Mesophotic and Deep Benthic Communities Restoration Type

Open Ocean Restoration Area

Mesophotic and deep benthic communities (MDBC) are vast and complex ecosystems on the ocean floor that are a foundation of Gulf of Mexico food webs. More than 770 square miles of deep-sea habitat and 4 square miles of mesophotic habitat were injured by the *Deepwater Horizon* (DWH) oil spill.

Draft Open Ocean Restoration Plan 2 focuses on the following MDBC restoration approaches, as well as robust resource-level monitoring and adaptive management to address critical uncertainties identified in the DWH Oil Spill Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement:

- Protect and manage MDBC.
- Place hard-ground substrate and transplant coral.

Implementation of all the proposed projects would include an initial one to two year planning and design stage, followed by a five-year field and lab-based implementation stage, and one year for final evaluation and reporting. An important aspect of the planning and design stage would be to ensure transparency in decision-making and effective approaches for stakeholder engagement, public input, and sharing data and project results over time.

MDBC Restoration Goals

- Restore mesophotic and deep benthic invertebrate and fish abundance and biomass for injured species, focusing on high-density mesophotic and deep-water coral sites and other priority hard-ground areas to provide a continuum of healthy habitats from the coast to offshore.
- Actively manage valuable MDBC to protect against multiple threats and provide a framework for monitoring, education, and outreach.
- Improve understanding of MDBC to inform better management and ensure resiliency.

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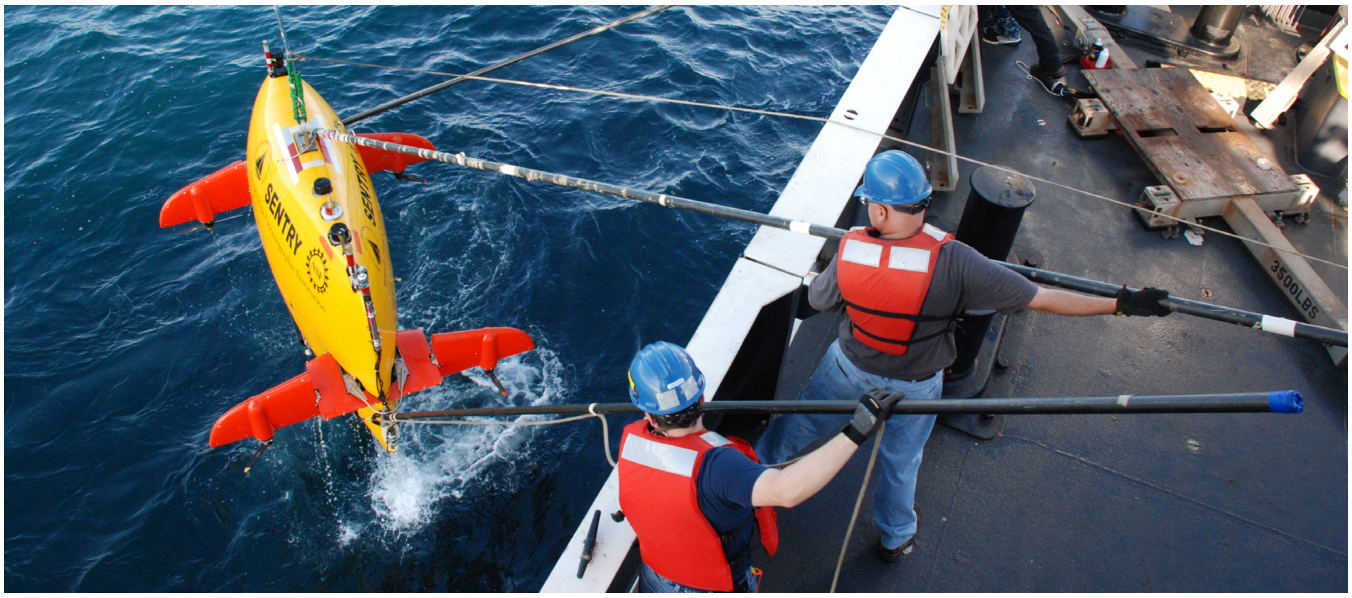
Mesophotic and Deep Benthic Communities Restoration Type Proposed Projects

