

Mesophotic and Deep Benthic Communities Restoration: Progress Updates and Planned Activities for 2024

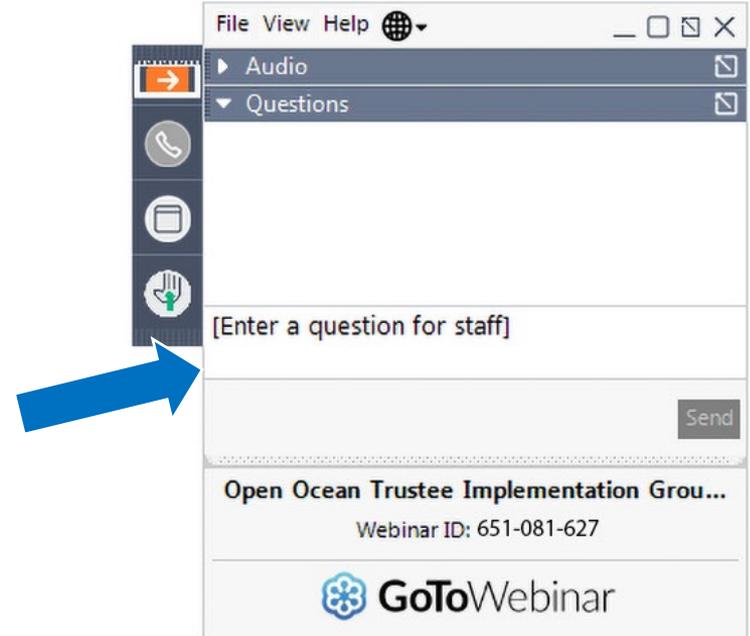
March 26th, 2024



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**Mesophotic &
Deep
Benthic
Communities
Restoration**

Webinar Participation

- If you're using a phone, turn off your computer's microphone and speakers
- Please use the "Questions" box to type questions for the Q&A session
- Presentation will be posted on www.gulfspillrestoration.noaa.gov
- A link to the recording will be sent to all registrants



MDBC Webinar Overview

- Deepwater Horizon Oil Spill Background
- Overview of 2023 Field Activities
- Planned 2024 Field Activities
- Individual Project Updates
 - Mapping, Ground-Truthing, & Predictive Habitat Modeling
 - Habitat Assessment and Evaluation
 - Coral Propagation Technique Development
 - Active Management & Protection
- Accessing MDBC Portfolio Products & Resources
- Q&A Session



Photo: NOAA, UNCW Undersea Vehicles Program

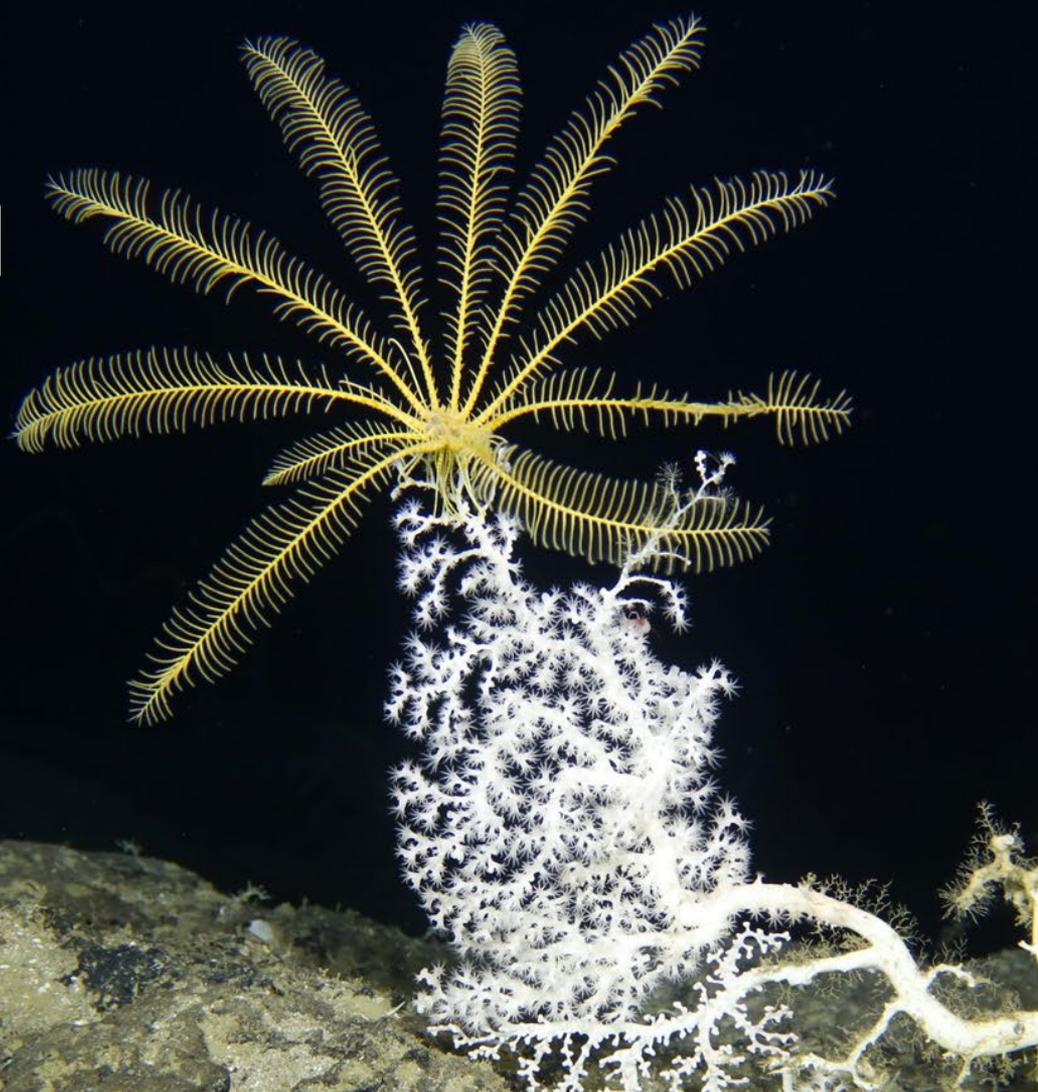
Common Acronyms



Photo: NOAA, Marine Applied Research & Exploration

- **MDBC** = Mesophotic & Deep Benthic Communities
- **MGM** = Mapping, Ground-Truthing, & Predictive Habitat Modeling
- **HAE** = Habitat Assessment and Evaluation
- **CPT** = Coral Propagation Technique Development
- **AMP** = Active Management & Protection

Deepwater Horizon Oil Spill Background



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Photo: NOAA, Oceaneering International, Inc.

Deepwater Horizon Incident



Photo: US Coast Guard

- The tragic loss of 11 workers and largest marine oil spill in U.S. history
- 3.2 million barrels (134 million gallons) of oil released into the ocean over 87 days
- 43,300 square miles: Cumulative extent of surface slick during the spill—an area almost the size of Virginia
- Estimated that two-fifths of the oil remained in the deep sea

Natural Resource Damage Assessment

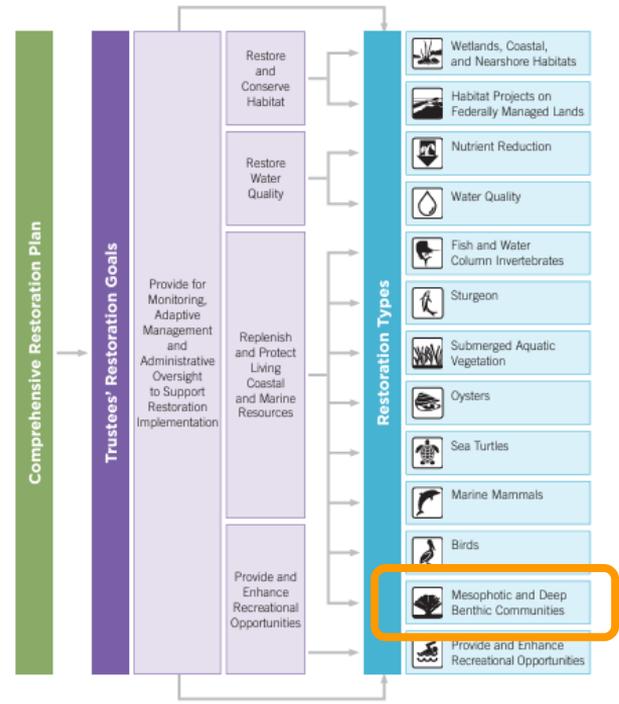


Photo: Lophelia II/Woods Hole Oceanographic Institution

- Federal and State agencies, as the Deepwater Horizon Natural Resource Damage Assessment Trustee Council, assessed natural resource injuries
- Injuries occurred at all trophic levels to virtually all species and habitats impacted by the oil
- Deep-sea habitats were impacted with oil deposited onto at least 400mi² of seafloor
- Quantified injury to over 770mi² of benthic habitat, substantial losses to corals and other deep-sea species

Settlement & Programmatic Restoration Plan

- 2016 settlement: up to \$8.8 billion to make the public whole for injuries to natural resources
- Programmatic Restoration Plan guides all subsequent restoration work
- 13 Restoration Types identified in the plan → Mesophotic and Deep Benthic Communities
- \$273 Million designated for MDBC restoration



Restoring Mesophotic & Deep Benthic Communities

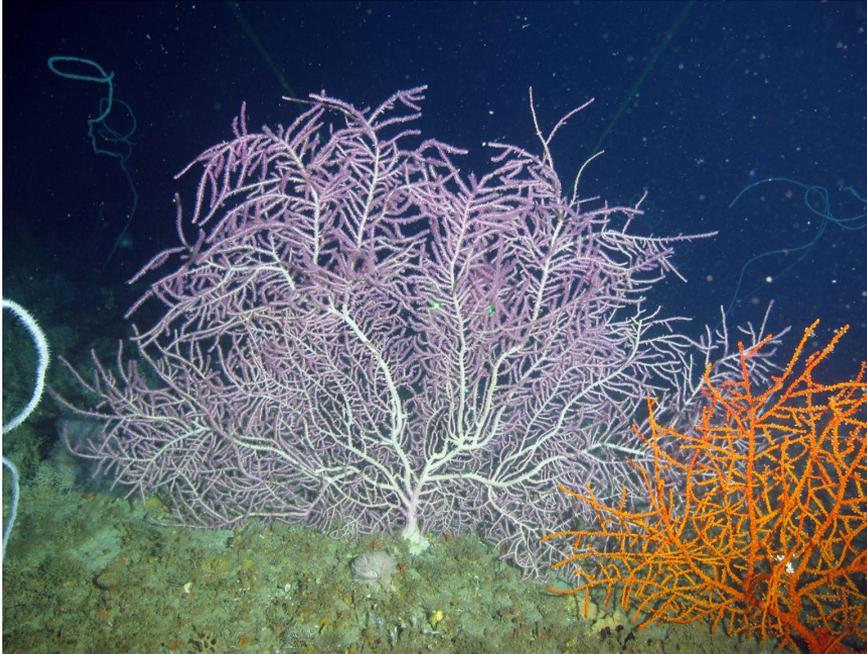


Photo: NOAA, UNCW Undersea Vehicles Program

Long-term Restoration Goals:

- Restore mesophotic and deep benthic invertebrate and fish abundance and biomass for injured species.
- 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.

Mesophotic and Deep Benthic Communities Restoration Portfolio

- Mapping, ground-truthing, and predictive habitat modeling (MGM): \$35.9M
- Habitat assessment and evaluation (HAE): \$52.6M
- Coral propagation technique development (CPT): \$17.0M
- Active management and protection (AMP): \$20.7M

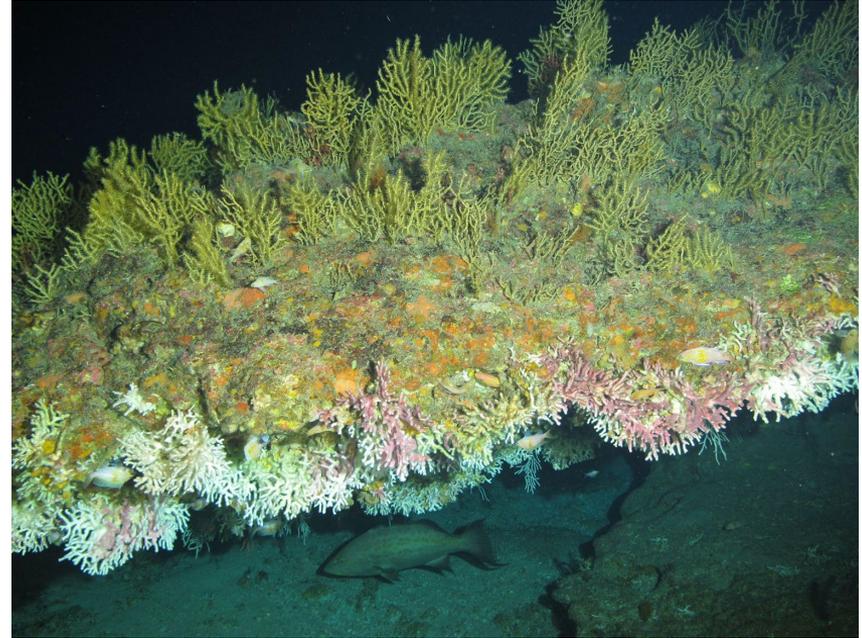


Photo: NOAA, UNCW Undersea Vehicles Program

2023 Field Activities Overview

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2023 Field Activities Overview



6 ships, including the NOAA ships Pisces and Nancy Foster and the research vessels Point Sur and Pelican

30+

collaborating partners,
agencies, and offices



8 cruises



151

total actual number of days at sea

143

Remotely Operated Vehicle
(ROV) dives accomplished for
mapping and habitat surveys

3,119

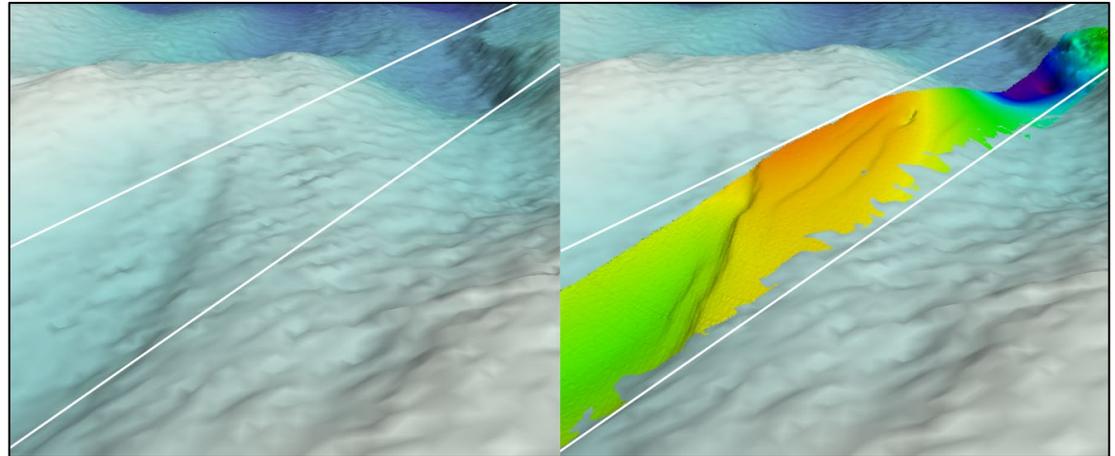
square miles mapped
(an area a bit smaller than the island of Puerto Rico)



