project has an estimated budget of \$20.6 million to be implemented over the next seven or eight years. The project coordination is in NOAA's national ocean office of national marine sanctuaries. I am also the superintendent of the Flower Garden Banks National Marine Sanctuary located in Galveston, Texas. The project is exciting to me because it is outside of the traditional box of restoration. It seeks to provide support to manage and protect high value mesophotic and deep benthic communities in the northern Gulf of Mexico. We intend to do this by supporting attempts to mitigate previous types of injury and actions to prevent potential future damage. Preventing habitat injury can be more environmentally beneficial and cost-effective than restoration, particularly when it comes to remote and less well-known ecosystems such as mesophotic and deep-benthic communities.

This work requires the support of the public and governmental and public stakeholders. We will develop and extend educational research programs, starting with protected area management frameworks. We will also coordinate with agencies and involved stakeholders to establish protections, both regulatory and in the marine protected area. We will provide information to management entities such as the Gulf of Mexico Fisheries Management Council, NOAA's Office of National Sanctuaries and DOI's Bureau of Ocean Energy Management. We are the conduit to supply the information generated by the mapping project and evaluation project that you were just told about. We also will do some direct active mitigation management, such as addressing anchor damage by installing mooring buoys where appropriate, identifying and removing marine debris and identifying and managing invasive species where we can. We are in the primary planning phase and are recruiting for a program analyst to serve as the project lead. We just hired a lead for the education outreach component and will follow with someone to lead the threat reduction component.

Slide 44. Project Implementation Planning Highlights

Speaker: G.P. Schmahl

Education and outreach: The image on the right-hand slide is from a website that we developed for the Flower Garden Banks National Marine Sanctuary about mesophotic habitats. We will expand website and social media development, Partnership development, Development of MDBC specific exhibits & displays at existing public venues (Zoos and Aquariums, Museums,

Nature Centers), K-12 and informal education program development, Development of a sort of “Telepresence” (real-time programming from offshore) from MDBC project expeditions to inform people of exactly what’s happening offshore, web portal for dissemination of information and data obtained from other projects.

Threat Reduction – Marine Debris. We have done a marine debris assessment for the reefs and banks on the Western side of the Gulf of Mexico, which was the subject of a recent expansion of the Flower Garden Banks National Marine Sanctuary. We know where these areas are and are developing plans and programs to remove debris where appropriate and necessary. With invasive species such as lionfish, typically we think of lionfish we have seen these fish as deep as 300 meters and there have been reports of lionfish as deep as 1000 meters so they’re all over the Northern Gulf of Mexico. We seek to assess the risk of this species. With the risk of abandoned infrastructure, primarily related to the oil and gas industry. Some of these sites have been shown to be leaking oil products. Finally, in the area of protected management (this is why the project was assigned to the Office of National Marine Sanctuaries), this is what we do. We just expanded the Flower Garden Banks National Marine Sanctuary and are focusing on the creation and management of marine MDBC areas, such as the Essential Fish Habitat to identify coral areas that are Habitat Areas of Particular Concern (GMFMC), and Outer Continental Shelf Sensitive Biological Features (BOEM). We also provide socioeconomic and policy analyses related to MDBC protection and management.

Slide 45. Coral Propagation Techniques Project Objectives

Speaker: Peter Etnoyer

Hello everybody. Peter Etnoyer, a marine biologist with NOAA based in Charleston, South Carolina. I’m the project co-manager for the coral propagation techniques development project. This project will develop field and laboratory methods for effective enhancement of coral recruitment and growth in deep water. It’s a trial project to test different methods, tools, and substrates over seven years. A key outcome is to recommend the most successful and promising methods to scale up in the second phase of the project. Specific tasks include data entry and analysis, fieldwork to identify restoration sites and lab work to test a host of coral propagation techniques that have been pioneered in shallow waters. We will design and engineer structures to enhance recruitment and propagation of corals that we will deploy in the field. We will develop a network of partners familiar with coral husbandry techniques and will push boundaries of coral restoration work into deeper waters.