PROJECT NAME	PROJECT DESCRIPTION	EST. COST AND TIMEFRAME
REPLENISH AND PROTECT LIVING COASTAL AND MARINE RESOURCES		
Mapping, Ground-Truthing, and Predictive Habitat Modeling	The abundance and distribution of MDBC across the Gulf of Mexico are not completely known, particularly in deeper waters, presenting a challenge to decision-making for restoration, management, and protection. This project would conduct high- resolution mapping efforts in both mesophotic and deep benthic habitats and use this information to refine predictive models to improve the effectiveness and cost efficiency of future restoration and mapping efforts. This project would also analyze the abundance and distribution of these communities, as well as provide data on depth ranges, densities, and distributions of specific coral species. The data collected in this project would provide fundamental information to support MDBC protection and management activities.	$35,909,000 7-8 Years
Habitat Assessment and Evaluation	The life histories, diversity, and population structures of MDBC species in the Gulf of Mexico are not well understood. The goal of this project is to fill those data gaps, determine baseline conditions, and characterize key community conditions at both injured and reference sites. This project would involve strategically designed field surveys, with subsequent laboratory-based analyses of MDBC. The surveys would support analyses of habitats and determinations of ages, growth rates, and reproductive potential of mesophotic and deepwater corals, as well as their health and condition. In addition, the project would maximize the effectiveness of MDBC restoration and protection efforts through the use of population genetic analysis methods. The proposed project results would fill critical gaps in our understanding of the biology, ecology, health, biodiversity, recovery, and resilience of mesophotic and deep sea habitats (corals and soft sediments) and would support and inform restoration planning and implementation for MDBC.	$52,639,000 7-8 Years
Coral Propagation Technique Development	The most direct approach to restoring MDBC is to facilitate the growth of new corals of the same species as those damaged by the DWH oil spill. The objective of this pilot project is to develop techniques that can be used for direct restoration of MDBC at a scale that is meaningful relative to the injury to these communities. The project proposes both field and lab work to test a variety of methods and substrates to enhance coral recruitment and growth, and to test a variety of coral propagation techniques, including fragmentation and transplantation. This project would primarily test substrates and techniques in the field, in areas where mesophotic and deep-water coral habitats naturally occur. Additional lab work would be conducted to develop coral cultivation techniques. Fragments grown in the laboratory would be used where possible to minimize impact on populations of corals obtained from the field.	$16,951,000 7 Years
Active Management and Protection	Despite the depth at which MDBC occur, human activities threaten the health and resiliency of these communities. The proposed project aims to protect and manage these communities through a framework for management and protection, including monitoring, education, outreach, and engagement. Project activities would include education and outreach targeting resource users and the public; engagement of stakeholders and development of socioeconomic analyses to evaluate potential impacts of management or protection actions; and directly addressing threats to MDBCs through management activities such as mooring buoy installations, removal of invasive species such as lionfish, documentation and removal of marine debris and derelict fishing gear, and assessing and remediating risks associated with leaking and abandoned oil and gas infrastructure.	$20,689,000 7-8 Years

For additional information, contact Stephen Heverly: stephen.heverly@noaa.gov

Mapping, Ground-Truthing, and Predictive Habitat Modeling

Mesophotic and Deep Benthic Communities Restoration Type



This project would provide fundamental information to prioritize and support mesophotic and deep benthic communities (MDBC) protection and management activities. Additionally, it would identify potential locations for direct restoration activities. The project would conduct high-resolution mapping of MDBC across the northern Gulf of Mexico to gain a better understanding of the abundance and distribution of these communities.

MDBC are vast and complex ecosystems on the ocean floor that are a foundation of Gulf of Mexico food webs. Mesophotic benthic communities are found at water depths where light levels are low. These habitats support many species of corals and associated animals, including fish, anemones, sponges, and sea cucumbers.

Estimated Cost and Timeframe

$35,909,000 • 7-8 years

This project would dramatically improve current knowledge of these communities and our ability to predictively model their extent and distribution.

Deep benthic communities are found where there is no light. At these depths, corals and associated species colonize rocky outcroppings covering a very small percentage of the ocean floor. These species provide shelter and food for many animals, including starfish, sea urchins, fish, and crabs. Deep-sea corals are slow growing and can live for over 1,000 years.

The abundance and distribution of MDBC across the Gulf of Mexico are not completely known, particularly in deeper waters. This complicates evaluation of *Deepwater Horizon* oil spill injuries and recovery, and presents challenges for decision-making regarding restoration, management, and protection.

This project would document the extent, distribution, and abundance of these communities. It would dramatically improve both current knowledge of these communities and our ability to predictively model their extent and distribution.

This project supports the Trustees' goal to improve understanding of MDBC to inform better management and ensure resiliency.

Components

This project would be conducted across the northern Gulf of Mexico. Initial high-priority areas would include sites designated as protected areas or sites under consideration for protected area designations.