2023 Field Activities Overview

Mapping, Ground-Truthing, and Predictive Habitat Modeling

- Data collected over more than 3,000 square miles of the seafloor
- Lower-resolution mapping data used to inform site selection for high-resolution data collection
- Predictive habitat distribution models tested and refined using data collected in 2023



16-meter multibeam echosounder
(MBES) data

1-meter autonomous underwater
vehicle (AUV) data

2023 Field Activities Overview

Habitat Assessment and Evaluation

- 143 ROV dives + 40 AUV dives = 27,000 seafloor images, 97 coral colony images
- Instruments deployed on the seafloor to collect long-term environmental data
- Biological samples and eDNA from water samples collected to better understand MDBC organisms

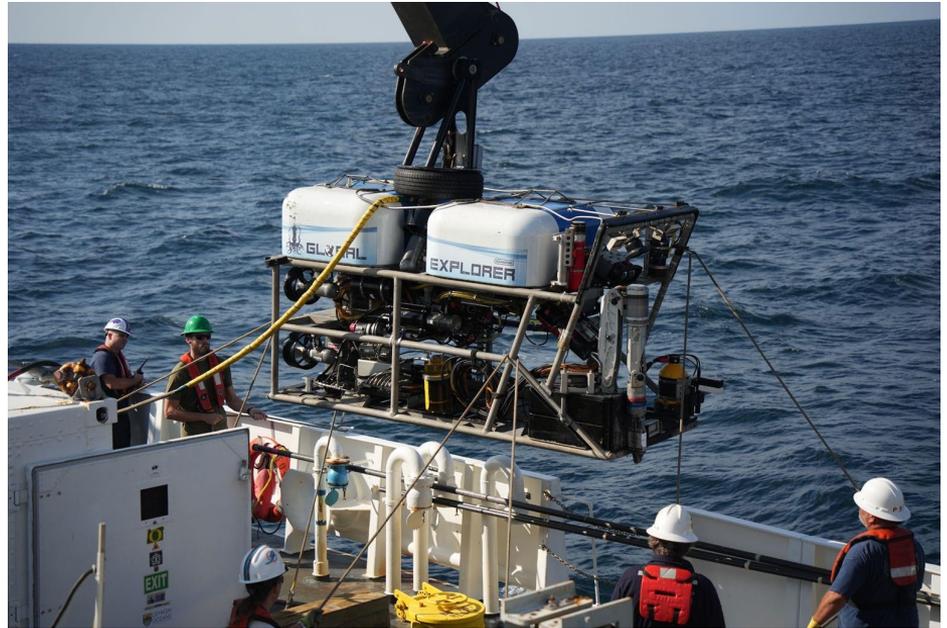


Photo: Patrick Flanagan/University of Rhode Island InnerSpace Center

2023 Field Activities Overview

Coral Propagation Technique Development

- First coral propagation test in the field with ~200 coral fragments, monitored by technical diving team
- First deployments of artificial substrates to test their potential to encourage the growth of new corals
- More than 160 live coral samples collected and transported to labs/aquariums for further study to support restoration

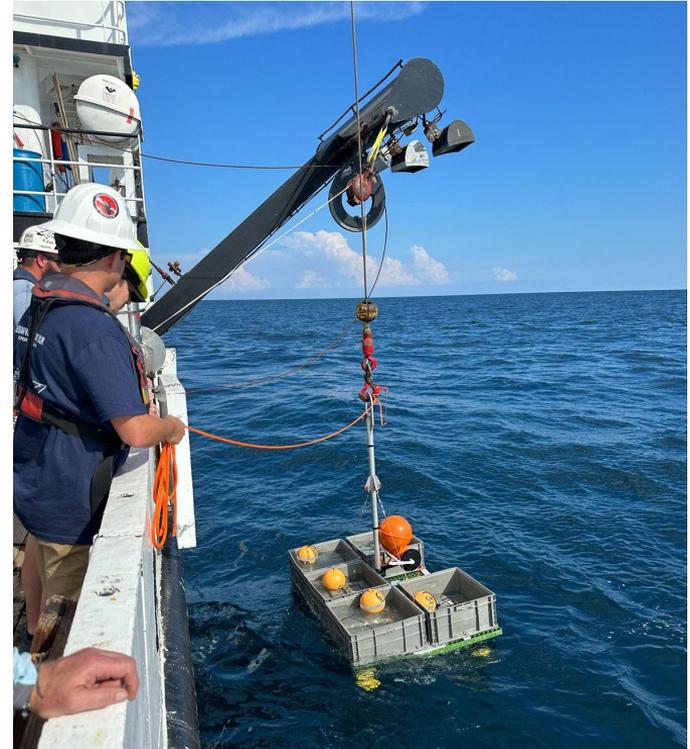


Photo: Peter Etnoyer/NOAA

2023 Field Activities Overview

Active Management and Protection

- Photo, video, and audio collected on every 2023 cruise to support education & outreach efforts
- Telepresence capabilities installed on the NOAA Ship *Nancy Foster* - 13 live broadcasts reached
- Underwater imagery to identify threats to MDBC habitat



Photo: Smithsonian National Museum of Natural History

2024 Planned Field Activities

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2024 Planned Field Activities

Summary:

- 13 cruises - some with multiple legs
- March - October
- ~198 days at sea (DAS)

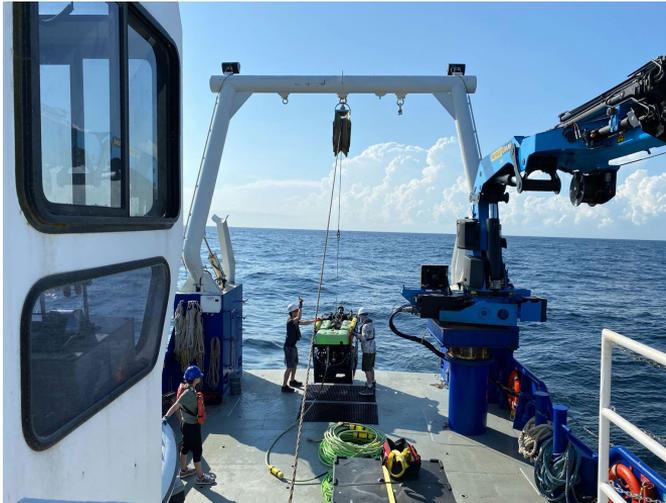


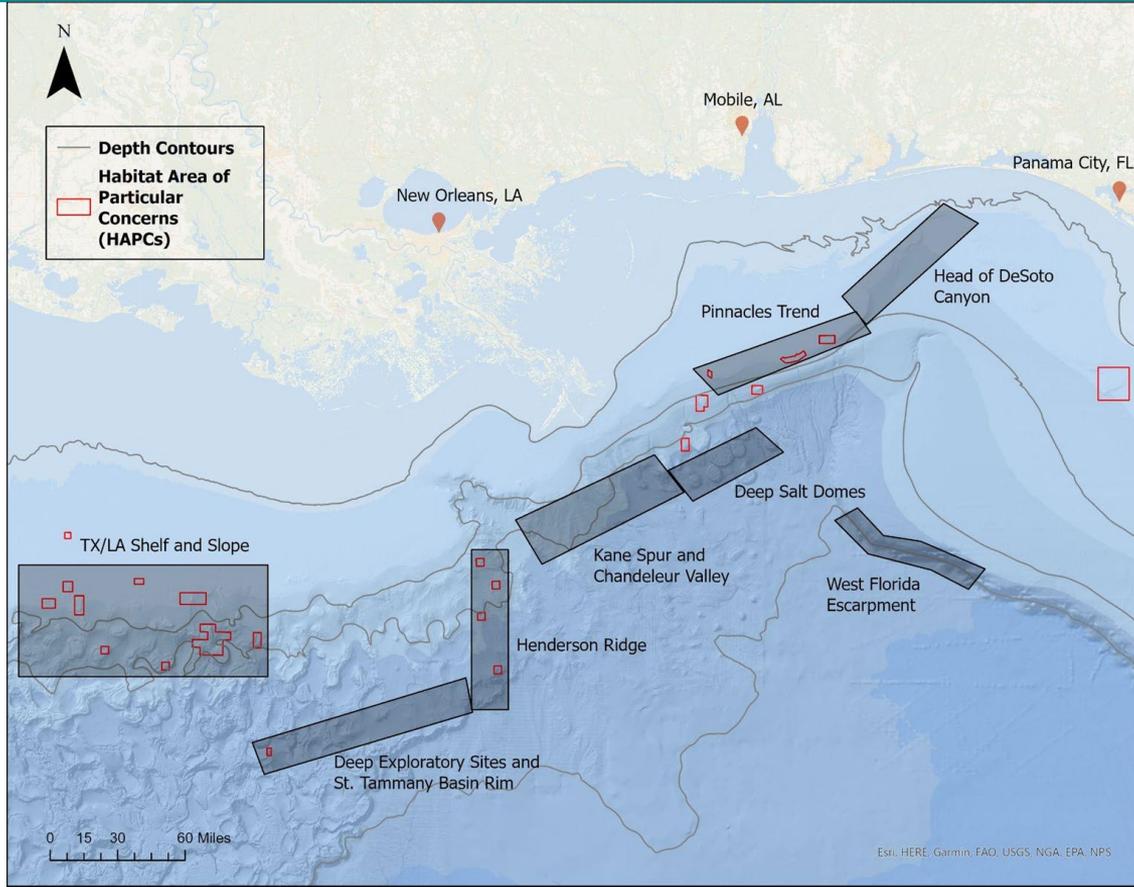
Photo: NOAA/Kristopher Benson

March 2024

Partners

- United States Geological Survey (USGS)
- Marine Applied Research & Exploration (MARE)
- National Marine Sanctuary Foundation (The Foundation)
- Univ. of North Carolina Wilmington Undersea Vehicles Program
- Oceaneering International, Inc.
- United States Navy Experimental Diving Unit (NEDU)
- Ocean Exploration Cooperative Institute (OECI)
- Woods Hole Oceanographic Institute (WHOI)
- Pelagic Research Services
- Civilian Tech Diver Corps – The Foundation, Moody Gardens Aquarium
- NOAA Office of Marine and Aviation Operations (OMAO)
- Florida Institute of Oceanography
- and many more...

2024 Field Activities Spatial Overview



R/V Oracle: March 2024

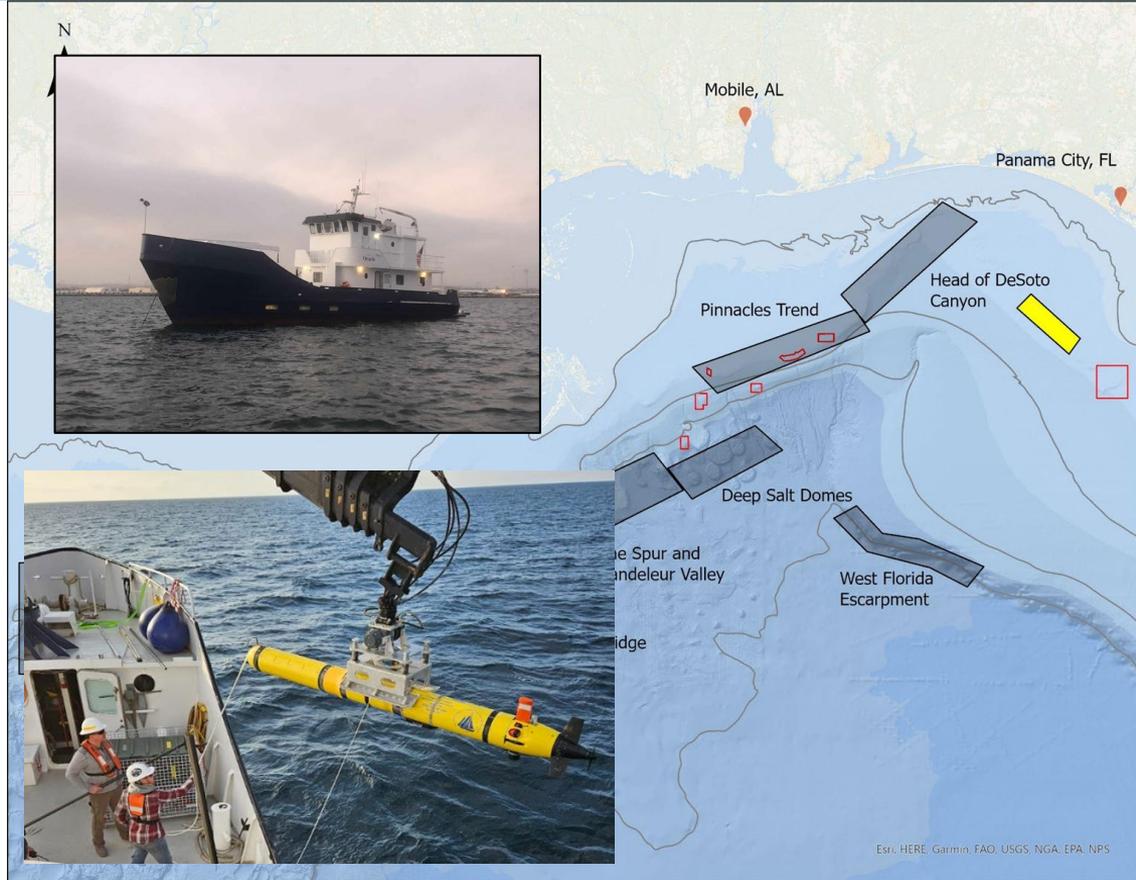
Dates: March 10-15

Asset(s): WHOI Remus 600 AUV

Accomplishments:

- 15 AUV dives to survey target areas
- Tests confirmed that the sensor is operating within specification
- Confirmed operational & safety requirements with Navy partners
- Images were collected of substrates and mesophotic benthic communities as well as fish
- Laser profiles captured benthic communities and fish in the water column

