Deepwater Horizon Oil Spill Natural Resource Damage Assessment and Restoration

Open Ocean Trustee Implementation Group
Draft Restoration Plan 2/Environmental Assessment

Fish, Sea Turtles, Marine Mammals, and Mesophotic and Deep Benthic Communities

Open Ocean Restoration Area

May 2019

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Executive Summary

On April 20, 2010, the *Deepwater Horizon* (DWH) mobile drilling unit exploded, resulting in a massive release of oil from the BP Exploration and Production Inc. (BP) Macondo well, causing loss of life and extensive natural resource injuries. Oil spread from the deep ocean to the surface and nearshore environment from Texas to Florida. Extensive response actions were undertaken to try to reduce harm to people and the environment. However, many of these response actions had collateral impacts on the environment and on natural resource services.

As part of a 2016 settlement, BP agreed to pay a total of $8.1 billion in natural resource damages (inclusive of Early Restoration funding) over a 15-year period, and up to an additional $700 million for adaptive management or to address injuries to natural resources that are presently unknown but may come to light in the future. The settlement allocated a specific sum for restoration within specific Restoration Areas and Restoration Types.

This *Deepwater Horizon* Oil Spill Open Ocean Trustee Implementation Group Draft Restoration Plan 2/Environmental Assessment: Fish, Sea Turtles, Marine Mammals, and Mesophotic and Deep Benthic Communities (RP/EA) was prepared by the Open Ocean Trustee Implementation Group (TIG) to conduct planning and restoration of lost natural resources in the Open Ocean Restoration Area as a result of the DWH oil spill. The Open Ocean TIG is responsible for restoring the natural resources and services within the Open Ocean Restoration Area that were injured by the April 20, 2010, DWH oil spill and associated spill response efforts. The Open Ocean TIG has prepared this RP/EA to 1) inform the public about its DWH natural resource damage assessment (NRDA) restoration planning efforts, and 2) present analysis on the potential restoration benefits and environmental consequences of the alternatives.

The purpose of restoration, as discussed in this document and detailed more fully in the *Deepwater Horizon* Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement (PDARP/PEIS), is to make the environment and the public whole for injuries resulting from the oil spill by implementing restoration actions that return injured natural resources and services to baseline conditions and compensate for interim losses in accordance with the Oil Pollution Act of 1990 (OPA) and associated NRDA regulations. The PDARP/PEIS and Record of Decision (ROD) can be found at:
https://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/

The Open Ocean TIG includes four federal Trustee agencies: U.S. Department of Commerce (DOC), represented by the National Oceanic and Atmospheric Administration (NOAA); U.S. Department of the Interior (DOI), represented by the U.S. Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Bureau of Land Management (BLM); U.S. Department of Agriculture (USDA); and U.S. Environmental Protection Agency (EPA). NOAA is the lead federal Trustee for preparing this RP/EA pursuant to the National Environmental Policy Act (NEPA). The federal agencies of the Open Ocean TIG are acting as cooperating agencies for the purposes of compliance with NEPA in the development of this RP/EA. Each federal cooperating agency on the Open Ocean TIG intends to adopt, if appropriate, the NEPA analyses in this RP/EA. In accordance with 40 CFR §1506.3(a), each of the three federal cooperating agencies (DOI, EPA, and USDA) participating on the Open Ocean TIG will review the RP/EA for adequacy in meeting the standards set forth in its own NEPA implementing procedures and make a decision whether to adopt the analysis in the RP/EA. Adoption of the environmental assessment would be completed via signature on the relevant NEPA decision document. The Open Ocean TIG has undertaken this restoration planning effort to meet the purpose of restoring those natural resources and services injured as a result of the DWH oil spill. Restoration activities are intended to restore or replace natural resources and services to their baseline condition and to compensate the public for interim losses from the time natural resources are injured until they recover to baseline conditions.

In developing a reasonable range of alternatives suitable for addressing the injuries caused by the DWH oil spill, the Open Ocean TIG reviewed the Trustee programmatic restoration goals and Restoration Type specific goals specified in the PDARP/PEIS. The Open Ocean TIG also used criteria identified in the PDARP/PEIS, including evaluation factors in the OPA regulations (15 CFR §990.54), the current and future availability of funds under the DWH NRDA settlement payment schedule, as well as projects already funded or proposed to be funded by the other DWH restoration funding sources.

Projects comprising the reasonable range of alternatives considered in this RP/EA were developed through review of project ideas submitted to the DWH project portal since the DWH restoration planning process was initiated in 2010. The Open Ocean TIG reviewed more than 1,600 restoration project ideas submitted by the public, non-governmental organizations, and local, state and federal agencies.

In this RP/EA, the Open Ocean TIG identified and evaluated 23 different projects in the range of reasonable alternatives, as well as a No Action alternative. The projects evaluated in this RP/EA are consistent with the restoration approaches described in the PDARP/PEIS for the Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and Mesophotic and Deep Benthic Communities Restoration Types. After evaluation of all 23 projects, the Open Ocean TIG proposes 18 projects as preferred for implementation, at a total estimated cost of $225,680,700 (Table ES-1). This RP/EA also includes Draft Monitoring and Adaptive Management Plans for all preferred projects, as Appendix A to this document.

The public is encouraged to review and comment on this RP/EA. Following public notice, the RP/EA will be available to the public for a 45-day comment period. The deadline for submitting written comments on the RP/EA is specified in the public notice published in the *Federal Register* and the DWH Trustee Council website. Comments must be postmarked no later than 45 days after the start of the comment period. Comments on the RP/EA can be submitted during the comment period by one of following methods:

- Online: http://www.gulfspillrestoration.noaa.gov/restoration-areas/open-ocean
- By mail (hard copy), addressed to: U.S. Fish and Wildlife Service, P.O. Box 29649, Atlanta, GA 30345. Please note that personally identifiable information included in submitted comments (e.g., address, phone number, email address, etc.) may be made publicly available.
- In writing or verbally at the public meeting and in writing online during public webinars.

The Open Ocean TIG will hold one public meeting and two public webinars to facilitate the public review and comment process for this Draft RP/EA. Public meeting and webinar dates and times are specified in the *Federal Register* notice announcing release of this document as well as on the DWH Trustee Council website. After the close of the public comment period, the Open Ocean TIG will consider all input received during the public comment period and then finalize the RP/EA. If appropriate, NOAA will prepare a Finding of No Significant Impact (FONSI). A summary of comments received, the Open Ocean TIG's responses, and any changes made to the Draft RP/EA will be included in the Final RP/EA.