Slide 46. Project Implementation Planning Highlights

Speaker: Peter Etnoyer

Products of planning to date include topical brief summaries of coral genetics and reproduction and the injury observed from Deepwater Horizon. We have also recruited new datasets from Flower Garden Banks and University of Florida to generate new maps of the distribution of

injured species. We've developed new aquarium designs that work in a variety of locations and that can sustain the cold temperatures necessary for the husbandry of these deep-water species. We are also developing protocols and procedures at multiple labs for care and feeding of corals to inform partners who want to be engaged in the network of activities in future years. Highlights include a virtual and oral presentation to the deep-sea biology society in France a few months ago. Some of the most enjoyable activities have been meetings and tours of public aquaria in Louisiana, South Carolina, Florida, Mississippi. Many of these aquaria are interested in coral propagation and outreach and education. We hope to formalize these partners to create a network of expertise not just in coral biology, but in technical diving and coral restoration techniques.

Slide 47. Fieldwork Highlights

Speaker: Peter Etnoyer

The most recent cruise out of Gulfport to collect live organisms for our laboratory was among the most rewarding. We had five-day field expedition on the RV Point Sur using the ROV Mohawk to recover live octocorals and to ship them alive to the lab. 34 live colonies were shipped to two labs in Charleston and Gainesville Florida and 12 samples of unidentified species that co-occur in these species were collected for genetic barcoding so we can put a name to the species in a future.

Slide 48. Laboratory Highlights

Speaker: Peter Etnoyer

In the lab, a highlight is that we have built these tanks in two of the three federal labs: one in Charleston, one in Gainesville, and one coming in Galveston. Corals are doing well and are feeding, and we have observed growth and regeneration in the samples. Our first samples were delivered from the Atlantic in June and we added to our numbers in September.

Interestingly and unexpectedly, one of these species spawned in two of our labs on the same day two weeks ago, producing fertilized eggs that have now settled out into our lab aquaria. This development accelerates our process and bodes well for the future of our project. As I said, everything that we learn as we work with these animals will be captured in will be documented in SOPs, designs, topical summaries, and protocols that will be fully available to stakeholders in the future.

Slide 49. Partnerships

Speaker: Peter Etnoyer

We have a long list of stakeholder engagements, including a dozen site visits, a few tours, and countless virtual meet ups. You can see them all here. We have focused on a few consortia,

including Associations of Zoos and Aquaria, which engages these organizations across the U.S. We've also collaborated with the Coral Restoration Consortium, which is a group of 100 or more institutions with significant expertise in coral propagation. We have broad network of state aquaria and experts in deep-water fieldwork at the U.S. Navy, Wood's Hole Oceanographic Institute, and the Force Blue Technical Diving Team. You can find our project and upcoming engagements at Reef Futures Conference and contact our meeting hosts for a meet-up if you'd like to share your ideas. Texas, Georgia, North Carolina, Monterey Bay Aquarium, Moody Gardens, local experts at Miami university, and others. Please contact our meeting host for a meet-up if you would like to hear more or to share your ideas.

Slide 50. Questions?

Speaker: Peter Etnoyer

I'll now turn you back over to Stephen Heverly with NOAA to guide us through the questions and answers portion of the meeting.

Slide 51. Questions

Speaker: Stephen Heverly

Ok. We've been collecting your questions along the way and we're going to paraphrase some of them or combine similar themes to try to answer as many questions as possible.

Remember, if you still have a question at this point, you can plug it into the "Questions" box at the bottom of the GoToWebinar control panel (where the green and blue arrow is pointing on this slide).

And if you didn't do it earlier, click on the link in the chat for a Mesophotic and Deep Benthic Communities fact sheet to help you follow along.

We'll take a few minutes to give you time to enter any additional questions before we begin. Next, we'll pass them on to someone on our team that can best respond, and they'll provide an answer if they can. We may not get to all the questions, but we'll try to get to as many as possible.

[See Question and Answer Summary for Q&A portion of the webinar.]

Slide 52. Thank you

Speaker: Stephen Heverly

Thank you for your time and interest in MDBC Restoration.

We'll post the presentation and written transcript from today's webinar to the Trustee's website. To find the webinar materials, please go to gulfspillrestoration.noaa.gov, and click on the Open Ocean icon, which is shown in the upper right of this slide.