March 2024



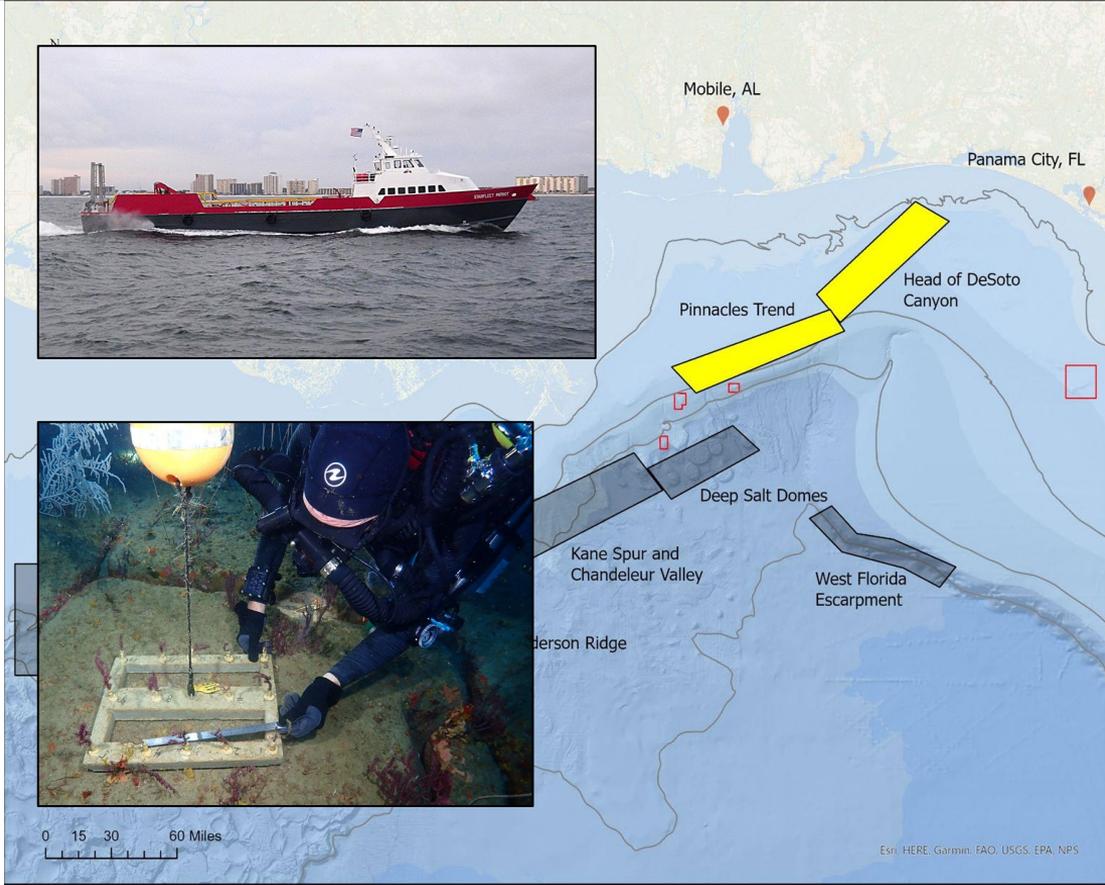
M/V Patriot: March 2024

Dates: March 13-15

Asset(s): Navy Technical Divers

Accomplishments:

- 4 dives completed
- Positioned artificial substrate tiles to study growth of new corals
- Photographed tiles to test feasibility of diver-based monitoring protocols
- Collected coral samples to study reproductive status of “wild” corals vs. those in the coral labs



NOAA Ship *Nancy Foster*: March - May 2024

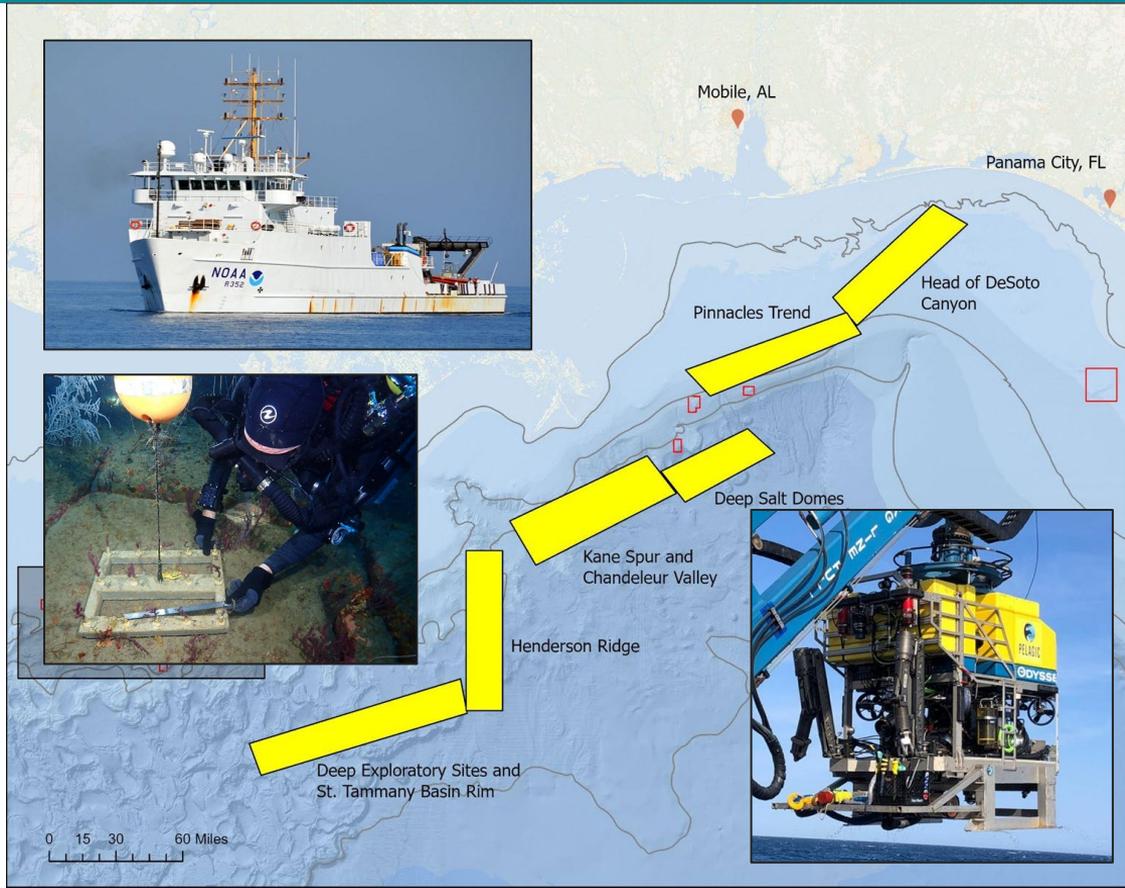
Dates: March 16-May 14 (4 legs)

Asset(s): Remotely operated vehicle (ROV) *Odysseus*, multibeam echosounder, civilian technical diver team

Objectives:

- ROV video surveys and mapping at/around the *Deepwater Horizon* wellhead
- Biological, water, and sediment sampling
- Coral imaging to monitor health & growth
- Deploy long-term data collection instruments on the seafloor
- High resolution mapping with ship multibeam system
- Technical diving for coral propagation activities
- Telepresence

March 2024



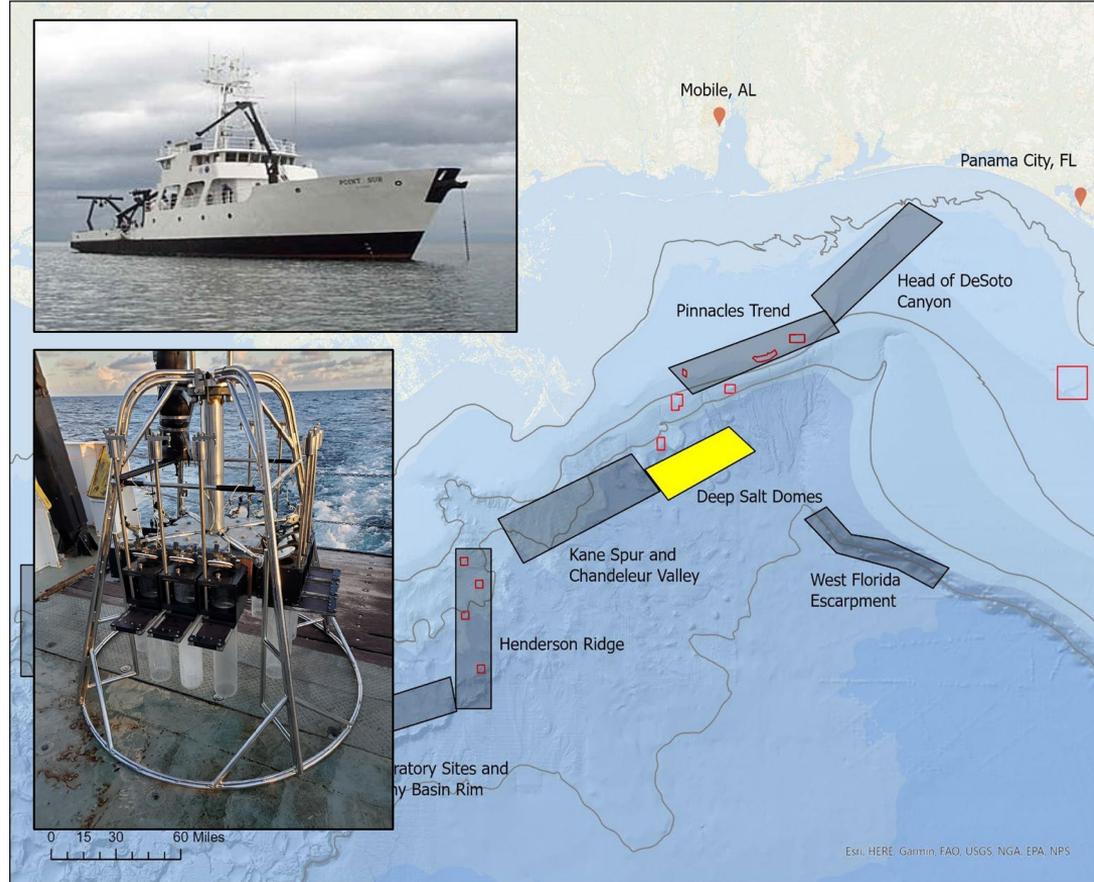
R/V Point Sur: April 2024

Dates: April 23-29

Asset(s): Multi-corer, conductivity temperature depth (CTD) rosette

Objectives:

- Sediment sampling using a multi-corer
- Determine physical properties of the seafloor using ship-based acoustics
- Conductivity temperature depth (CTD) casts for water quality data and water samples



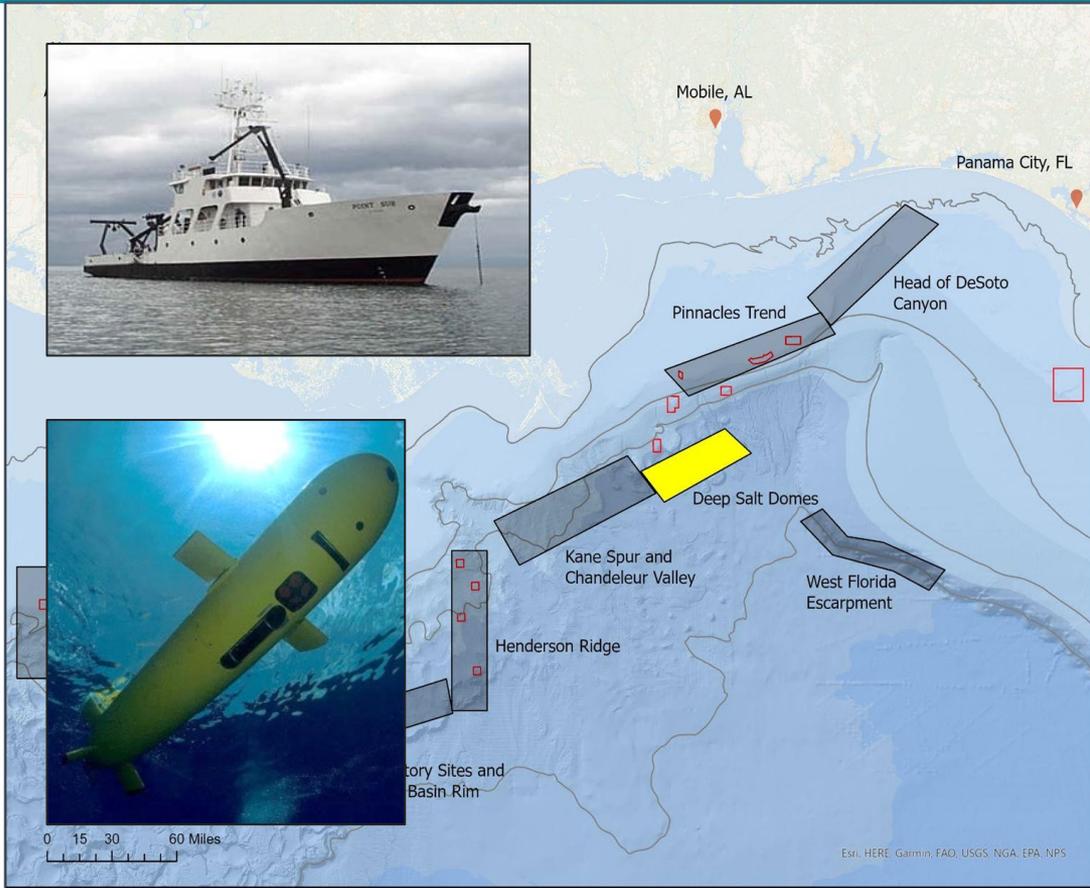
R/V Point Sur: May 2024

Dates: May 3-13

Asset(s): Autonomous Underwater Vehicle (AUV) *Eagle Ray*

Objective(s):

- High resolution mapping of *Deepwater Horizon* wellhead site and surrounding MDBC habitat
- Seafloor mapping of other deep priority habitat areas



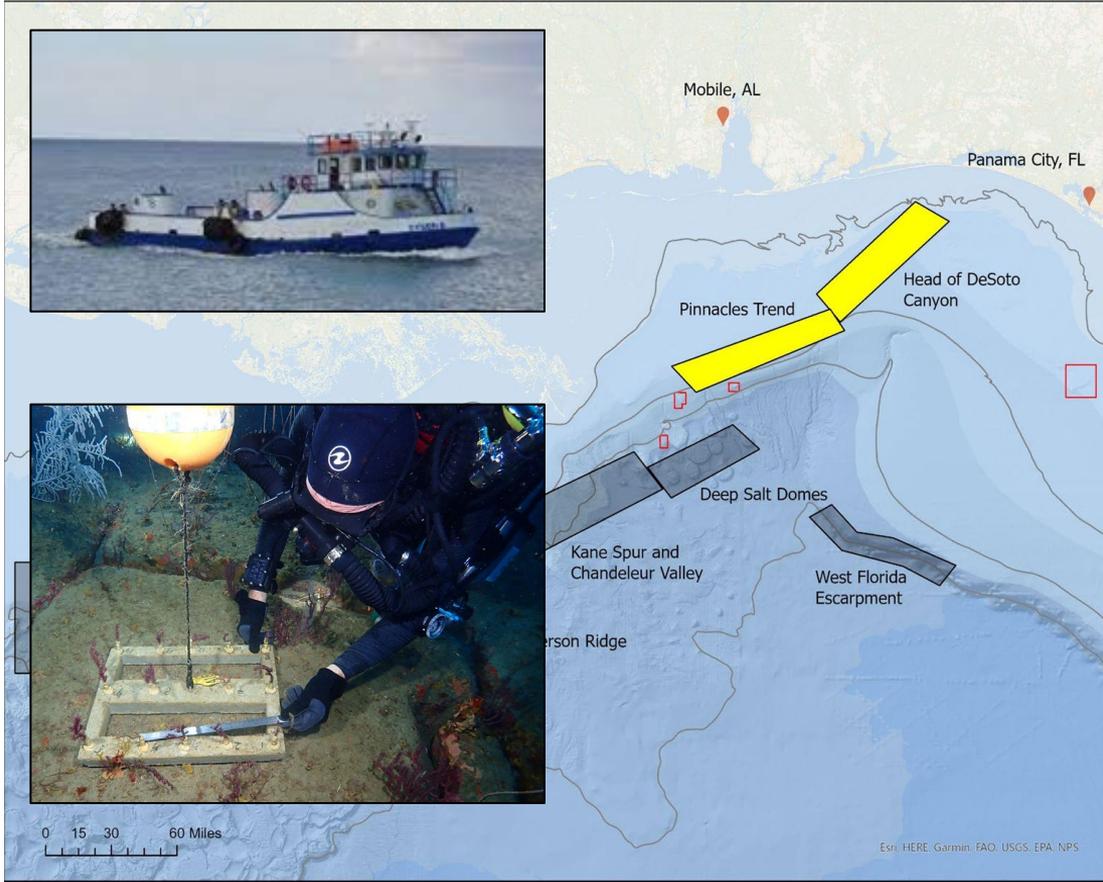
M/V Tyson B: June 2024

Dates: June 1-10

Asset(s): Civilian Technical Diver Team

Objectives:

- Monitor previously deployed artificial substrates and coral fragments
- Deploy new artificial substrate structures and additional coral fragmentation
- Coral and live rock sample collection



NOAA Ship *Pisces*: June/July 2024

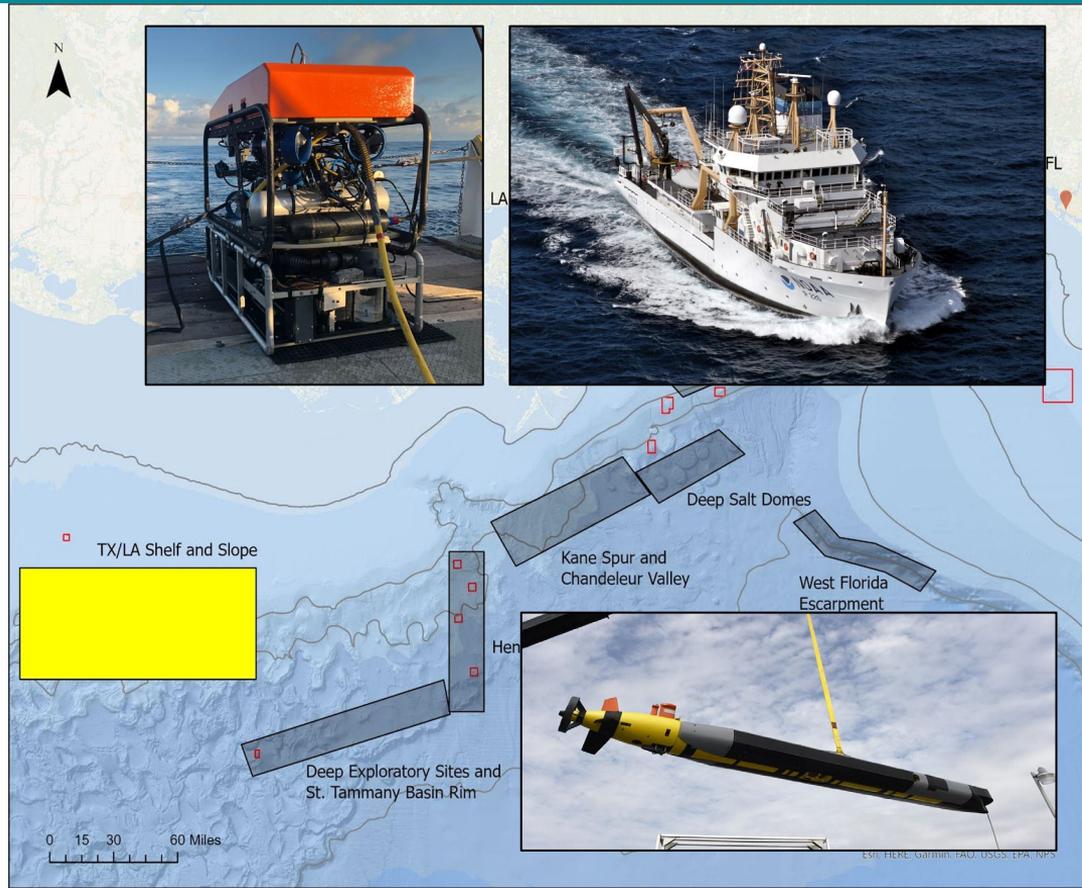
Dates: June 5-July 27 (3 legs)

Asset(s): ROV *Mohawk*, WHOI Remus 600 AUV

Objectives:

- Characterize the communities and collect samples to measure diversity
- Collect high resolution mapping and images with the AUV
- Collect water chemistry and quality data
- Collect water samples to understand food sources
- Collect high resolution mapping with the ship multibeam system
- Deploy long-term data collection instruments

March 2024



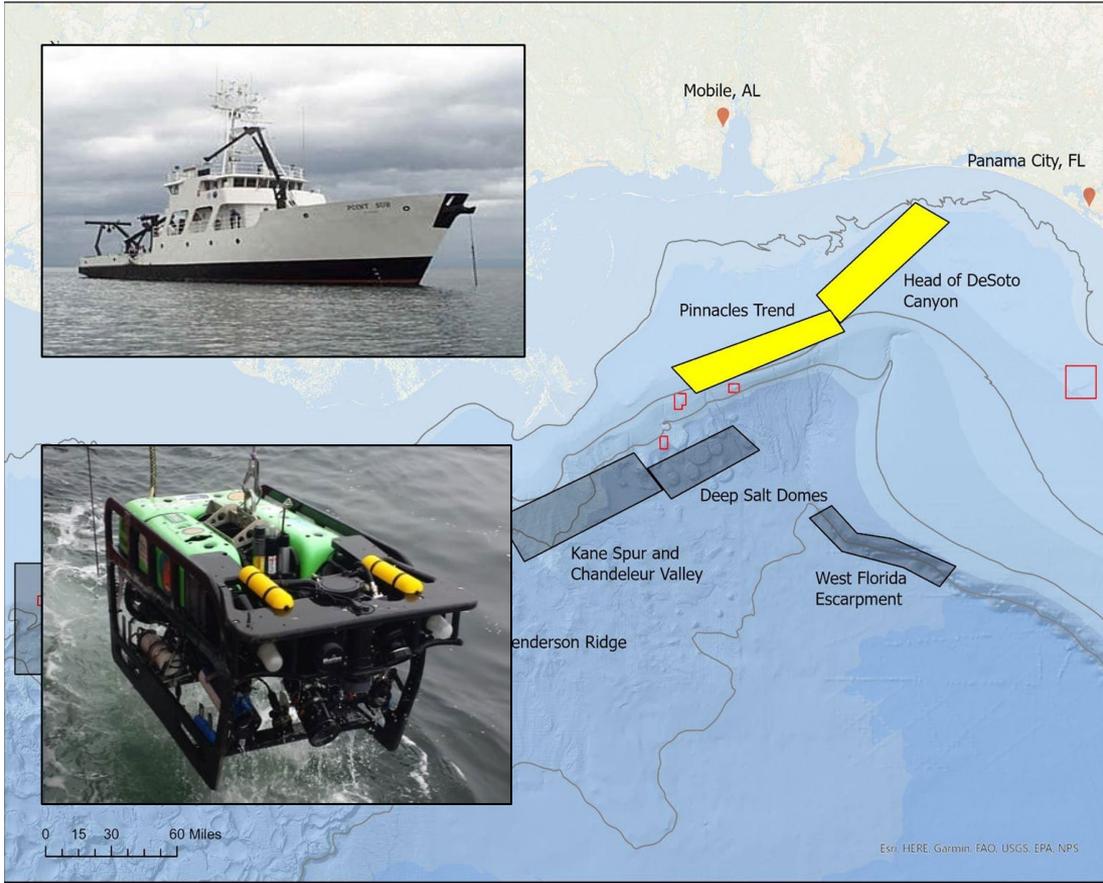
R/V Point Sur: June 2024

Dates: June 18-28

Asset(s): ROV Beagle

Objectives

- Surveys to assess coral health
- Recovery of long-term data collection instruments
- Biological sample collection
- Water quality data and water sample collection
- Live corals collected to support husbandry in labs & aquaria



TBD Vessel: June - July 2024

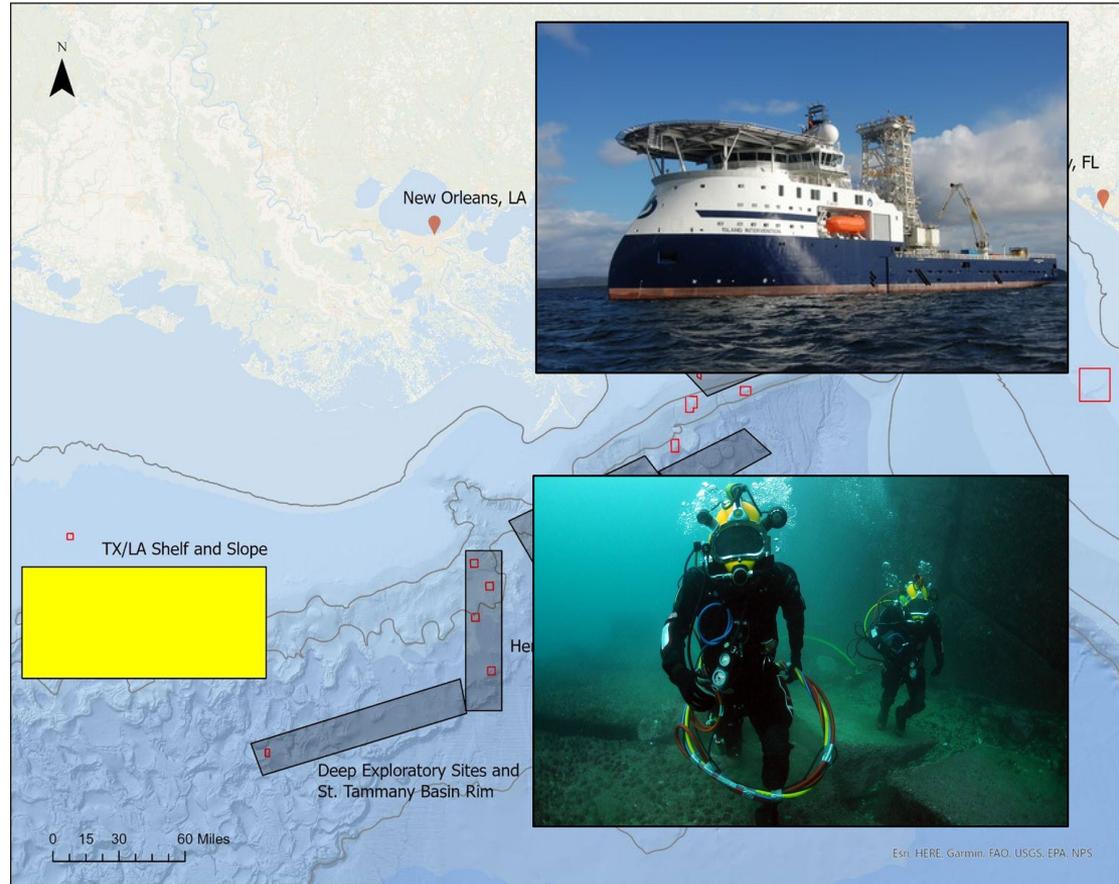
Dates: June 20 - July 9

Asset(s): Navy Saturation Divers, TBD working class ROV

Objectives

- Mooring installation and marine debris removal
- ROV surveys to characterize communities
- Deploy long-term data collection instruments
- Deploy artificial substrates
- Sample collection and coral propagation
- Telepresence

March 2024



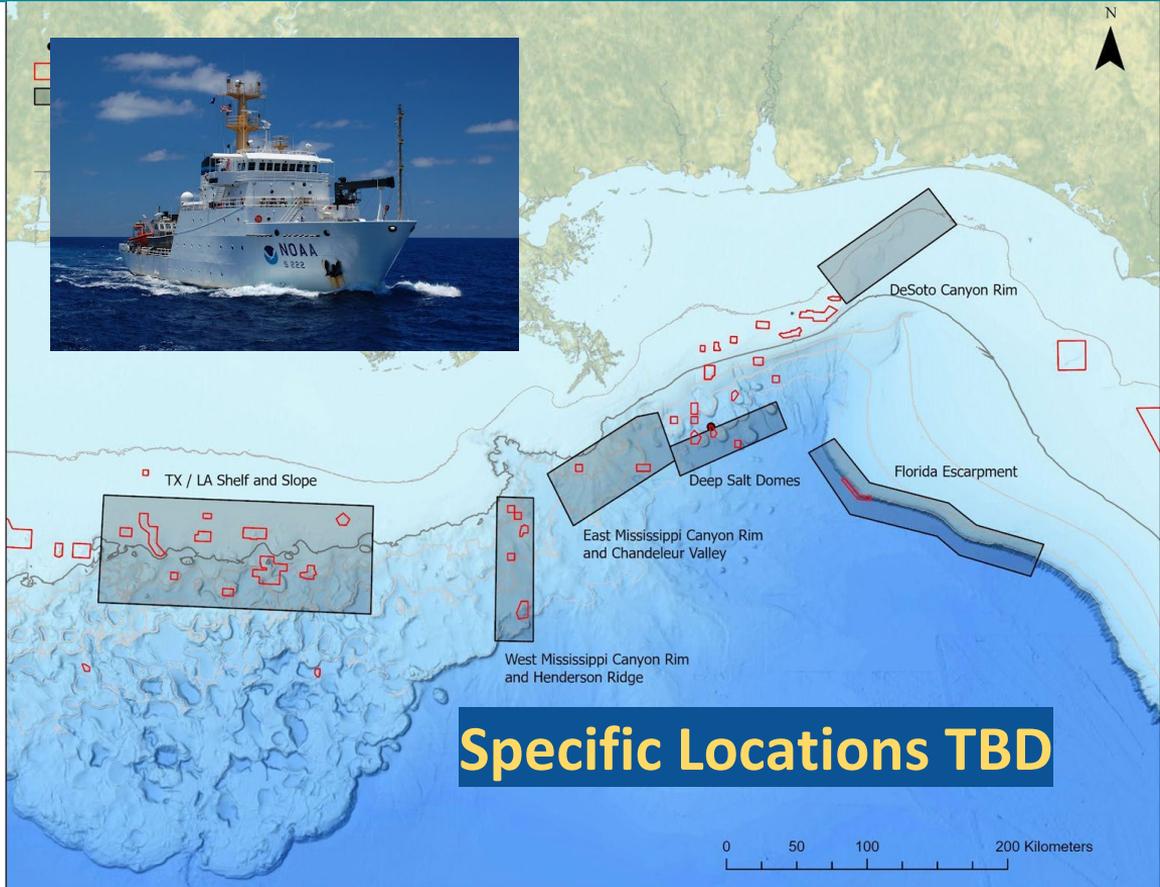
NOAA Ship *Thomas Jefferson*: Jun-July '24