Overall, this RP/EA is intended to provide the public with information and analysis needed to enable meaningful review and comment on the Open Ocean TIG's proposal to implement projects addressing injuries to the Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and Mesophotic and Deep Benthic Communities Restoration Types. Ultimately, this Draft RP/EA and the corresponding opportunity for the public to review and comment on the document are intended to guide the Open Ocean TIG's selection of projects for implementation that best meet its purpose and need, as summarized above and described in more detail in subsequent sections of this document.

Table ES-1. Alternatives considered in this RP/EA. Asterisk (*) indicates preliminary phase restoration alternatives.

Project Alternative	Preferred/ Not Preferred	Estimated Project Costs
Fish and Water Column Invertebrates		
Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries	Preferred	$30,011,000
Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery	Preferred	$17,171,000
Communication Networks and Mapping Tools to Reduce Bycatch—Phase 1*	Preferred	$4,416,000
Restoring for Bluefin Tuna via Fishing Depth Optimization	Preferred	$6,175,000
Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats	Not Preferred	$6,128,000
Sea Turtles		
Gulf of Mexico Sea Turtle Atlas*	Preferred	$5,700,000
Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery*	Preferred	$290,000
Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection*	Preferred	$655,000
Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery	Preferred	$3,000,000
Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices	Preferred	$2,153,000
Long-term Nesting Beach Habitat Protection for Sea Turtles	Preferred	$7,000,000
Reducing Sea Turtle Entanglement from Recreational Fishing Debris	Not Preferred	$1,113,600
Reducing Sea Turtle Bycatch at Recreational Fishing Sites*	Not Preferred	$1,329,000
Marine Mammals		
Reducing Impacts to Cetaceans during Disasters by Improving Response Activities	Preferred	$4,287,000
Compilation of Environmental, Threats, and Animal data for Cetacean Population Health Analyses*	Preferred	$5,808,500
Reduce Impacts of Anthropogenic Noise on Cetaceans	Preferred	$8,992,200
Reduce and Mitigate Vessel Strike Mortality of Cetaceans	Preferred	$3,834,000
Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns	Not Preferred	$4,620,000
Mesophotic and Deep Benthic Communities		
Mapping, Ground-Truthing, and Predictive Habitat Modeling	Preferred	$35,909,000
Habitat Assessment and Evaluation	Preferred	$52,639,000
Coral Propagation Technique Development	Preferred	$16,951,000
Active Management and Protection	Preferred	$20,689,000
Habitat Characterization at Known High Priority Sites	Not Preferred	$21,500,000
	Sum (Preferred)	**$225,680,700**

A summary of the anticipated environmental consequences of these projects is provided in Table ES-2. The six proposed preliminary phase restoration projects identified in Table ES-1 are not included as they fall within the previous analysis in Section 6.14.4 of the PDARP/PEIS.

Table ES-2. Summary of environmental consequences for alternatives considered in this RP/EA.

ALTERNATIVE	PHYSICAL RESOURCES				BIOLOGICAL RESOURCES				HUMAN USE AND SOCIOECONOMIC RESOURCES								
	Geology and Substrates	Hydrology and Water Quality	Air Quality	Noise	Habitats	Wildlife Species (birds)	Marine and Estuarine Fauna	Protected Species	Socioeconomics/ Environmental Justice	Cultural Resources	Infrastructure	Land and Marine Management	Tourism and Recreational Use	Fisheries	Marine Transportation	Aesthetics and Visual Resources	Public Health and Safety
Fish																	
Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries	NE	NE	NE	NE	s	NE	+/s	+/s	+	NE	NE	NE	+	+	NE	NE	NE
Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery	NE	NE	NE	NE	NE	+	+	+	+	NE	NE	NE	+	+	NE	NE	NE
Restoring for Bluefin Tuna via Fishing Depth Optimization	NE	NE	NE	NE	NE	NE	+/s	+/s	+	NE	NE	NE	+/s	+/s	NE	NE	NE
Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats	+/s	+/s	NE	NE	+/s	+	+/s	+/s	+	NE	NE	NE	+	+	NE	NE	NE
Sea Turtles																	
Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery	NE	NE	NE	NE	NE	NE	+	+	NE	NE	NE	NE	NE	NE	NE	NE	NE
Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices	s	s	NE	NE	s	NE	+/s	+	NE	NE	NE	NE	NE	NE	NE	NE	NE
Long-term Nesting Beach Habitat Protection for Sea Turtles	+	+	NE	NE	+	+	+	+	l	NE	NE	+	+	NE	NE	NE	NE
Reducing Sea Turtle Entanglement from Recreational Fishing Debris	NE	NE	NE	NE	+/s	+	+	+	+	NE	NE	NE	+	+	NE	NE	NE
Marine Mammals																	
Reducing Impacts to Cetaceans during Disasters by Improving Response Activities	s	s	NE	NE	s	NE	s	+/s	+	NE	NE	NE	NE	NE	NE	NE	NE
Reduce Impacts of Anthropogenic Noise on Cetaceans	s	NE	NE	+/s	s	NE	NE	+/s	NE	NE	NE	NE	NE	NE	+/s	NE	NE
Reduce and Mitigate Vessel Strike Mortality of Cetaceans	NE	NE	NE	NE	NE	NE	+	+	NE	NE	NE	NE	NE	NE	l	NE	NE
Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns	NE	NE	NE	NE	NE	NE	NE	+/s	NE	NE	NE	NE	NE	NE	NE	NE	NE
Mesophotic and Deep Benthic Communities																	
Mapping, Ground-Truthing, and Predictive Habitat Modeling	+/s	NE	NE	s	+	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Habitat Assessment and Evaluation	+/s	NE	NE	s	+/s	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Coral Propagation Technique Development	+/s/l	NE	NE	s	+/s	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Active Management and Protection	+/s/l	NE	NE	s	+/l	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Habitat Characterization at Known High Priority Sites	+/s	NE	NE	s	+	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
No Action	s/l	s/l	NE	S/L	**S/L**	S/L	S/L	S/L	s/l	+/l	NE	s/l	s/l	s/l	s/l	NE	NE

Notes: + Beneficial effect; NE No effect; s - short-term, minor adverse effect; S - short-term, moderate adverse effect; **S - short-term, major adverse effect**; l - long-term, minor adverse effect; L - Long-term, moderate adverse effect; **L - Long-term, major adverse effects**

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List of Abbreviations and Acronyms