Finally, if you're not signed up for our email blasts, please consider signing up. Aside from visiting the website, it's the best way to stay up to date on all the Deepwater Horizon NRDA restoration activities. You can easily do that on our home page by scrolling down to the green boxes and clicking the 'sign up now' button.

We'll now conclude our webinar. Thank you all very much for participating.

October 2021 Mesophotic and Deep Benthic Community Special Session

October 28, 2021 Webinar – Summary of Questions and Answers

Question: Is there a layer of oil on the Gulf floor?

Response [from Laurie Rounds, NOAA]: Thanks Stephen and thank you for this question, which is a subject of on-going study by the research community, so it's a great question. The Trustees conducted a detailed assessment to determine the injuries from the Deepwater Horizon incident, which you can find in the Deepwater Horizon Programmatic Restoration Plan. As part of that assessment, the Trustees documented that oil sank onto the sea floor over hundreds of square miles.

The injury assessment studies collected data in 2010-2011 and determined that an area of over 770 square miles around the Macondo well had been polluted with oil from the spill. Later studies in 2014 indicated that despite natural weathering processes, Deepwater Horizon oil was still present, but within a smaller area of the seafloor.

Since the assessment and those studies, there have been other researchers who have conducted studies to understand what remains of the Deepwater Horizon oil in the marine environment and what potential impacts it may be having. A 2021 study by Dierks et al. found that currents moved large quantities of contaminated sediments that accumulated in the deeper parts of the Gulf of Mexico and that oil residue on the seafloor expanded beyond the previously reported extent to the southeast of the wellhead. Other studies, such as the research by Reacher et al. in 2020, also suggested that oil spread further from the well than previously thought, impacting benthic communities.

You can learn more about this question of oil remaining on the seafloor through studies. One great place to look is the work funded by the Gulf of Mexico Research Initiative into the movement, placement, and

degradation of oil. They provide fact sheets and other information on their website at gulfresearchinitiative.org.

The MDBC projects will conduct studies as part of their restoration activities to better understand the impacts to deep-sea communities and their recovery. These activities will continue to inform our understanding of the fate of the Deepwater Horizon oil in the deep-sea environment. I think it may be helpful to hand it over to Randy Clark to provide more information on the related project work.

Response [from Randy Clark, NOAA]: Great, thanks Laurie. And that is a good question, particularly ten years after the fact. One of the objectives of the objective of the Habitat Assessment and Evaluation project is to go out and survey the seafloor and provide data to detect and quantify trends affecting these habitats and the examine the recovery trajectories of sediment communities and hard-bottom communities injured by exposure to contaminants. As Tim mentioned earlier, we have a variety of cruises planned for next year. One of those cruises is a 20 – 25-day cruise specifically targeting soft-bottomed communities to do this very thing. We plan on doing quantitative sediment sampling in impacted zones (including the expanded footprints of those zones that Laurie mentioned), we will build on time series of data from previous experts that have collected samples since the spill. We want to follow up on that time series and to provide additional data where previous collections have not been performed yet. We plan to do this over the next three or four years. I can pass the torch to our benthic expert Dr. Demopoulos if you have anything to add.

Response [from Amanda Demopoulos, USGS]: Thanks Laurie and Randy, great answer so far. I think you've both covered it well so far. Basically, the sediment communities were impacted by the oil spill, but we have a lot to learn about how these communities are currently, and how they're persisting and whether they have recovered or are continuing to. In terms of sampling coming up next year we'll get a better understanding of how these communities are handling post-spill effects and the distribution of effects and how they compare to reference communities, as Randy mentioned. Overall, the sediment communities are vast in the Gulf of Mexico and the animals that live within this environment fuel the basal food source (they provide a food for a variety of different mobile invertebrates and fish). They provide a variety of different, important ecosystem functions so assessing their health is the critical component of this damage assessment recovery estimate as well as our planning for future management actions of the deep-sea floor. Thank you for the great question and I really appreciate everyone engaging in today's webinar.

Question: Thanks for mentioning Monterey Bay Aquarium. Did you consult with anyone concerning the recent oil spill in California?