Dates: June 17 - July 16 (tentative)

Asset(s): Multibeam, Fishery Acoustics

Objectives

- Map priority seafloor areas
- More details to be determined



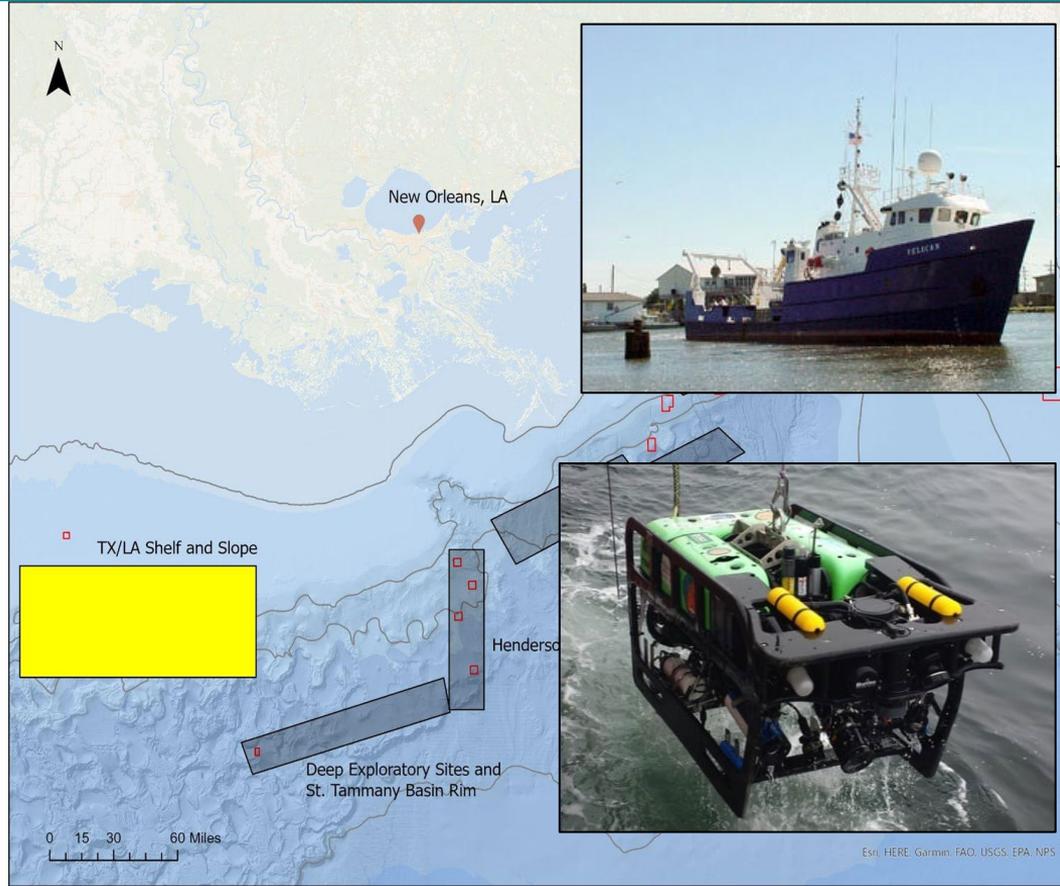
R/V *Pelican*: August - September 2024

Dates: August 29-September 9

Asset(s): ROV *Beagle*

Objectives

- ROV dives to survey areas of interest and better understand population connectivity
- Biological sample collection
- CTD casts to collect water quality data and water samples



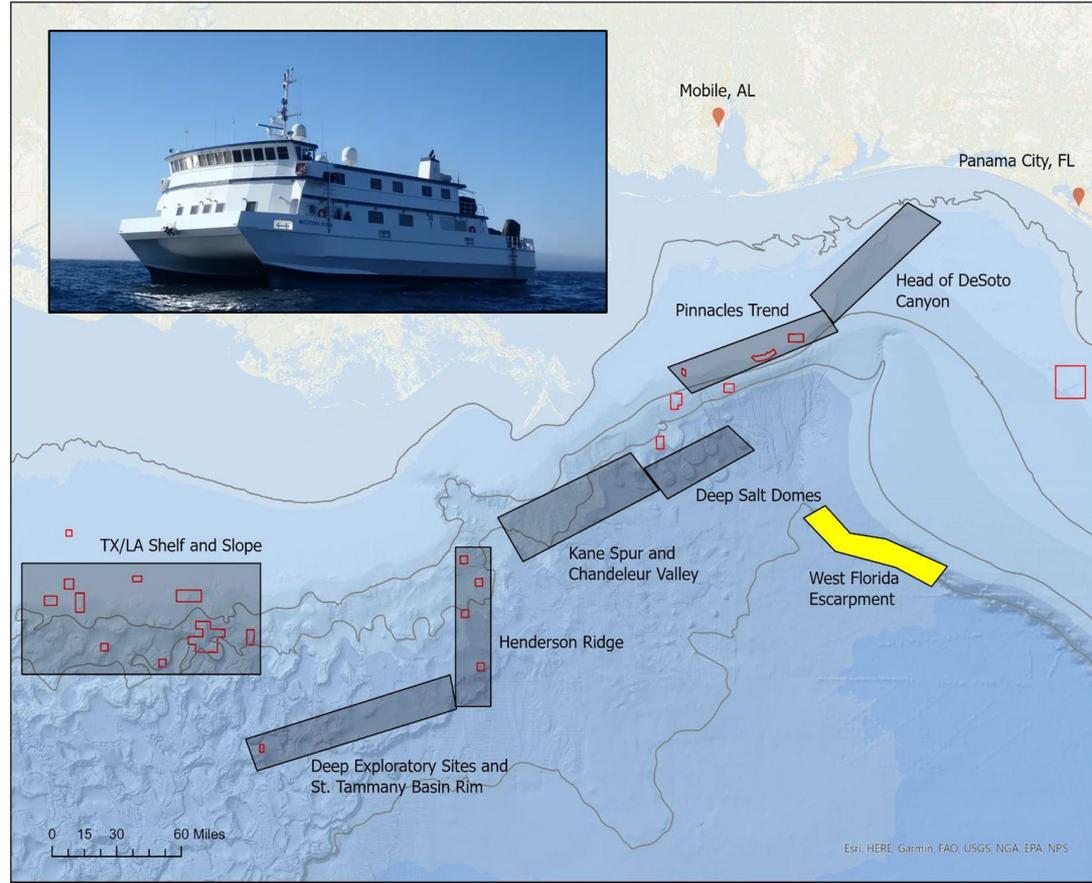
R/V *Western Flyer*: September 2024

Dates: September 3-13

Asset(s): TBD 4K ROV

Objectives

- Coral propagation via fragmentation and 3D printed artificial substrate deployment
- Coral sample collection
- Surveys and sample collection to assess genetic diversity and connectivity of populations across the Gulf
- Collect water samples for eDNA and other analyses



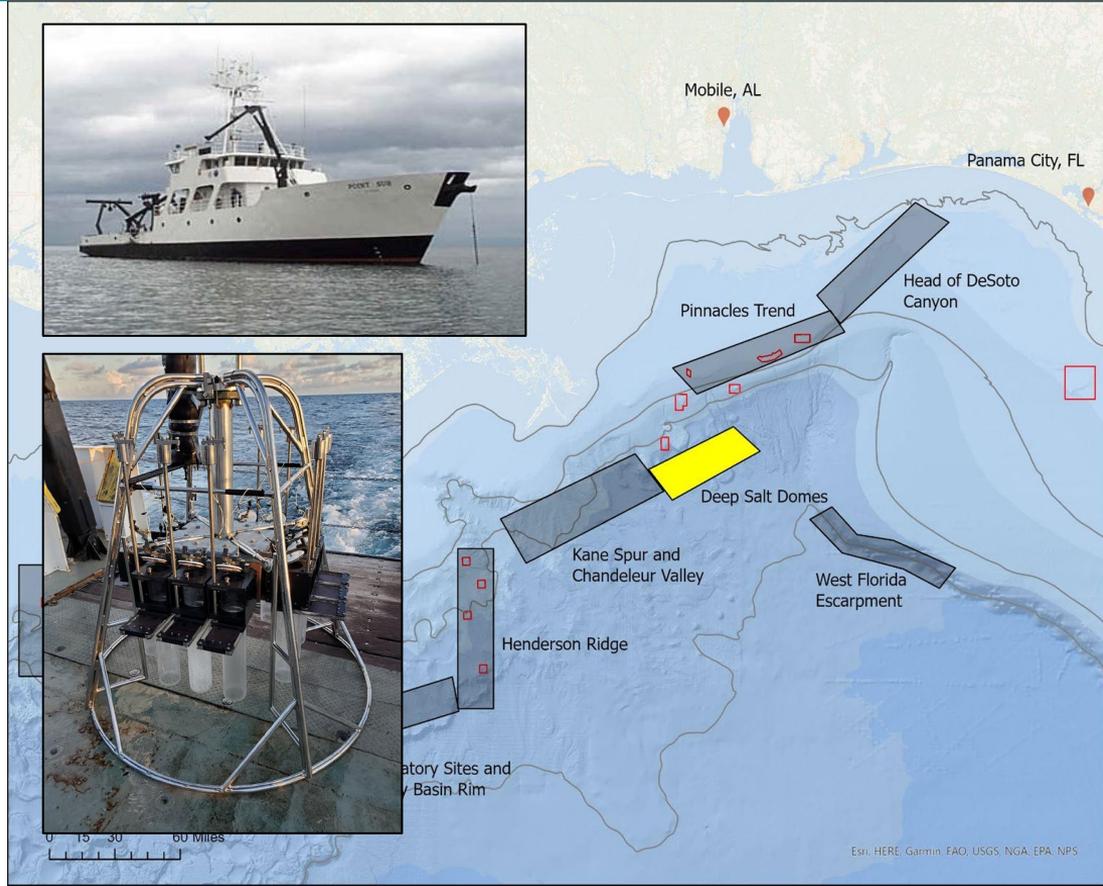
R/V Point Sur: September 2024

Dates: September 20-26

Asset(s): Multi-corer, conductivity temperature depth (CTD) rosette

Objectives

- Sediment sampling using a multi-corer
- Determine physical properties of the seafloor using ship-based acoustics
- Conductivity temperature depth (CTD) casts for water quality data and water samples



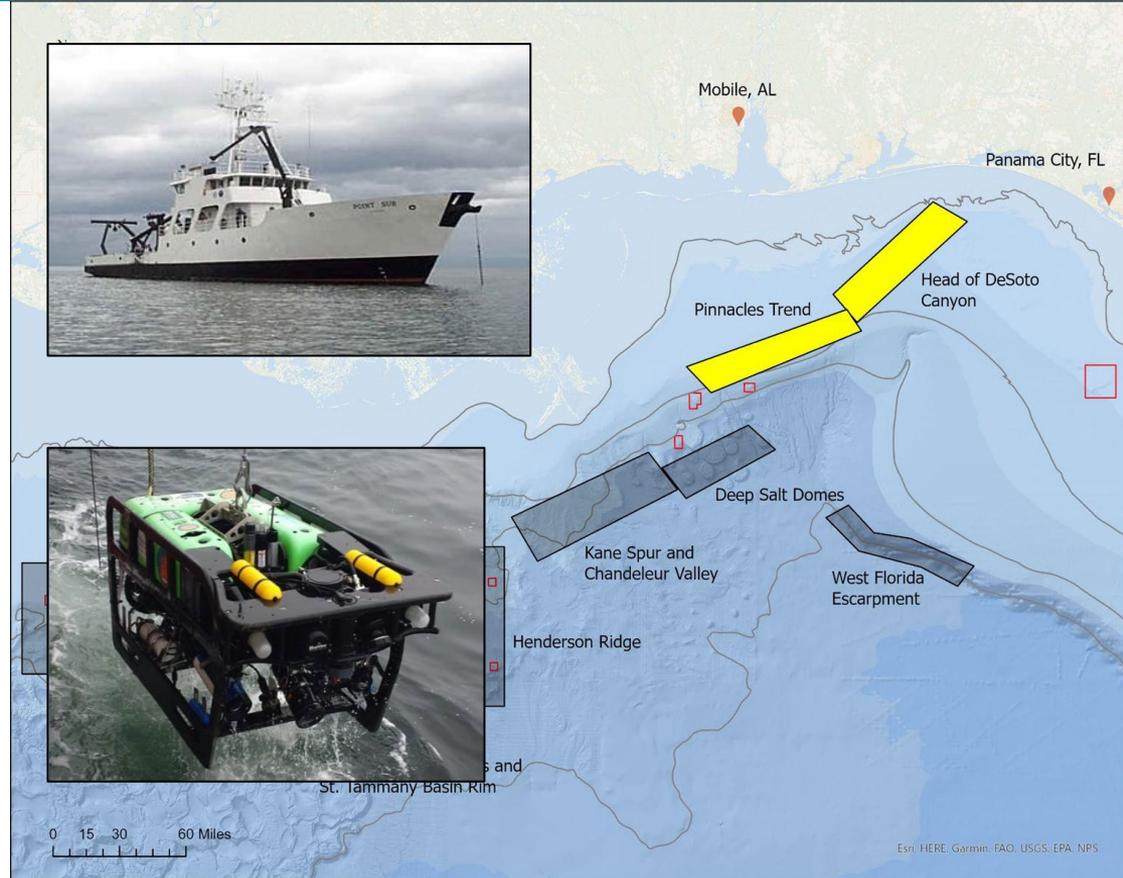
R/V Point Sur: September/October 2024

Dates: September 29-October 10

Asset(s): ROV *Beagle*, WHOI Remus 600 AUV

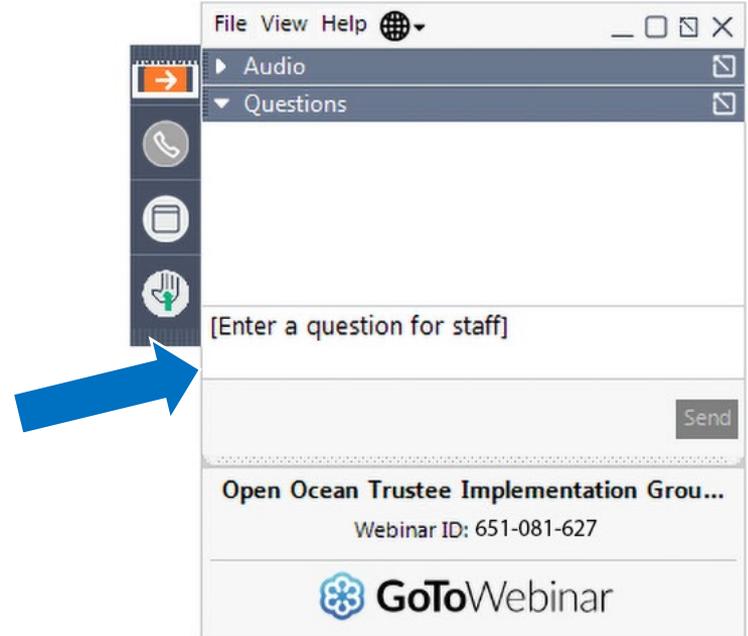
Objectives

- Artificial substrate deployment near sites with documented injury
- Coral sampling and fragmentation
- CTD casts to collect water samples for eDNA and nutrient analysis
- AUV surveys of target sites