A	
ACNWR	Archie Carr National Wildlife Refuge
AUV	autonomous underwater vehicle
B	
BLL	bottom longline
BLM	Bureau of Land Management
BMPs	best management practices
BOEM	U.S. Bureau of Ocean Energy Management
BP	BP Exploration and Production Inc.
BRD	bycatch reduction device
BSEE	U.S. Bureau of Safety and Environmental Enforcement
C	
CETACEAN	**C**ompilation of **E**nvironmental, **T**hreats, and **A**nimal data for **CE**tacean population health **AN**alyses
CEQ	Council on Environmental Quality
CPUE	catch per unit effort
D	
DIVER	Data Integration Visualization Exploration and Reporting
DOC	U.S. Department of Commerce
DOI	U.S. Department of the Interior
DPS	distinct population segment
DWH	*Deepwater Horizon*
E	
E&D	engineering and design
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act

F

FDD	fish descender device
FONSI	finding of no significant impact
FGBNMS	Flower Gardens Banks National Marine Sanctuary
FMP	fishery management plan

G

GMFMC	Gulf of Mexico Fishery Management Council
GoMMMDRG	Gulf of Mexico Marine Mammal Disaster Response Guidelines
GOMRI	Gulf of Mexico Research Initiative

H

HAPC	Habitat Area of Particular Concern
HARP	high frequency acoustic recording package
HMS	highly migratory species
HOV	human operated vehicle

L

LARP	low frequency acoustic recording package

M

MAM	monitoring and adaptive management
MDBC	Mesophotic and Deep Benthic Communities
MMPA	Marine Mammal Protection Act
MPA	Marine Protected Area

N

NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFWF GEBF	National Fish and Wildlife Foundation Gulf Environmental Benefit Fund
NGO	non-governmental organization
NOI	Notice of Intent
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRC	National Research Council
NRDA	natural resource damage assessment

O

OBIS-SEAMAP	Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations
OCSLA	Outer Continental Shelf Lands Act
ONMS	Office of National Marine Sanctuaries
OPA	Oil Pollution Act of 1990

P

PAM	passive acoustic monitoring
PCB	polychlorinated biphenyls
PDARP/PEIS	Final Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement
PLL	pelagic longline
PSAT	pop-up satellite archival tags

R

RESTORE	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
ROD	Record of Decision
ROV	remotely operated underwater vehicle
RP/EA	Draft Restoration Plan 2 and Environmental Assessment

S

SAFMC	South Atlantic Fishery Management Council
SOP	standard operating procedures
STSSN	Sea Turtle Stranding and Salvage Network

T

TED	turtle excluder device
TIG	Trustee Implementation Group

U

UME	unusual mortality event
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service

Chapter 1: Introduction, Purpose and Need, and Public Participation

The *Deepwater Horizon* (DWH) Oil Spill Open Ocean Trustee Implementation Group (TIG) prepared this Draft Restoration Plan 2 and Environmental Assessment: Fish, Sea Turtles, Marine Mammals, and Mesophotic and Deep Benthic Communities (RP/EA) to address injuries to natural resources in the Open Ocean Restoration Area[1] as a result of the DWH oil spill. The Open Ocean TIG is responsible for restoring natural resources and their services within the Open Ocean Restoration Area that were injured by the DWH oil spill. The purpose of this RP/EA is to 1) inform the public about the DWH Natural Resource Damage Assessment restoration planning efforts, 2) analyze the potential restoration benefits and environmental consequences of projects/alternatives[2] proposed for implementation to help restore the target Restoration Types, and 3) seek public comment on the restoration alternatives considered in this document. The purpose of restoration, as discussed in this document and detailed in the 2016 *Deepwater Horizon* Oil Spill Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement (PDARP/PEIS)[3], is to make the environment and the public whole for injuries resulting from the DWH oil spill. The Trustees accomplish this by implementing restoration actions that return injured natural resources and services to baseline conditions and compensate for interim losses, in accordance with the Oil Pollution Act of 1990 (OPA) and associated natural resource damage assessment (NRDA) regulations.

The Open Ocean TIG includes four federal Trustee agencies: U.S. Department of Commerce (DOC), represented by the National Oceanic and Atmospheric Administration (NOAA); U.S. Department of the Interior (DOI), represented by the U.S. Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Bureau of Land Management (BLM); U.S. Department of Agriculture (USDA); and U.S. Environmental Protection Agency (EPA). NOAA is the lead federal agency responsible for preparing this RP/EA pursuant to the Council on Environmental Quality's (CEQ) National Environmental Policy Act (NEPA) implementing regulations and NOAA NEPA implementing procedures (NAO 216-6A). NEPA implementing regulations require a federal agency to serve as the lead agency to supervise the preparation of the NEPA analysis when more than one federal agency is involved in the same action (40 CFR 1501.5(a)). Each of the co-Trustees on the Open Ocean TIG is participating as a cooperating agency pursuant to NEPA (40 CFR 1508.5).

As federal agencies, each cooperating agency on the Open Ocean TIG intends to adopt the NEPA analysis in this RP/EA. In accordance with 40 CFR 1506.3(a), each of the federal cooperating agencies participating on the Open Ocean TIG will review the RP/EA for adequacy in meeting the standards set forth in its own NEPA implementing procedures. Each agency will then make a decision whether to adopt the analysis to inform its own federal decision-making and fulfill its responsibilities under NEPA. More information about OPA and NEPA, as well as their application to DWH oil spill restoration planning, can be found in Chapters 5 and 6 of the PDARP/PEIS.

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[1] The Open Ocean TIG addresses a wide range of resources that make use of the open ocean, including water column and ocean bottom fish and invertebrates, sea turtles, birds, marine mammals, sturgeon, and MDBC. Many of these species that spend part of their lives in the Gulf of Mexico also migrate to other places—as far away as Canada and the Mediterranean Sea. The Open Ocean Restoration Area will address species throughout their life stages and geographic range, in some cases outside of the Gulf of Mexico (if/as restoration needs require).

[2] For the purposes of this RP/EA, each proposed project is considered a separate alternative and so the terms project and alternative may be used interchangeably in this document.

[3] The PDARP/PEIS and Record of Decision (ROD) can be found at http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/.

This RP/EA proposes 18 projects preferred for implementation for the Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and Mesophotic and Deep Benthic Communities (MDBC) Restoration Types at a total estimated cost of $225,680,700. This RP/EA is the second planning effort for the Open Ocean TIG following the first Open Ocean Trustee Implementation Group Final Restoration Plan 1/ Environmental Assessment: Birds and Sturgeon released in March 2019[4].