The project would begin with comprehensive implementation planning to develop detailed work plans, establish resource requirements, and assess existing data. Annual workshops would be held to evaluate current mapping data, prioritize mapping sites, and coordinate data management. Data collection and surveys would be performed using high resolution mapping and ground-truthing equipment to document the distribution and abundance of MDBC habitats and to improve existing habitat suitability models.

The timeline includes one to two years for implementation planning, five years for implementation, and one year for project evaluation and reporting.

Project Objectives

- Document the abundance and distribution of MDBC.
- Inform better management and enhance resiliency by providing high resolution maps and habitat information for MDBC.
- Improve the effectiveness and cost efficiency of future mapping efforts.
- Inform restoration by refining predictive models of habitat suitability for MDBC.

We Want Your Comments

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Habitat Assessment and Evaluation

Mesophotic and Deep Benthic Communities Restoration Type

This project would fill critical gaps in our understanding of mesophotic and deep benthic communities (MDBC) through data collection on baseline habitat conditions and key community characteristics.

MDBC are vast and complex ecosystems on the ocean floor that are a foundation of Gulf of Mexico food webs. Mesophotic benthic communities are found at water depths where light levels are low. These habitats support many species of corals and associated animals, including fish, anemones, sponges, and sea cucumbers. Deep benthic communities are found where there is no light. At these depths, corals and associated species colonize rocky outcroppings covering a very small percentage of the ocean floor. These species provide shelter and food for many animals, including starfish, sea urchins, fish, and crabs. Deep-sea corals are slow growing and can live for over 1,000 years.

The life histories, diversity, and population structures of MDBC species in the Gulf of Mexico are not well understood. This project would fill the critical gaps in our understanding of the biology, ecology, health, biodiversity, recovery, and resilience of mesophotic and deep benthic habitats (corals and soft sediments).

Estimated Cost and Timeframe

$52,639,000 • 7-8 years

The assessment and evaluation of mesophotic and deep benthic habitats and species would improve our understanding of their life histories, diversity, and population structures in the Gulf of Mexico, which are not well understood.

The information provided by the project would maximize the effectiveness of approaches to manage, protect, and restore MDBC throughout the northern Gulf of Mexico.

The project supports the Trustees' goals to improve understanding of mesophotic and deep-benthic communities to inform better management and ensure resiliency.

Components

The project would take place in sites directly impacted by the *Deepwater Horizon* oil spill in the Pinnacles Trend region and Mississippi Canyon region, as well as in reference and active restoration or protection sites across the northern Gulf of Mexico.

The project would begin with comprehensive implementation planning to develop detailed work plans, establish resource requirements, and assess existing data. Annual workshops would be conducted to assess recently collected data, prioritize sites to be evaluated, and coordinate data management.

Multi-disciplinary data collection and assessment surveys would be performed in mesophotic and deep benthic zones, in coral and soft sediment communities. An ecosystem-based approach would be used to examine the environment and the organisms that live in those zones, including the ways they change, naturally or through restoration actions, in space and over time.

The timeline includes one to two years for implementation planning, five years for implementation, and one year for project evaluation and reporting.

Project Objectives

- Document changes to structure and function of MDBC impacted by the DWH oil spill and other threats.
- Establish environmental baseline conditions and changes over time around impacted and healthy MDBC.
- Develop dispersal models for coral larvae.
- Provide critical information to prioritize and support MDBC protection and management.

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Coral Propagation Technique Development

Mesophotic and Deep Benthic Communities Restoration Type

This project would develop techniques for enhancing habitats of mesophotic and deep-water coral species in the northern Gulf of Mexico.