Webinar Participation

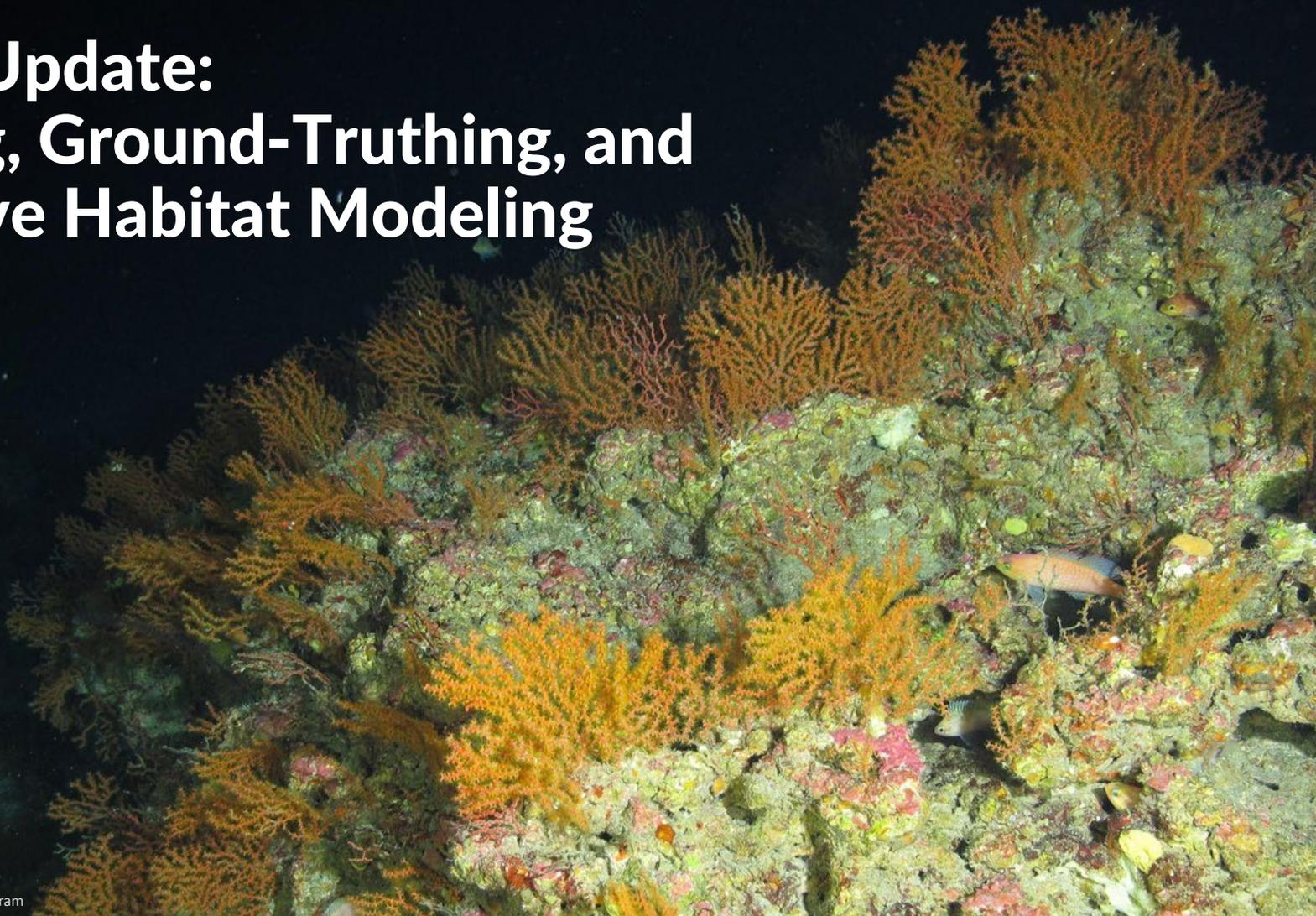
- Please type your questions in the “Questions” box.
- We’ll do our best to get to as many questions as possible.



Project Update: Mapping, Ground-Truthing, and Predictive Habitat Modeling (MGM)

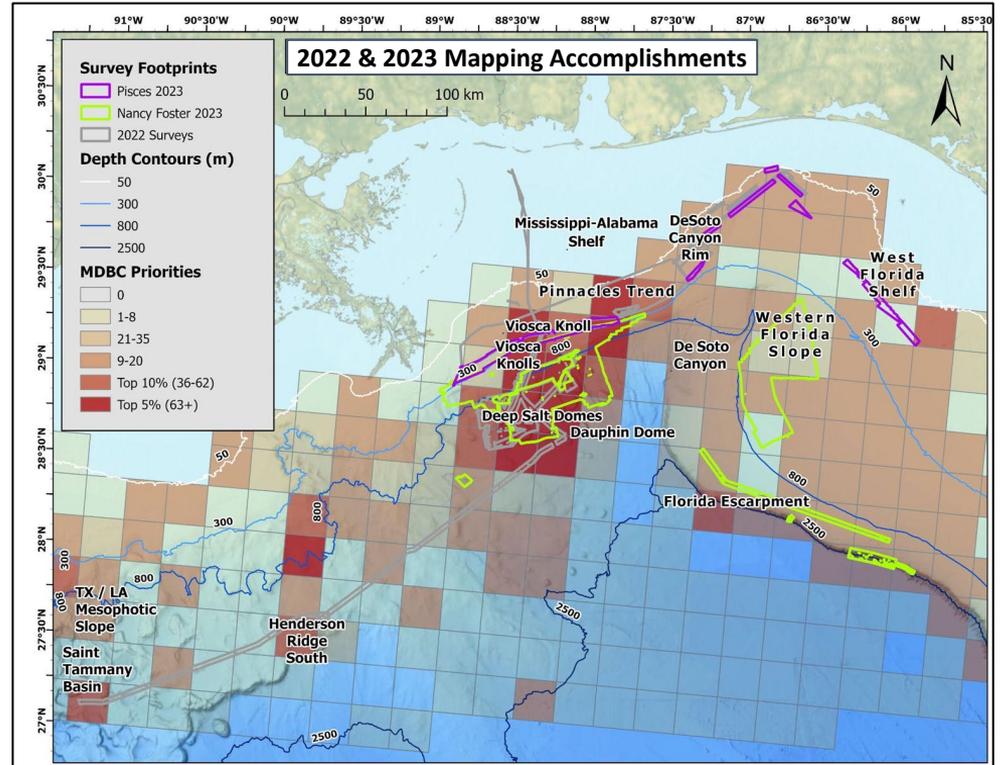
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Photo: NOAA, UNCW Undersea Vehicles Program



Project Update - MGM

- Planning phase → data inventory + stakeholder prioritization
- 2022 and 2023 mapping activities guided by identified data gaps and stakeholder priorities
- Filling data gaps and improving resolution of seafloor data → inform restoration planning
- Updating and improving accuracy of predictive habitat models

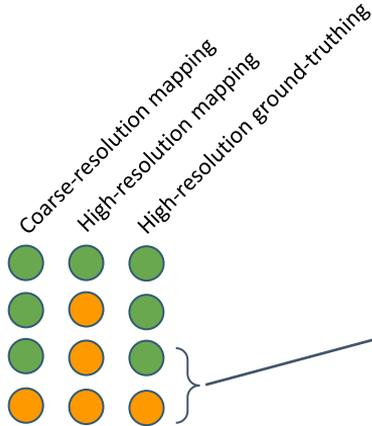


Project Update - MGM

- Sufficient data
- More data needed

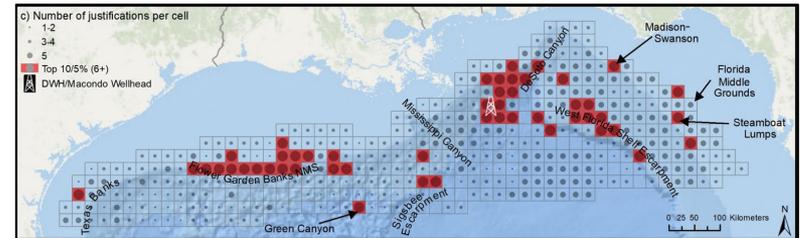
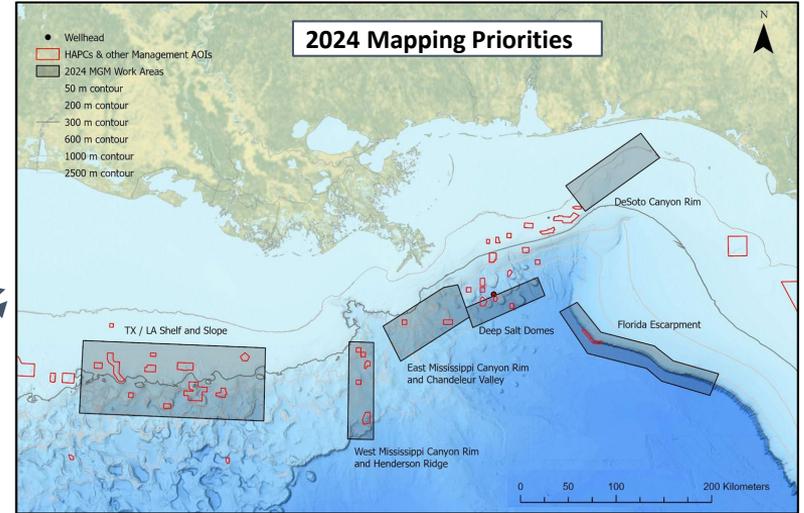
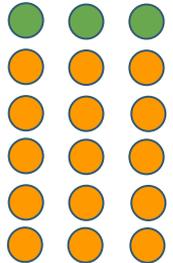
Mesophotic Sites:

- Pinnacles Trend
- West Florida Shelf
- DeSoto Canyon Rim
- TX/LA Slope



Deep Water Sites:

- Viosca Knolls
- TX/LA Slope
- Henderson Ridge
- Deep Salt Domes
- Florida Escarpment
- West Florida Slope



Spatial Prioritization: Sum of all coins representing the total number of different Justifications used in each cell

Project Update - MGM

Implementation partners & collaborators:

- Ocean Exploration Cooperative Institute
- U.S Navy
- Bureau of Ocean Energy Management
- Subject-matter experts
- Penn State U, Applied Research Lab
- CVision AI

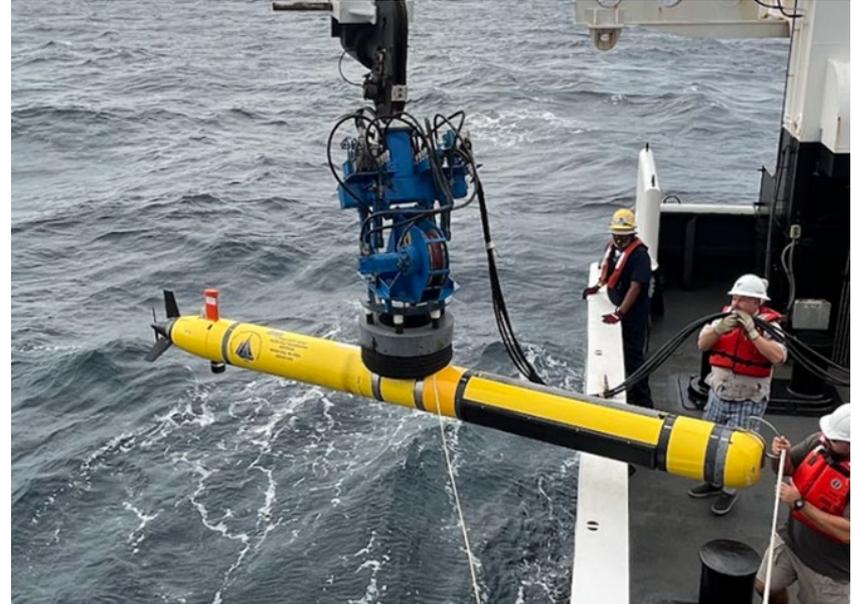


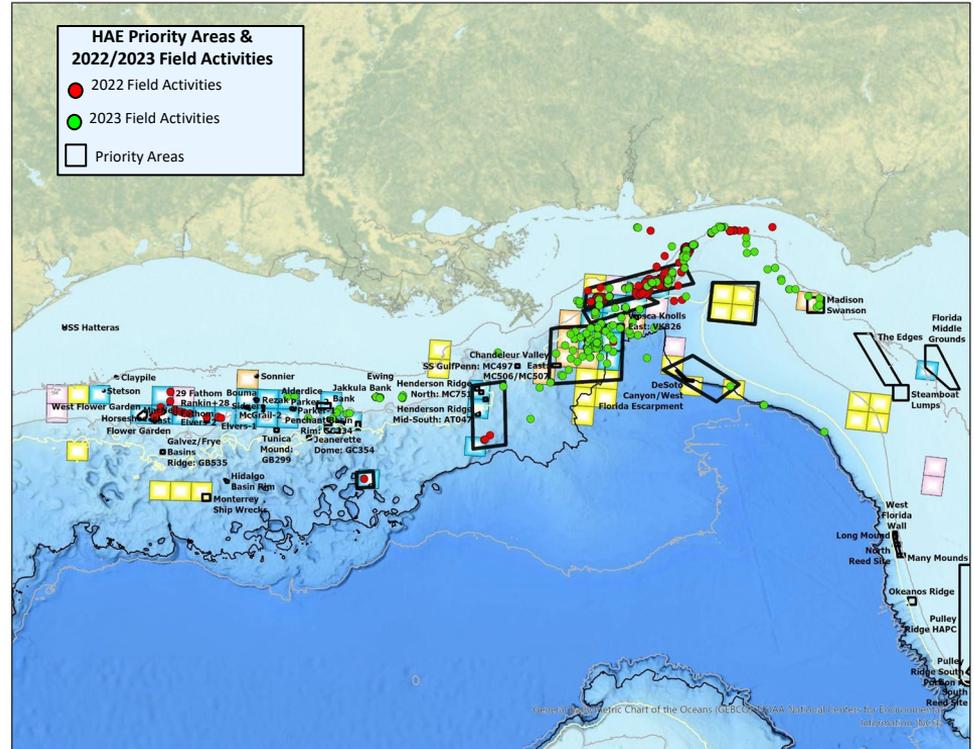
Photo: Claire Huang/NOAA

Project Update: Habitat Assessment and Evaluation (HAE)