1.1 Background and Summary of Settlement

On April 20, 2010, the DWH mobile drilling unit exploded, resulting in a massive release of oil from the BP Exploration and Production Inc. (BP) Macondo well, causing loss of life and extensive natural resource injuries. Oil spread from the deep ocean to the surface and nearshore environment from Texas to Florida. Extensive response actions were undertaken to try to reduce harm to people and the environment. However, many of these response actions had collateral impacts on the environment and on natural resource services.

On April 20, 2011, BP agreed to provide up to $1 billion toward Early Restoration projects in the Gulf of Mexico, representing a preliminary step toward the restoration of injured natural resources. Early Restoration proceeded in phases, with each phase adding additional projects to partially address injuries to nearshore resources, birds, fish, sea turtles, federally managed lands, and recreational uses. Sixty-five projects with a total cost of approximately $866 million were selected through the five phases of Early Restoration planning[5].

On February 19, 2016, the DWH Trustee Council issued the PDARP/PEIS detailing a specific proposed plan to fund and implement restoration projects over the next 15 years. In March 2016, the Trustees published a Notice of Availability of a Record of Decision (ROD) for the PDARP/PEIS. Based on the DWH Trustees' injury determination established in the PDARP/PEIS, the ROD set forth the basis for the DWH Trustees' decision to select Alternative A: Comprehensive Integrated Ecosystem Alternative. In April 2016, the United States District Court for the Eastern District of Louisiana entered a Consent Decree resolving civil claims by the DWH Trustees against BP arising out of the DWH oil spill[6].

As part of the settlement, BP agreed to pay a total of $8.1 billion in natural resource damages (inclusive of Early Restoration funding) over a 15-year period, and up to an additional $700 million for adaptive management or to address injuries to natural resources that are presently unknown but may come to light in the future. The settlement allocated a specific sum for restoration within specific Restoration Areas and Restoration Types. Table 1-1 provides the final settlement allocation for the Open Ocean Restoration Area.

[4] The Open Ocean Trustee Implementation Group Final Restoration Plan 1/ Environmental Assessment: Birds and Sturgeon can be found at: https://www.gulfspillrestoration.noaa.gov/sites/default/files/2019-03%20OO%20TIG%20Final%20RPEA1%20FINAL.pdf

[5] The Early Restoration Plans I-V can be found at: http://www.gulfspillrestoration.noaa.gov/planning-archives

[6] See United States v. BPXP et al., Civ. No. 10-4536, centralized in MDL 2179, In re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010 (E.D. La.)

Table 1-1: Allocation of DWH settlement funds for the Open Ocean Restoration Area by Restoration Type.

Restoration Goal	Restoration Type	Open Ocean Early Restoration Funds	Open Ocean Post-Settlement Funds	Total Restoration Funding
Replenish and Protect Living Coastal and Marine Resources	Fish and Water Column Invertebrates	$20,000,000	$380,000,000	$400,000,000
	Sturgeon	$0	$15,000,000	$15,000,000
	Sea Turtles	$0	$55,000,000	$55,000,000
	Marine Mammals	$0	$55,000,000	$55,000,000
	Birds	$0	$70,000,000	$70,000,000
	Mesophotic and Deep Benthic Communities	$0	$273,300,000	$273,000,000
Provide and Enhance Recreational Opportunities	N/A	$22,397,916	$0	$22,397,916
Monitoring and Adaptive Management	N/A	$0	$200,000,000	$200,000,000
Administrative Oversight and Comprehensive Planning	N/A	$0	$150,000,000	$150,000,000
Total Natural Resource Damage Funding for Open Ocean		**$42,397,916**	**$198,300,000**	**$1,240,697,916**

1.2 DWH Trustees, Trustee Council, and TIGs

The DWH Trustees are the government entities authorized under OPA to act as Trustees on behalf of the public to 1) assess the natural resource injuries resulting from the oil spill, and then 2) develop and implement a restoration plan that would make the environment and public whole for those injuries. Trustees fulfill these responsibilities by developing restoration plans, providing the public with an opportunity to suggest restoration projects and to review and comment on proposed plans, implementing and monitoring restoration projects, managing NRDA funds, and documenting Trustee decisions through a public administrative record. The DWH Trustees are responsible for governance of restoration planning. To work collaboratively on the NRDA, the DWH Trustees organized a Trustee Council composed of Designated Natural Resource Trustee Officials, or their alternates, for each of the DWH Trustee agencies.

The following federal and state agencies are designated DWH Trustees[7]:

- National Oceanic and Atmospheric Administration (NOAA), on behalf of the U.S. Department of Commerce (DOC)
- U.S. Department of the Interior (DOI), represented by the U.S. Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Bureau of Land Management (BLM)
- U.S. Department of Agriculture (USDA)
- U.S. Environmental Protection Agency (EPA)
- The State of Alabama's Department of Conservation and Natural Resources and Geological Survey of Alabama
- The State of Florida's Department of Environmental Protection and Fish and Wildlife Conservation Commission
- The State of Louisiana's Coastal Protection and Restoration Authority Department of Natural Resources; Department of Environmental Quality; Oil Spill Coordinator's Office; and Department of Wildlife and Fisheries
- The State of Mississippi's Department of Environmental Quality
- The State of Texas' Parks and Wildlife Department, General Land Office, and Commission on Environmental Quality.

The DWH NRDA funds were distributed among restoration areas to address the diverse suite of injuries that occurred at both regional and local scales. As specified in the Consent Decree and PDARP/PEIS, specific amounts of money were allocated to seven Restoration Areas: each of the five Gulf State Restoration Areas (Texas, Louisiana, Mississippi, Alabama, and Florida), Regionwide, and the Open Ocean. The funding distribution was based on the DWH Trustees understanding and evaluation of exposure and injury to natural resources and services, as well as their evaluation of where restoration spending for the various Restoration Types would be most beneficial within the ecosystem-level restoration portfolio.

Each TIG plans for, chooses, and implements specific restoration actions under the PDARP/PEIS (see Chapter 7 of the PDARP/PEIS).

1.3 Authorities and Regulations

1.3.1 Oil Pollution Act

As an oil pollution incident, the DWH Oil Spill is subject to the provisions of OPA. A primary goal of OPA is to make the environment and public whole for injuries to natural resources and services resulting from an incident involving an oil discharge or substantial threat of an oil discharge. Under OPA, each party responsible for a vessel or facility from which oil is discharged, or which poses the substantial threat of a discharge, is liable for, among other things, removal costs and damages for injury to, destruction of, loss of, or loss of use of natural resources, including the reasonable costs of assessing the damage.