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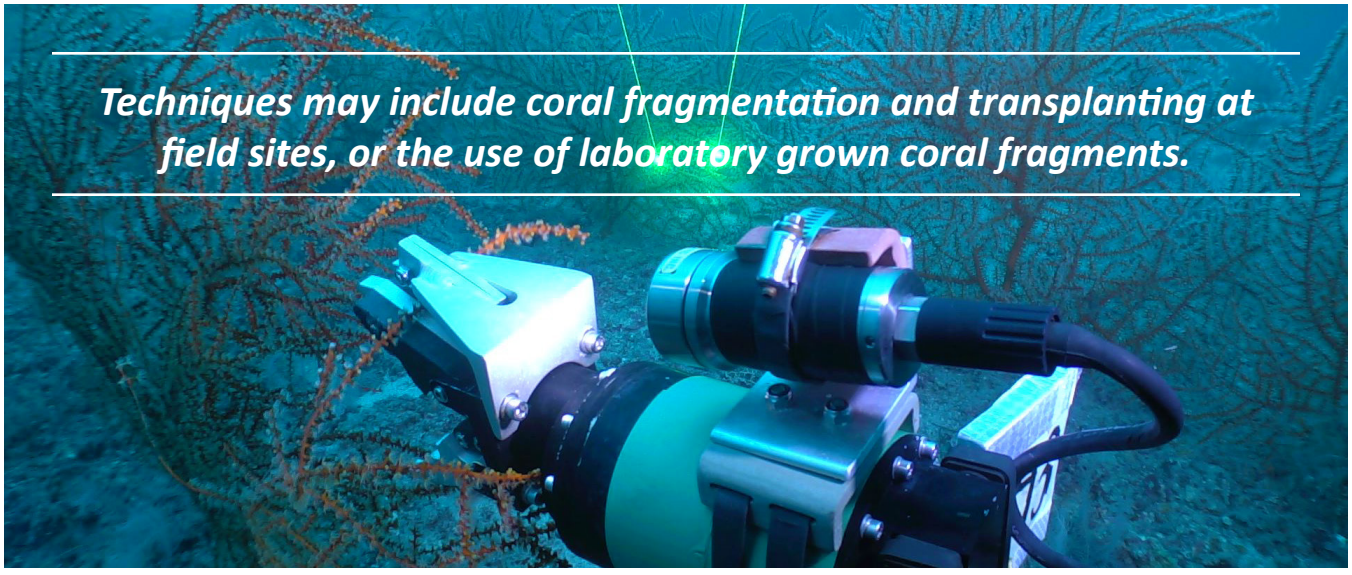
Estimated Cost and Timeframe

$16,951,000 • 7-8 years

The most direct approach to restoring MDBC is to facilitate the growth of new corals of the same species as those injured by the *Deepwater Horizon* (DWH) oil spill. This project would undertake field and lab work to test a variety of methods and substrates to enhance coral recruitment and growth, and to test a variety of coral propagation techniques, including fragmentation and transplantation.



Techniques may include coral fragmentation and transplanting at field sites, or the use of laboratory grown coral fragments.

Project Objectives

- Develop methods and techniques for effective enhancement of coral recruitment and growth.
- Assess the potential for applying successful methods at large scale for restoration.
- Fill critical knowledge gaps and inform future restoration efforts.

Testing would be primarily performed in the field, in areas where MDBC naturally occur. Additional lab work would be conducted to develop coral cultivation techniques. Fragments grown in the laboratory would be used, where possible, to minimize impact on populations of corals obtained from the field. Development of these methods and techniques would be designed to identify applications ultimately scalable to a level meaningful in the scope and context of DWH injury to MDBC.

The project supports the Trustees' goal to restore abundance and biomass of injured mesophotic and deep benthic invertebrate species, focusing on high-density coral sites and other priority hard-ground areas to provide a continuum of healthy habitats from the coast to offshore.

Components

The project would begin with comprehensive implementation planning to develop detailed work plans, establish resource requirements, and assess existing data. Annual project implementation coordination meetings would be held with subject matter experts to develop and evaluate methods, review and analyze performance and results, identify and prioritize restoration pilot test sites, coordinate field and lab efforts, and coordinate data management.

Fieldwork associated with this project would be performed across the northern Gulf of Mexico with initial high-priority areas to include sites designated as protected areas or sites under consideration for protected area designations. Field and lab work would involve testing a variety of potential coral colonization substrates and transplant methods.

Techniques may include coral fragmentation and transplanting at field sites, or the use of laboratory grown coral fragments. Field-based components would include monitoring of potential test sites to evaluate conditions and post-implementation monitoring to ensure coral survival and recruitment.

The timeline includes one to two years for implementation planning, five years for implementation of field data collection and analysis, and one year for project evaluation and reporting.