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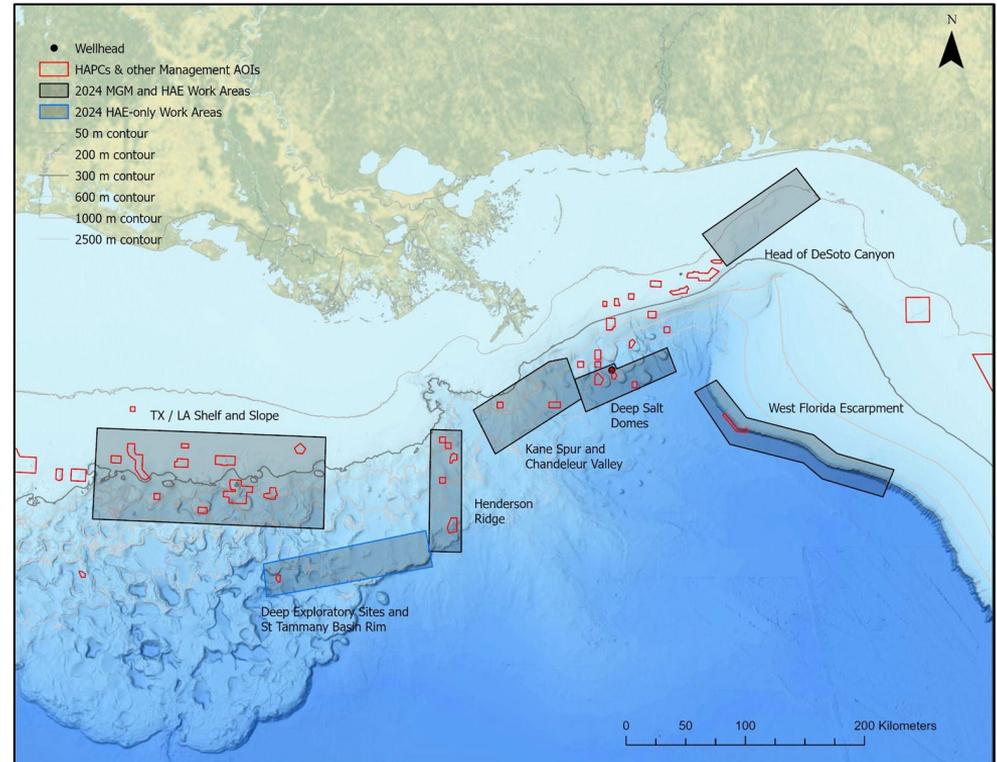
Project Update - HAE

- Planning phase → data inventory + subject-matter expert input
- Characterization of possible impacted sites & poorly known unimpacted sites, population genetics, and environmental characterization
- Filling data gaps informs restoration planning and long-term monitoring strategy



Project Update - HAE

- 2024 fieldwork priorities aligned with mapping team - one additional priority area
- 9 cruises this year with HAE project objectives using a wide variety of tools
- Data and sample processing → annotation of ROV imagery and biological samples to understand connectivity across the Gulf of Mexico



Project Update - HAE

Implementation partners & collaborators:

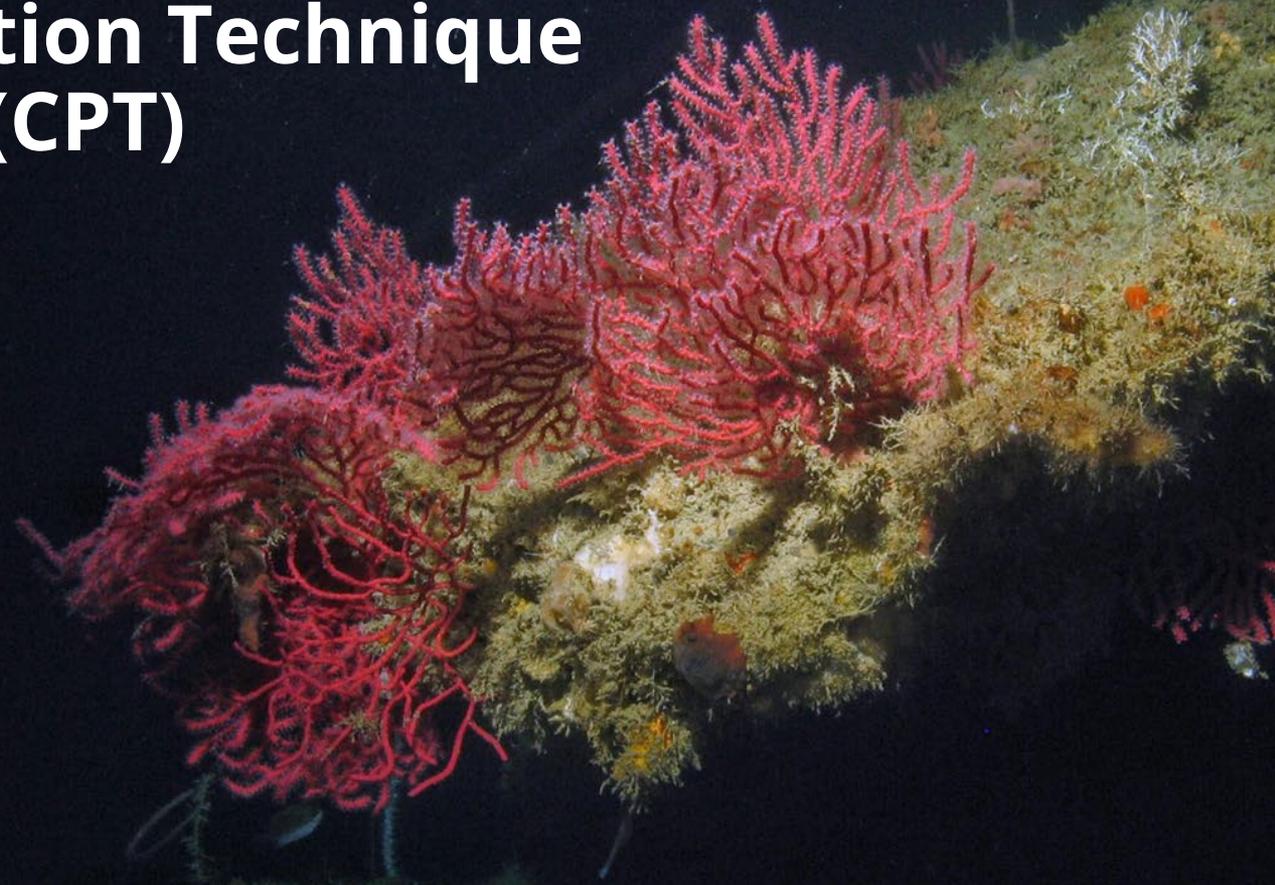
- United States Geological Survey
- Ocean Exploration Cooperative Institute
- Academic partners:
 - Lehigh University
 - Temple University
 - University of Louisiana - Lafayette
 - University of Nevada - Reno
 - University of Georgia
 - University of Hawaii - Manoa
 - University of North Carolina - Wilmington
- Smithsonian National Museum of Natural History
- National Marine Sanctuary Foundation
- CVision AI

March 2024



Photo: NOAA

Project Update: Coral Propagation Technique Development (CPT)



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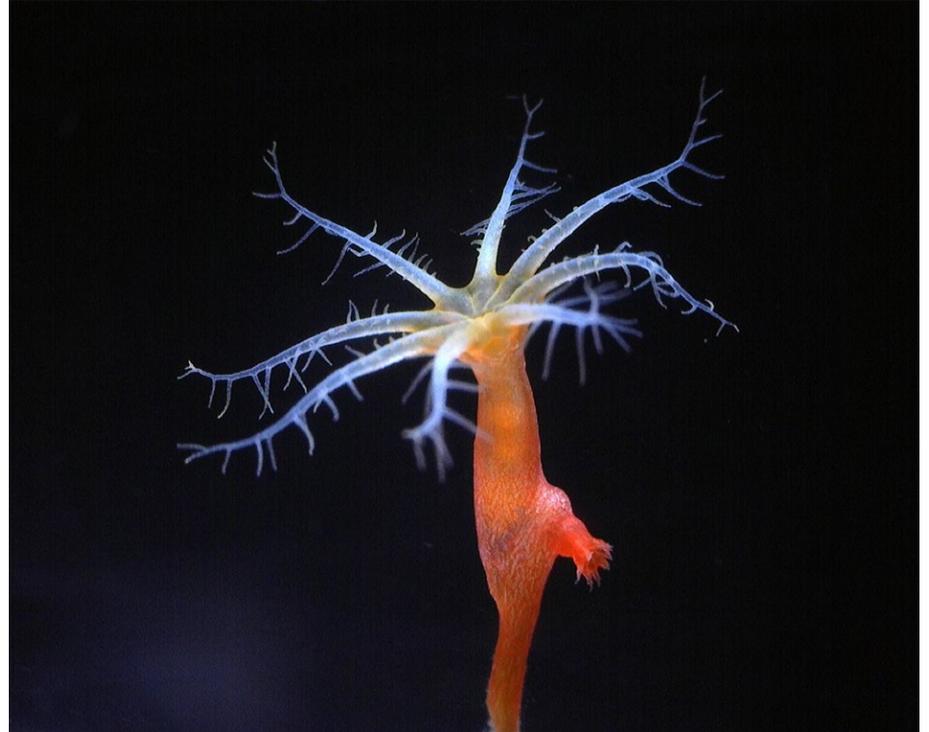
Project Update - CPT

- 12 coral species identified as priorities for restoration during planning phase
- Progress made in at least one category for 10 out of 12 species so far
 - live husbandry
 - reproductive mode
 - whole genome skimming
 - population genetics
- Developing partner aquarium network
- First test of coral fragmentation in the field and first artificial substrate deployments

Species	Zone	Restoration Progress
<i>Muricea pendula</i>	Meso	Y
<i>Swiftia exserta</i>	Meso	Y
<i>Paramuricea biscaya</i>	Deep	Y
<i>Bebryce spp.</i>	Meso	Y
<i>Thesea nivea</i>	Meso	Y
<i>Antipathes atlantica</i>	Meso	-
<i>Paramuricea sp. B3</i>	Deep	Y
<i>Placogorgia sp.</i>	Meso	Y
<i>Bathypathes cf patula</i>	Deep	-
<i>Leiopathes glaberrima</i>	Deep	Y
<i>Callogorgia delta</i>	Deep	Y
<i>Lophelia pertusa</i>	Deep	Y

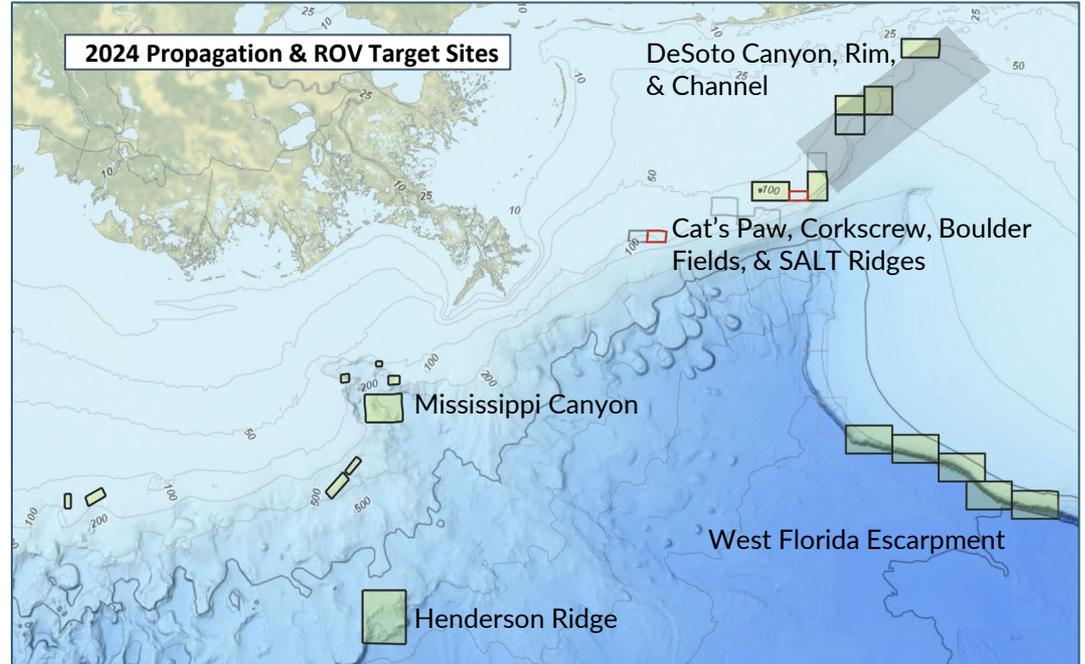
Project Update - CPT

- Identified critical timeline for reproduction for multiple species
- High survivorship of eggs to recruits
- Revealed species preferences for settlement substrate
- Algae are also very important for larval settlement
- Further experimentation on feeding, care to accelerate growth



Project Update - CPT

- Lab experiments to identify best-practices for restoration
- Expanding partner aquarium network to build capacity
- Field work including surveys, sample collection, and expanding coral propagation and artificial substrate deployment
- Artificial substrates evaluation and prioritization report



Project Update - CPT

Implementation partners & collaborators:

- Ocean Exploration Cooperative Institute
- National Marine Sanctuary Foundation
- Moody Gardens
- Marine Applied Research & Exploration
- U.S. Navy Experimental Diving Unit
- Temple University
- Frost Science Museum
- Mississippi Aquarium
- Audubon Aquarium
- University of North Carolina - Wilmington
- Smithsonian National Museum of Natural History



Photo: NOAA

Project Update: Active Management and Protection (AMP)



Project Update - AMP

- Building database of identified threats to key habitat
- Establishing connections with management entities to use MDBC science to support decision-making, inform restoration planning
- Filling gaps in educational content about deep coral communities in the Gulf of Mexico



Photo: Marine Applied Research & Exploration, NOAA

Project Update - AMP

- Navy saturation diving mission to address threats to mesophotic habitat in the Flower Garden Banks National Marine Sanctuary
- Continued engagement with natural resource groups, potential socioeconomic analyses of data
- Aquarium exhibits, MDBC restoration documentary, school and community programs and events, live telepresence broadcasts from restoration expeditions



Photo: NOAA

Project Update - AMP

Implementation partners & collaborators:

- United States Geological Survey
- Ocean Exploration Cooperative Institute
 - University of Rhode Island Inner Space Center
- National Marine Sanctuary Foundation
 - Venue Partners: Audubon Aquarium, Mississippi Aquarium, Man-in-the-Sea Museum
 - Education Partners: Gulf Reach Institute, Artist Boat, Mississippi State University, Grayling Education
 - Technical Partners: Moody Gardens, Marine Applied Research & Exploration
- Smithsonian National Museum of Natural History
- U.S. Navy Experimental Diving Unit