[7] The federal trustees are designated pursuant to OPA (33 U.S.C. §2706(b)(2)) and by Executive Order 12580 (1987) as amended by Executive Order 12777 (1991); by the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR §300.600; and by Executive Order 13626 (2012). Although a trustee under OPA by virtue of the proximity of its facilities to the *Deepwater Horizon* oil spill, the U.S. Department of Defense is not a member of the Trustee Council and did not participate in development of the PDARP/PEIS.

This process of injury assessment and restoration planning is referred to as NRDA. NRDA is described under Section 1006 of OPA (33 United States Code [U.S.C.] § 2706) and the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300.600).

Restoration activities under OPA are intended to return injured natural resources and services to their baseline condition (primary restoration) and to compensate the public for interim losses from the time of the incident until the time resources and services recover to baseline conditions (compensatory restoration). To meet these goals, the restoration activities must produce benefits that are related to or have a nexus (connection) to natural resource injuries and service losses resulting from the spill.

As described in OPA NRDA regulations (15 CFR Part 990)[8], the NRDA process consists of three phases: 1) Pre-assessment, 2) Restoration Planning, and 3) Restoration Implementation. The DWH Trustees are currently undertaking activities for project specific restoration plans that fall within the Restoration Planning phase of the NRDA. As part of this phase, the Open Ocean TIG has prepared this RP/EA, which identifies a reasonable range of restoration alternatives addressing injury in the Open Ocean Restoration Area, evaluates those alternatives under applicable criteria, and selects a suite of preferred alternatives for implementation.

1.3.2 National Environmental Policy Act

Federal Trustees must comply with NEPA and CEQ's NEPA implementing regulations, 40 CFR Parts 1500-1508, when proposing restoration projects. NEPA requires federal agencies to consider the potential environmental impacts of proposed actions. NEPA provides a mandate and framework for federal agencies to determine if their proposed actions have significant environmental effects[9] and related social and economic effects, consider these effects when choosing between alternative approaches, and inform and involve the public in the environmental analysis and decision-making process.

In this RP/EA, the Open Ocean TIG addresses these requirements by tiering from environmental analyses conducted in the PDARP/PEIS, evaluating existing analyses, and, where applicable, incorporating by reference relevant information and analyses from existing project environmental assessments and conservation plans into this RP/EA. Tiering and incorporating by reference from existing analyses cuts down on redundancy, focuses on issues of significance, and shows the interconnection of the proposed alternatives with existing programs and regional efforts to address resource issues at an ecosystem level. All material incorporated, adopted or which is otherwise used to support the NEPA analysis is publicly available. See Chapter 4 for more information on tiering and incorporation by reference under NEPA and how they apply to this RP/EA.

As part of the planning process for the Open Ocean TIG, this RP/EA identifies a reasonable range of restoration alternatives to begin addressing DWH-caused injuries to the Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and MDBC Restoration Types; evaluates them under OPA and NEPA; and identifies a subset of alternatives that are preferred at this time by the Open Ocean TIG for implementation.

[8] The OPA NRDA regulations can be found at https://darrp.noaa.gov/sites/default/files/OPA_CFR-1999-title15-vol3-part990.pdf

[9] "Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial." (40 CFR § 1508.8).

1.4 Trustee Council Standard Operating Procedures

Another document which guides restoration planning is the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill (Trustee Council SOP)[10]. The Trustee Council developed the standard operating procedures (SOP) for administration, implementation, and long-term management of restoration under the PDARP/PEIS. The Trustee Council SOP documents the overall structure, roles, and decision-making responsibilities of the Trustee Council and provides the common procedures to be used by all TIGs. The Trustee Council SOP addresses, among other issues, the following topics: decision-making and delegation of authority, funding, administrative procedures, project reporting, monitoring and adaptive management (MAM), consultation opportunities among the DWH Trustees, public participation, and the Administrative Record.

The Trustee Council SOP was developed and approved by consensus of the Trustee Council and may be amended as needed. The division of responsibilities among the Trustee Council, TIGs, and Individual Trustee Agencies is summarized in Table 7.2-1 of the PDARP/PEIS.

1.5 Restoration Purpose and Need

The Open Ocean TIG has undertaken this restoration planning effort to meet the purpose of contributing to the restoration of natural resources and services injured in the Open Ocean Restoration Area as a result of the DWH oil spill. Proposed restoration activities are intended to restore or replace habitats, species, and services to their baseline condition (primary restoration) and to compensate the public for interim losses from the time natural resources were injured until they recover to baseline conditions (compensatory restoration).

This RP/EA is consistent with the PDARP/PEIS and its purpose and need falls within the scope of the purpose and need identified in the PDARP/PEIS. More specifically, the alternatives identified and evaluated in this RP/EA address the programmatic restoration goal of replenishing and protecting living coastal and marine resources for Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and MDBC Restoration Types. Additional information about the purpose and need for DWH NRDA restoration can be found in Section 5.3.2 of the PDARP/PEIS.

The PDARP/PEIS identifies goals for each Restoration Type (Sections 5.5.2 through 5.5.14). These Restoration Type-specific goals help to guide restoration planning and project selection. In addition, the PDARP/PEIS identifies restoration approaches that describe options for implementation and in some cases, techniques and methods. The Open Ocean TIG considered the following restoration approaches in development of a reasonable range of restoration alternatives:

- **Fish and Water Column Invertebrates:** Reduce impacts of ghost fishing through gear conversion and/or removal of derelict fishing gear to reduce impacts of ghost fishing; incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship; voluntary fisheries-related actions to increase fish biomass; and reduce post-release mortality of red snapper and other reef fishes in the Gulf of Mexico recreational fishery using fish descender devices.

[10] The Trustee Council SOP is available through the NOAA Restoration Portal, at the link below: https://www.gulfspillrestoration.noaa.gov/sites/default/files/TC%20SOP%202.0%20with%20appendices.pdf.

- **Sea Turtles:** Reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures; enhance sea turtle hatchling productivity and restore and conserve nesting beach habitat; and reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures.
- **Marine Mammals:** Increase marine mammal survival through better understanding of causes of illness and death as well as early detection and intervention for anthropogenic and natural threats; measure noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals; and reduce injury and mortality of marine mammals from vessel collisions.
- **Mesophotic and Deep Benthic Communities:** Place hard ground substrate and transplant coral; and protect and manage MDBC. In addition, the PDARP/PEIS identifies the need for robust resource-level monitoring and adaptive management to address critical uncertainties, such as deep water and mesophotic community characteristics, food web dynamics, and habitat distribution.