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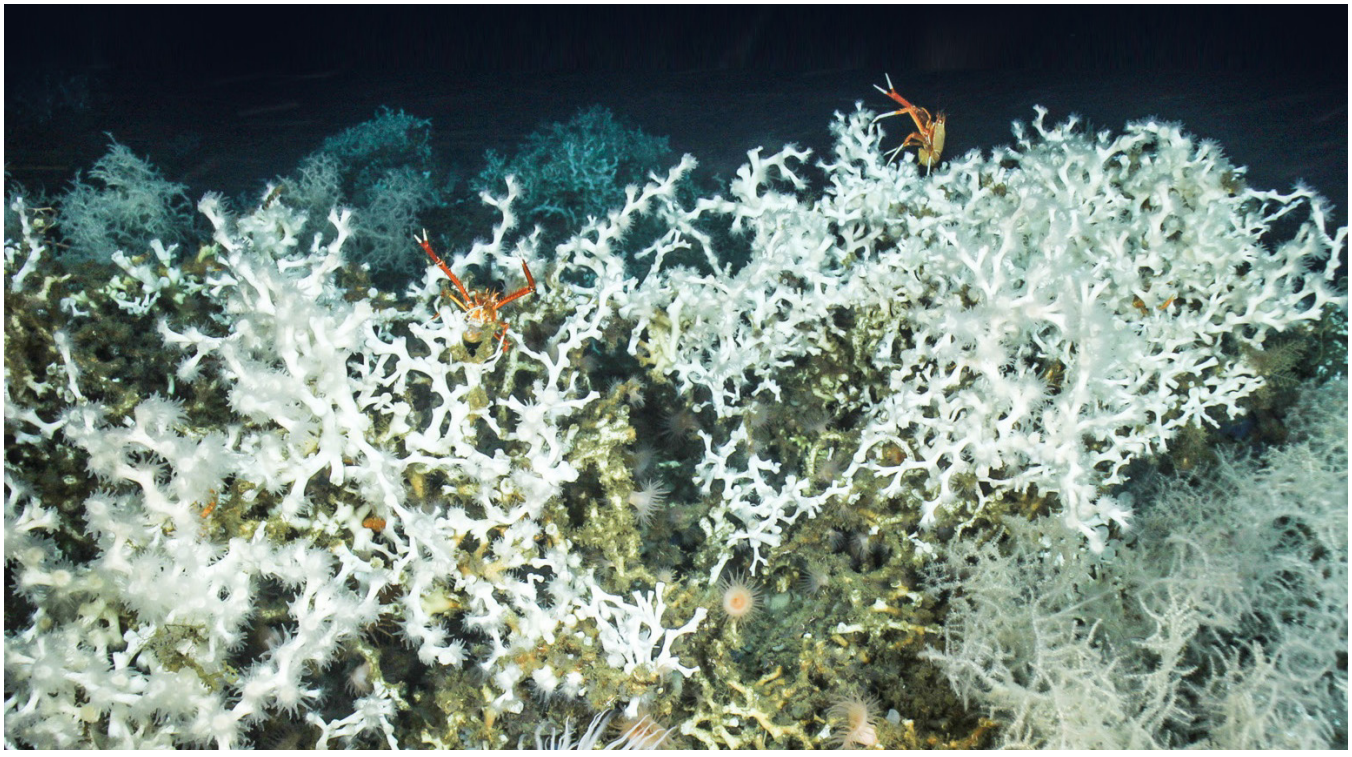
Active Management and Protection

Mesophotic and Deep Benthic Communities Restoration Type

This project would enhance public awareness and perform active management and restoration efforts for mesophotic and deep benthic communities (MDBC) across the northern Gulf of Mexico.

Estimated Cost and Timeframe
$20,689,000 • 7-8 years

Although they occur at great depths, human activities can threaten the health and resiliency of mesophotic and deep benthic communities. This project would conduct activities to reduce these threats through public education and enhanced management activities.



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Although these resources occur at great depths, human activities threaten the health and resiliency of these communities. The project supports the Trustees' goal to actively manage valuable mesophotic and deep-sea communities to protect against multiple threats and provide a framework for monitoring, education, and outreach.

Components

This project would be conducted across the northern Gulf of Mexico. Initial high-priority areas would include sites designated as protected areas or sites under consideration for protected area designations.

The project would begin with comprehensive implementation planning to develop detailed work plans and establish resource requirements. Public education and outreach would be conducted through programs engaging students and the broader public, collaboration with researchers to interpret related science, and data sharing and communication to support resource managers.

Project Objectives

- Extend the education and outreach components of existing protected area management frameworks.
- Coordinate with the agencies and stakeholders involved in establishing protections.
- Assess opportunities to manage and protect sensitive MDBC.
- Reduce threats to MDBC and increase ecosystem resilience.

The project would directly address threats to MDBC by: 1) preventing damage from boat anchoring; 2) reducing user conflicts; 3) assessing and remediating threats from abandoned or leaking oil and gas infrastructure; 4) removing marine debris and derelict fishing gear; 5) removing invasive species; and 6) enhancing resource protection capacity.

The timeline includes one to two years for implementation planning, five years for implementation, and one year for project evaluation and reporting.

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