Photo: NOAA

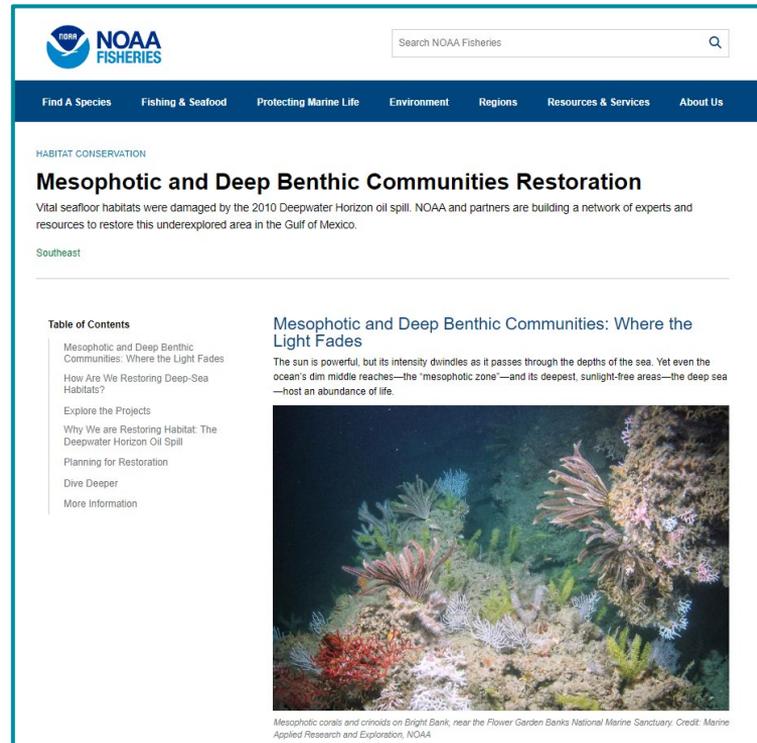
MDBC Portfolio Products & Resources



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MDBC Webpages

- [Gulf Spill Restoration](#)
- [NOAA Fisheries Office of Habitat Conservation - MDBC Webpage](#)
- [NOAA National Centers for Coastal Ocean Science - MDBC Webpage](#)



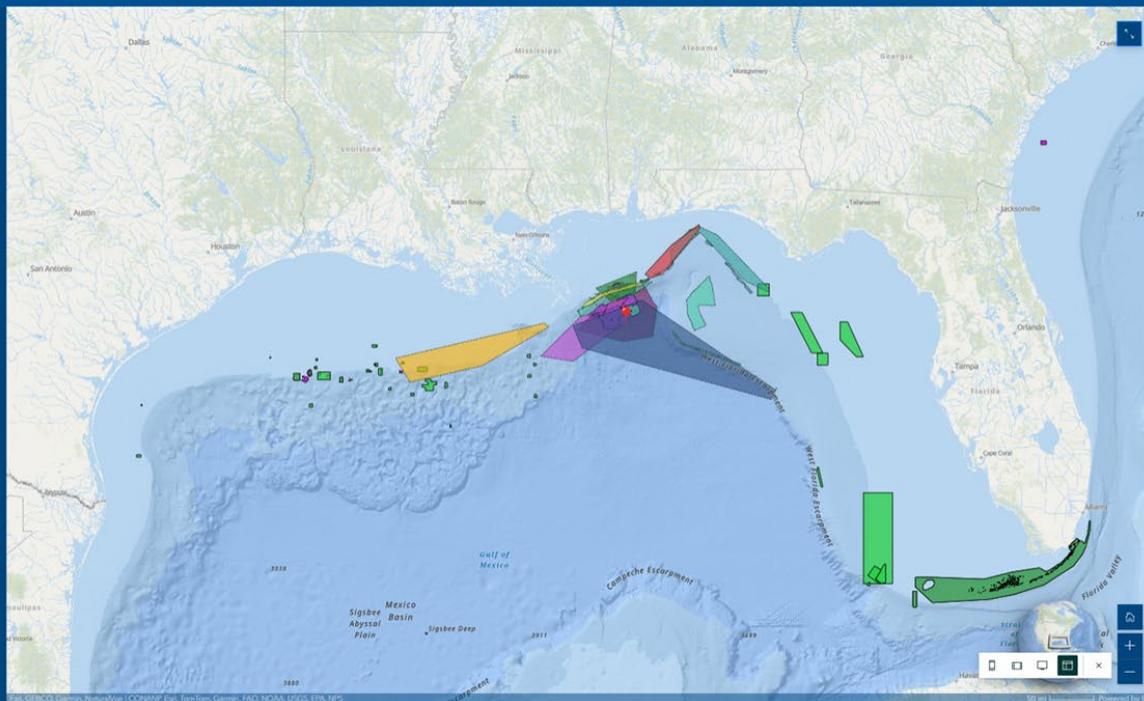
The screenshot shows the NOAA Fisheries website. At the top left is the NOAA Fisheries logo. To its right is a search bar labeled "Search NOAA Fisheries". Below the logo and search bar is a dark blue navigation bar with white text for "Find A Species", "Fishing & Seafood", "Protecting Marine Life", "Environment", "Regions", "Resources & Services", and "About Us". The main content area has a white background. At the top of this area is the text "HABITAT CONSERVATION". Below that is the main heading "Mesophotic and Deep Benthic Communities Restoration" in bold. Underneath is a paragraph: "Vital seafloor habitats were damaged by the 2010 Deepwater Horizon oil spill. NOAA and partners are building a network of experts and resources to restore this underexplored area in the Gulf of Mexico." Below the paragraph is the word "Southeast" in green. To the left of the main text is a "Table of Contents" section with a list of links: "Mesophotic and Deep Benthic Communities: Where the Light Fades", "How Are We Restoring Deep-Sea Habitats?", "Explore the Projects", "Why We are Restoring Habitat: The Deepwater Horizon Oil Spill", "Planning for Restoration", "Dive Deeper", and "More Information". To the right of the table of contents is the main article title "Mesophotic and Deep Benthic Communities: Where the Light Fades" in bold. Below the title is a paragraph: "The sun is powerful, but its intensity dwindles as it passes through the depths of the sea. Yet even the ocean's dim middle reaches—the 'mesophotic zone'—and its deepest, sunlight-free areas—the deep sea—host an abundance of life." Below the paragraph is a large photograph of a deep-sea coral reef. The corals are various colors, including red, orange, and white, and are set against a dark blue background. Below the photograph is a caption: "Mesophotic corals and crinoids on Bright Bank, near the Flower Garden Banks National Marine Sanctuary. Credit: Marine Applied Research and Exploration, NOAA".

MDBC Expeditions Story Map

NOAA Mesophotic and Deep Benthic Communities Expeditions

Introduction 2021 Expedition 2022 Expeditions 2023 Expeditions Photo Gallery Dive Deeper

2023 Expeditions

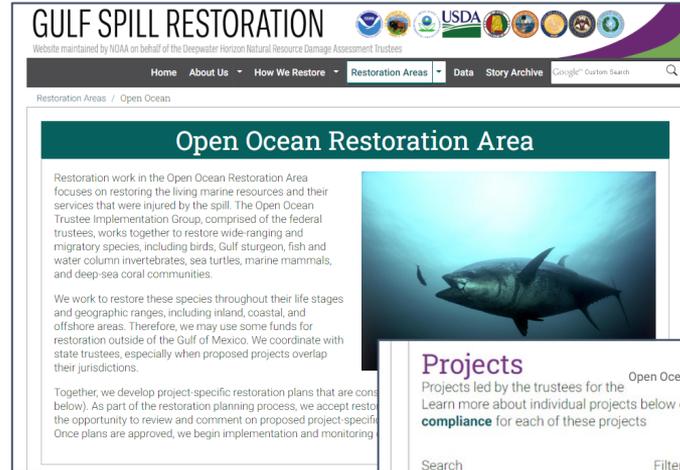


Publications are posted in the [NOAA Institutional Repository](#). Five new publications since April 2023 webinar:

- [Comprehensive Inventory of Seafloor Mapping, Ground-truthing, and Predictive Habitat Modeling Datasets to Support Deepwater Horizon Mesophotic and Deep Benthic Communities](#)
- [Cruise Report : MDBC Expedition R/V Point Sur, May 31–June 11, 2022](#)
- [Data Report : Summary and Assessment of Environmental Data from MDBC Expedition R/V Point Sur, May 31–June 11, 2022](#)
- [Cruise Report: MDBC Expedition NOAA Ship Pisces, June 29–July 30, 2022](#)
- [Cruise Report: MDBC Expedition NOAA Ship Nancy Foster, August 9–29, 2022](#)

MDBC Data

- Portfolio data catalog published with annual project progress reports available on Gulf Spill Restoration website



Projects Open Ocean Restoration Area

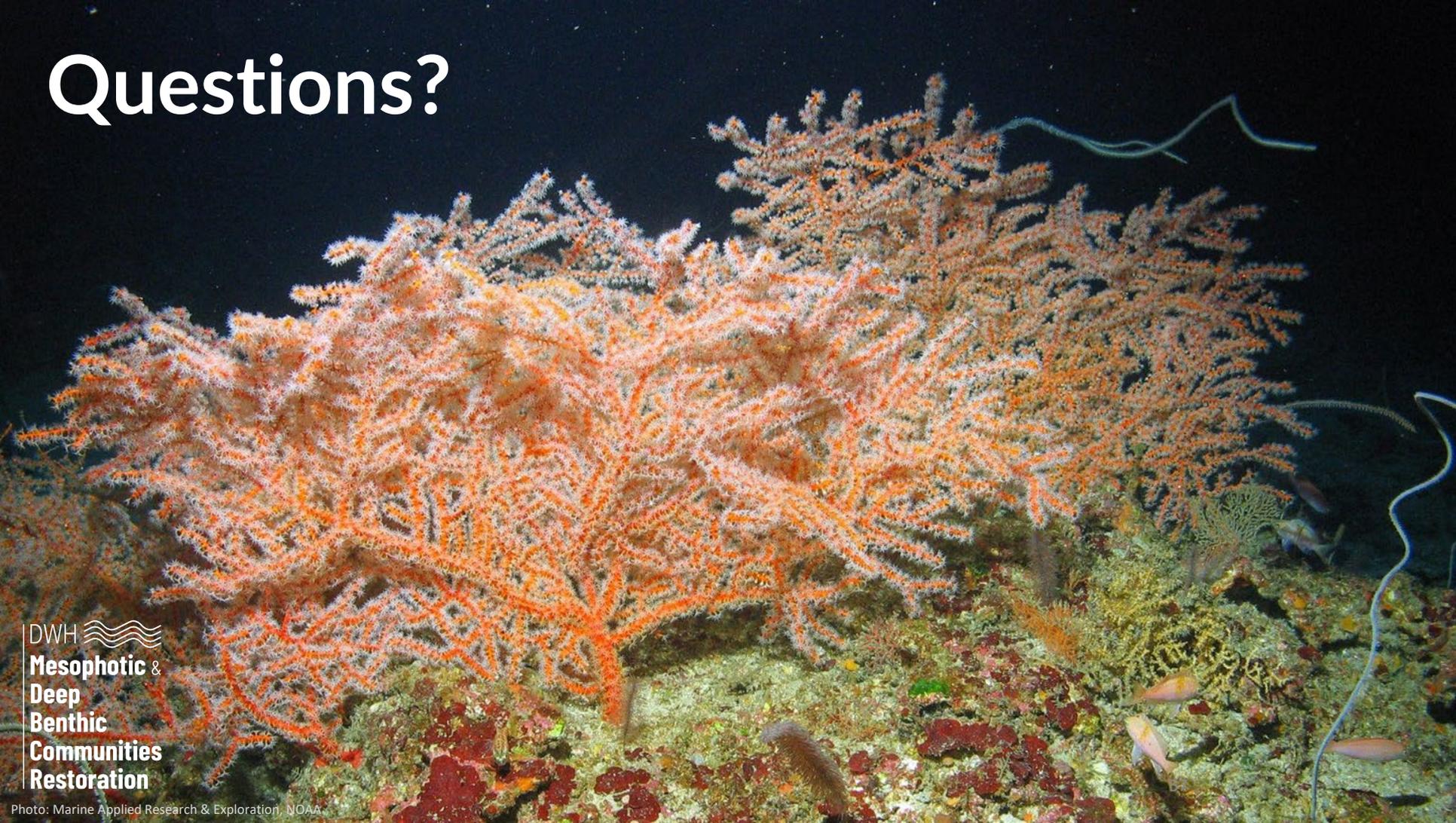
Projects led by the trustees for the Open Ocean Restoration Area are below. Use the filters below to search for specific projects. Learn more about individual projects below or view them in our [interactive map](#). You can also learn about the **environmental compliance** for each of these projects

Search Filter by restoration type Status

Apply **Reset**

Types	Project name	Status
	Mesophotic and Deep Benthic Communities - Active Management and Protection	In Progress
	Mesophotic and Deep Benthic Communities - Coral Propagation Technique Development	In Progress
	Mesophotic and Deep Benthic Communities - Habitat Assessment and Evaluation	In Progress
	Mesophotic and Deep Benthic Communities - Mapping, Ground-truthing, and Predictive Habitat Modeling	In Progress

Questions?

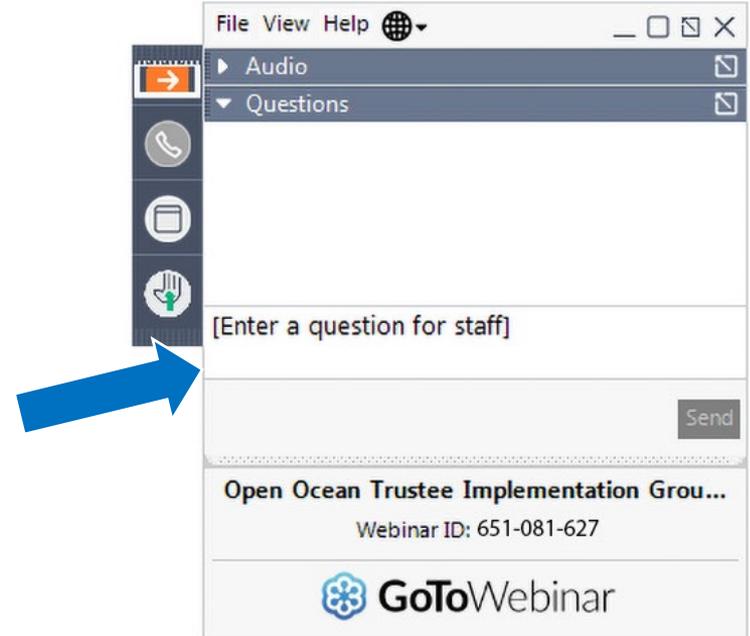


DWH 
**Mesophotic &
Deep
Benthic
Communities
Restoration**

Photo: Marine Applied Research & Exploration, NOAA

Webinar Participation

- Please type your questions in the “Questions” box.
- We’ll do our best to get to as many questions as possible.
- Keep your eye on the chat, as some questions may be answered there.



Thank you for tuning in!

openocean.TIG@noaa.gov

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**Mesophotic &
Deep
Benthic
Communities
Restoration**

Photo: NOAA, Oceaneering International, Inc.