1.6 Phasing of Projects

The PDARP/PEIS provides the structure for TIGs to implement projects utilizing a phased approach. For example, a TIG may propose funding a planning phase (e.g., collection/analysis of data critical to the restoration planning process, conducting a feasibility study, or undertaking engineering and design [E&D] work) in one restoration plan, allowing TIGs to develop projects to the extent needed to fully consider a subsequent implementation phase of those projects in a future restoration plan. A phased approach to restoration can inform restoration implementation and maximize benefits of restoration. Results from planning in earlier phases may be used to inform larger-scale implementation. Trustees may also implement phased restoration using pilot projects or feasibility studies that then inform scaling of the project to full implementation in a subsequent phase (or restoration plan). Pilot projects are only to be undertaken when, in the judgment of the Trustees, these projects would provide the information at a reasonable cost and in a reasonable time-frame. Project phasing for this RP/EA is discussed further in Section 4.1.1-4.1.3.

1.7 Reasonable Range of Alternatives

The Trustees considered a reasonable range of restoration alternatives before selecting their preferred alternative(s) (OPA § 990.53). Restoration alternatives in this RP/EA were developed through review of project ideas submitted to the DWH project portal[11] by the public and Trustee agencies. Public involvement is an important component of restoration planning (PDARP/PEIS, Section 1.7). Chapter 2 of this RP/EA summarizes the full screening process used to develop a reasonable range of alternatives, which is consistent with the DWH Trustees' selected programmatic alternative in the PDARP/PEIS, the Consent Decree, and OPA. In total, the Open Ocean TIG evaluated 23 projects as a reasonable range of alternatives in this RP/EA. Table 1-2 identifies the alternatives that comprise the reasonable range evaluated for this RP/EA, their estimated costs, and which of those projects are preferred for implementation. Alternatives proposed as phased projects are also identified in Table 1-2.

[11] This portal can be accessed at http://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas

Table 1-2: Alternatives considered in this RP/EA. Asterisk (*) indicates preliminary phase restoration alternatives.

Alternative	Preferred/ Not Preferred	Estimated Project Costs
Fish and Water Column Invertebrates		
Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries	Preferred	$30,011,000
Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery	Preferred	$17,171,000
Communication Networks and Mapping Tools to Reduce Bycatch—Phase 1*	Preferred	$4,416,000
Restoring for Bluefin Tuna via Fishing Depth Optimization	Preferred	$6,175,000
Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats	Not Preferred	$6,128,000
Sea Turtles		
Gulf of Mexico Sea Turtle Atlas*	Preferred	$5,700,000
Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery*	Preferred	$290,000
Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection*	Preferred	$655,000
Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery	Preferred	$3,000,000
Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices	Preferred	$2,153,000
Long-term Nesting Beach Habitat Protection for Sea Turtles	Preferred	$7,000,000
Reducing Sea Turtle Entanglement from Recreational Fishing Debris	Not Preferred	$1,113,600
Reducing Sea Turtle Bycatch at Recreational Fishing Sites*	Not Preferred	$1,329,000
Marine Mammals		
Reducing Impacts to Cetaceans during Disasters by Improving Response Activities	Preferred	$4,287,000
Compilation of Environmental, Threats, and Animal Data for Cetacean Population Health Analyses*	Preferred	$5,808,500
Reduce Impacts of Anthropogenic Noise on Cetaceans	Preferred	$8,992,200
Reduce and Mitigate Vessel Strike Mortality of Cetaceans	Preferred	$3,834,000
Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns	Not Preferred	$4,620,000
Mesophotic and Deep Benthic Communities		
Mapping, Ground-Truthing, and Predictive Habitat Modeling	Preferred	$35,909,000
Habitat Assessment and Evaluation	Preferred	$52,639,000
Coral Propagation Technique Development	Preferred	$16,951,000
Active Management and Protection	Preferred	$20,689,000
Habitat Characterization at Known High Priority Sites	Not Preferred	$21,500,000

1.8 Proposed Action: Implementation of the Open Ocean TIG Draft Restoration Plan 2/Environmental Assessment

To address the DWH Trustee programmatic restoration goals and Restoration Type-specific goals described in the PDARP/PEIS, the Open Ocean TIG proposes to undertake the planning and implementation of 18 projects identified as preferred alternatives in this RP/EA. These 18 projects would provide compensatory restoration of Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and MDBC in the Open Ocean Restoration Area using funds allocated to the Open Ocean TIG. The reasonable range of alternatives (Table 1-2) proposed for implementation is described briefly in Section 2.6 and in more detail in Chapter 3.

1.9 Severability

Preferred alternatives identified in this Draft RP/EA are independent of each other and may be selected individually by the Open Ocean TIG. A decision not to select one or more of the alternatives does not affect the Open Ocean TIG's selection of any remaining alternatives. Projects not included in the reasonable range of alternatives for this Draft RP/EA, or not selected for implementation in the final RP/EA, may continue to be considered for inclusion in future restoration plans by the Open Ocean TIG.

1.10 Coordination with Other Gulf Restoration Programs

As discussed in Section 1.5.6 of the PDARP/PEIS, the Open Ocean TIG is committed to coordination with other Gulf of Mexico restoration programs to maximize the overall ecosystem impact of DWH NRDA restoration efforts. This coordination will help ensure that funds are allocated for critical restoration projects across the affected regions of the Gulf of Mexico and within the Open Ocean Restoration Area.

During the course of the restoration planning process, the Open Ocean TIG has coordinated and will continue to coordinate with all of the other DWH TIGs and other DWH oil spill and Gulf of Mexico restoration programs, including the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States (RESTORE) programs, and the National Fish and Wildlife Foundation Gulf Environmental Benefit Fund (NFWF GEBF). The Open Ocean TIG will seek to develop synergies with these programs when possible to ensure the most effective use of available funds for the maximum ecosystem and resource benefit.

1.11 Public Participation

Public input is an integral part of NEPA, OPA, and the DWH oil spill restoration planning effort. On October 1, 2010, the DWH Trustees published the Notice of Intent (NOI) to Conduct Restoration Planning (75 *FR* 60800). Since then, the DWH Trustees have sought restoration project ideas from the public through a variety of means. In addition, the DWH Trustees conducted an extensive public outreach process as part of PDARP/PEIS development efforts; that process and associated public comments are described more fully in Chapter 8 of the PDARP/PEIS. The DWH Trustees also solicited public review and comment on several draft DWH restoration plan/environmental reviews and held numerous public meetings.