Response [from Peter Etnoyer, NOAA]: Thank you for this question. I have been watching the news and am familiar with this spill and have colleagues in this region. I have not been asked to consult on this spill, but in a way, I think that this is because we've done our job well in making data available. We have a website that was developed with the deep-sea coral research technology program that debuted in 2015. This has all our field work observations going back to the early 2000s. It documents the distribution of deep-water corals in this region. The website is accessible through the url: deepseacoraldata.noaa.gov. I think you will see that there are quite a few aggregations of coral just offshore in that region. The question of their vulnerability will be, of course, how many days the oil slick

was above the aggregations, and whether chemical dispersants were used as with the Deepwater Horizon oil spill. Understand that the Deepwater Horizon oil spill went on for about 100 days and was treated from the air, the sea, and underwater with highly toxic chemical dispersants. The data is available and accessible, but I'll be standing by if they need me. There are already many experts on site and hopefully, they will be able to access the data that I told you about.

Question: Hello all, thank you very much for the presentations and time. This question is a curiosity-based question for mooring considerations in mesophotic depths. Can you provide more information on this (in other words, what mooring type, site selection, and anticipated vessel size for use)?

Response [from G.P. Schmahl, NOAA]: This is an interesting question. First, we need to identify areas that would benefit the most from mooring buoys. These are high-use areas utilized by fishers and other boats. Installing a mooring buoy is difficult and complex. The typical installation pioneered in the Florida Keys where anchor bolts are embedded into the sea floor by divers and are cemented in, may be appropriate at the highest level of the mesophotic zone. Utilizing divers below 130 feet or so requires specialized consideration and technical diving in certain situations. The first thing we will do is to hold stakeholder engagement workshops to identify areas most in need of the buoys based on our surveys and the habitat and evaluation surveys, and an assessment of feasibility and whether the people using the area desire a buoy. There are some areas where fishermen have stated that they don't want to be "tied down" to a certain environment based on a mooring buoy to better account for fish movement. We do have several areas on the shallower part of the mesophotic zone (40 – 50 m and sometimes deeper) where typical mooring buoys can be installed, including the Pinnacles area off Mississippi and Alabama. When you get deeper, we use heavier anchor blocks, which involves a different sort of installation (true marine construction). We have had discussions with the US Navy that do saturation diving and work of various sorts that would include this type of activity. We may be able to enter into agreements of them to test different methods of mooring buoy installation. The process is complex and gets more difficult, technical, and expensive the deeper you go. That's how we plan to approach this. We will do some known installations where we know we can do this and will work with stakeholders to identify the best deep-sea areas.

Question: What techniques are available to directly restore deep sea corals? Where will restoration be done?

Response [from Peter Etnoyer, NOAA]: These are excellent questions, and on all of our minds. We think about these and talk about these routinely, so thank you for the opportunity to respond. There are basically two ways to go about it: lab-based techniques and field-based techniques.

The paradigm for this is well-developed in shallow coral environments and is referred to as coral gardening. We collect coral from the deep sea, in this case, or from shallow coral reefs, rear them in the lab, and then transplant or outplant them into natural reefs. This has never been tried in the deep sea, so we're going about it one step at a time. We have lab-based techniques such as simulating spawning by simulating their environment (controlling temperature and light levels). We can also collect coral and fragment them. These are colonial, modular organisms and this is one of their natural modes of reproduction.

In the field, we have a number of options. We can deploy a natural substrate like limestone rock. If we put it in the right place, we hope it will naturally recruit larvae that will settle and grow out to become mature, reproductive coral – this is the ideal scenario. We could perhaps speed this along by in-situ fragmentation in which we find an aggregation of large colonies and take small pieces from those and grow them in-situ, hoping that they will reach maturity and spawn themselves. This will require significant innovation. We want to start in the deep water with technical divers who have been trained by the experts from shallow water shallow water, and once we figure out these methods and techniques, we want to emulate this process using submersibles that can go down to the very deep sea, down to 1500 meters.

That is the short-list of techniques. As for where restoration will be done, we are still working on that. I think it's safe to assume that where the injury has occurred is where we want to make repairs. However, we don't want to invest lots of effort there if it wouldn't be successful or would be subject to continued environmental insults or climate change. The spill is over and gone, unlike climate change and offshore nutrification, which are continuing problem. We're hopeful that if we can hone these techniques, we can apply them at areas of injury. We will continue to answer these questions in workshop-form with as much expertise as we can muster.