1.11.1 Public Involvement in this RP/EA

Restoration project submissions potentially relevant to the Open Ocean TIG and other DWH restoration planning activities have been collected since the internet-based DWH project portal was opened in 2010. On March 31, 2017, the Open Ocean TIG solicited restoration project ideas from the public for the six Restoration Types identified in the Open Ocean Restoration Area: Birds, Sturgeon, Sea Turtles, Marine Mammals, Fish and Water Column Invertebrates, and Mesophotic and Deep Benthic Communities (NOAA 2017a). The Open Ocean TIG continued the collection of project ideas relevant to these Open Ocean Restoration Types through May 15, 2017. The Open Ocean TIG held a public webinar on April 27, 2017 to provide information about the restoration planning process, the request for project ideas, and next steps for the Open Ocean Restoration Area.

The Open Ocean TIG reviewed more than 1,600 restoration project ideas proposed by the public, non-governmental organizations (NGOs), and state, federal, and local agencies. The project screening process is described in more detail in Chapter 2.

The public is encouraged to review and comment on this RP/EA. Following public notice, the Draft RP/EA will be available to the public for a 45-day comment period. The deadline for submitting written comments is specified in the public notice published in the *Federal Register* and on the Trustee Council Gulf Spill website (see link below). Comments sent by mail must be postmarked no later than 45 days after the start of the comment period. Comments on the Draft RP/EA can be submitted during the comment period by one of following methods:

- Online: http://www.gulfspillrestoration.noaa.gov/restoration-areas/open-ocean
- By mail (hard copy), addressed to: U.S. Fish and Wildlife Service, P.O. Box 29649, Atlanta, GA 30345. Please note that personally identifiable information included in submitted comments (e.g., address, phone number, email address, etc.) may be made publicly available.
- In writing or verbally at the public meeting and in writing online during public webinars.

The Open Ocean TIG will host one public meeting and two public webinars to facilitate the public review and comment process for this Draft RP/EA. This information is also specified in the *Federal Register* notice announcing the release of this document.

1.11.2 Next Steps

After the close of the public comment period, the Open Ocean TIG will consider all input received during the public comment period and then finalize the RP/EA. A summary of comments received, the Open Ocean TIG’s responses, and any changes made to the Draft RP/EA will be included in the final RP/EA. If appropriate, NOAA will prepare a finding of no significant impact (FONSI).

1.11.3 Decisions to be Made

This RP/EA is intended to provide the public and decision makers with information and analysis needed to enable meaningful review and comment on the Open Ocean TIG’s proposal to implement 18 projects addressing injuries to the Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and MDBC Restoration Types. Ultimately, this RP/EA and the corresponding opportunity for the public to review and comment on the document are intended to guide the Open Ocean TIG’s selection of projects for implementation that best meet the purpose and need as described above.

1.11.4 Administrative Record

The DWH Trustees opened a publicly available Administrative Record for the NRDA of the DWH oil spill, including restoration planning activities, concurrently with publication of the 2010 NOI (pursuant to 15 CFR § 990.45). DOI is the lead federal Trustee for maintaining the Administrative Record, which can be found at http://www.doi.gov/deepwaterhorizon/adminrecord. This administrative record site is also used by the Open Ocean TIG for DWH restoration planning. Information about restoration project implementation is being provided to the public through the Administrative Record and other outreach efforts, including at http://www.gulfspillrestoration.noaa.gov.

1.12 Document Organization

Chapter 1: Introduction, Purpose and Need, and Public Participation—Introductory information and context for this document

Chapter 2: Restoration Planning Process—Background on the NRDA restoration planning process, summary of injuries to resources resulting from the DWH oil spill that the Open Ocean TIG intends to address in this RP/EA, screening of a suite of restoration projects to address those injuries, coordination with other restoration planning efforts and development of a reasonable range of alternatives

Chapter 3: OPA Evaluation of Alternatives— Evaluation of the reasonable range of alternatives for NRDA restoration identified in this RP/EA using OPA evaluation factors and rationale for preferred restoration alternatives

Chapter 4: Environmental Assessment—Discussion of the affected environment and the environmental impacts that could result from implementation of the reasonable range of alternatives for NRDA restoration identified in this RP/EA, the basis for supplementary NEPA analysis, and compliance with federal and state environmental protection laws that may apply to the proposed preferred alternatives

Appendix A: Draft Monitoring and Adaptive Management Plans—Includes draft plans for preferred restoration alternatives identified by the Trustees

Appendix B: Literature Cited

Appendix C: Impact Thresholds—Impact Thresholds used for the analysis of environmental consequences, as presented in the PDARP/PEIS

Appendix D: Life Stages of Species with Essential Fish Habitat in the Northern Gulf of Mexico

Appendix E: Marine Mammals Occurring in the Northern Gulf of Mexico

Appendix F: List of Preparers and Reviewers—Identification of individuals who substantively contributed to the development of this document

Appendix G: List of Repositories

Chapter 2: Restoration Planning Process

NRDA restoration under OPA is a process that includes evaluating injuries to natural resources and natural resource services to determine the types and extent of restoration needed to address the injuries. Restoration activities need to produce benefits that are related to or have a nexus (connection) to natural resource injuries and service losses resulting from an oil spill. The DWH Trustees must identify a reasonable range of restoration alternatives and then evaluate those proposed alternatives. The OPA NRDA regulations (15 CFR §990.54) provide factors to be used by Trustees to evaluate projects designed to compensate the public for injuries caused by oil spills. Consistent with the OPA regulations (15 CFR §990.53), the Open Ocean TIG used a screening process to develop the reasonable range of alternatives evaluated in this plan.

This chapter describes the screening process used by the Open Ocean TIG to develop the reasonable range of alternatives for Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and MDBC Restoration Types. The reasonable range of alternatives identified is consistent with the DWH Trustees' selected programmatic alternative and the goals identified in the PDARP/PEIS. Consequently, this chapter also summarizes the restoration decisions stated in the PDARP/PEIS and ROD, the relationship of the PDARP/PEIS to this document, injuries addressed by this restoration plan, and the projects considered for implementation in the reasonable range of alternatives. The restoration planning process was also conducted in accordance with the Consent Decree, Trustee Council SOP, and OPA and NEPA regulations.

2.1 PDARP/PEIS and Record of Decision

On February 19, 2016, the DWH Trustees issued the PDARP/PEIS detailing a programmatic plan to fund and implement restoration projects to fully allocate the settlement funds to be paid by BP over 15 years. Based on the DWH Trustees' assessment of impacts to the Gulf's natural resources, a comprehensive, integrated ecosystem restoration approach for implementation was proposed. On March 29, 2016, in accordance with OPA and NEPA, the DWH Trustees published a Notice of Availability of a ROD for the PDARP/PEIS in the *Federal Register* (81 *FR* 17438). Based on the DWH Trustees' injury determination established in the PDARP/PEIS, the ROD sets forth the basis for the DWH Trustees' decision to select Alternative A: Comprehensive Integrated Ecosystem Alternative (DWH NRDA Trustees 2016c).

2.1.1 Relationship of this RP/EA to the PDARP/PEIS

As a programmatic restoration plan, the PDARP/PEIS provides direction and guidance for identifying, evaluating, and selecting future restoration projects to be carried out by the TIGs (Section 5.10.4 and Chapter 7 of the PDARP/PEIS). The results of PDARP/PEIS analysis indicates injuries caused by the oil spill cannot be fully described at the level of a single species, a single habitat type, or a single region. The DWH Trustees found that extensive injuries to multiple habitats, species, ecological functions, and geographic regions affected by the oil spill establish the need for comprehensive restoration planning on a landscape and ecosystem scale that recognizes and strengthens existing connectivity among habitats, resources, and natural resource services in the Gulf of Mexico.

The DWH Trustees considered this ecosystem context in deciding how best to restore for the vast array of resources and services injured by the oil spill. The PDARP/PEIS employed a comprehensive, integrated ecosystem approach to best address these ecosystem-level injuries, seeking synergies and building on previous and current planning efforts across Gulf restoration programs to maximize benefits to injured resources.

In the PDARP/PEIS, the DWH Trustees developed a set of Restoration Types for inclusion in programmatic alternatives, consistent with the desire to seek a diverse set of projects providing benefits to a broad array of injured resources and services. This process resulted in 13 Restoration Types in the five Programmatic Restoration goals (Table 2-1). The alternatives included in this RP/EA (see Table 1-2 in Section 1.7) are consistent with the restoration approaches described for the Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and MDBC Restoration Types, as described in Sections 5.5.6, 5.5.10, 5.5.11, and 5.5.13 respectively of the PDARP/PEIS.

Table 2-1: The Trustee programmatic restoration goals and associated Restoration Types identified in the PDARP/PEIS. Bold text indicates the Restoration Types in the Open Ocean addressed in this plan.

Trustee Programmatic Restoration Goals	Restoration Type
Restore and Conserve Habitat	Wetlands, Coastal, and Nearshore Habitats
	Habitat Projects on Federally Managed Lands
Restore Water Quality	Nutrient Reductions (nonpoint source)
	Water Quality
Replenish and Protect Living Coastal and Marine Resources	**Fish and Water Column Invertebrates**
	Sturgeon
	Submerged Aquatic Vegetation
	Oysters
	Sea Turtles
	Marine Mammals
	Birds
	Mesophotic and Deep Benthic Communities
Provide and Enhance Recreational Opportunities	Provide and Enhance Recreational Opportunities
Provide for Monitoring, Adaptive Management and Administrative Oversight	N/A

2.2 Summary of Injuries Addressed in this RP/EA

The DWH oil spill introduced numerous contaminants into the environment. Estimated releases included 3.19 million barrels of oil (~507 million liters), 7.7 billion standard cubic feet (218 billion liters) of natural gas discharged into the deep-sea, 1.84 million gallons (7.0 million liters) of chemical dispersants used in response to the spill, and an unknown volume (up to 30,000 barrels [4.8 million liters]) of synthetic-based drilling mud released during the blowout and response. Each of these contaminants introduced chemicals of known and unknown toxicity into the northern Gulf of Mexico. Natural weathering processes (e.g., photo-oxidation) and intentional burning of the floating oil at sea formed additional contaminants of known and unknown toxicity.

Chapter 4 of the PDARP/PEIS summarizes the injury assessment and documents the nature, degree, and extent of injuries from the incident to both natural resources and the services they provide. Restoration projects proposed in this RP/EA and in future Open Ocean TIG restoration plans are designed to address injuries in the Open Ocean Restoration Area resulting from the DWH oil spill.

The sections below summarize the injury assessment information from Chapter 4 of the PDARP/PEIS with specific reference to injuries to open ocean species and habitats that informed the selection of the restoration alternatives proposed in this plan.

2.2.1 Injury to Fish and Water Column Invertebrates

The DWH Trustees evaluated injuries to fish and water column invertebrates as part of the injury assessment (PDARP/PEIS, Section 4.4), which is incorporated by reference here. A vast quantity of water across the northern Gulf of Mexico was exposed to DWH oil. The surface slick alone covered a cumulative area of at least 43,300 square miles (112,000 square kilometers) across 113 days in 2010. The estimated average daily volume of contaminated water under surface oil slicks was approximately 75 billion cubic yards (57 billion cubic meters). As a comparison, this volume is approximately 40 times the average daily discharge of the Mississippi River at New Orleans, Louisiana.

Water column resources injured by the DWH oil spill include species from all levels in the food chain, from bacteria, to estuarine-dependent species, such as red drum, shrimp, and sea trout, to large predatory fish such as bluefin tuna that can migrate from the Gulf of Mexico into the Atlantic and as far as the Mediterranean Sea.

The Trustees estimate that 2 to 5 trillion larval fish and 37 to 68 trillion invertebrates were killed in the surface waters, and between 86 million and 26 billion fish larvae and between 10 million and 7 billion planktonic invertebrates were killed in deeper waters. The fish larvae killed include herring (menhaden and relatives), anchovies, snappers, and tunas and mackerels (French McCay et al. 2015). The larval loss likely translated into millions to billions of fish that would have reached a year old. Larval fish that were killed but would not have survived to age one were also a significant loss as they are a food source for larger predatory species such as reef fish and highly migratory species.

The Trustees determined that additional injuries occurred, but these were not quantified. Examples include adverse effects to fish physiology (e.g., impaired reproduction and reduced growth) and adverse effects to reef fish communities (e.g., reductions in abundance and changes in community composition). For example, species-specific data for red snapper indicated that injuries included growth reductions (Patterson 2015), shifts in diet (Tarnecki and Patterson 2015), and increased prevalence of tissue lesions (Murawski et al. 2014).

For highly migratory species, researchers estimated that the DWH oil spill overlapped 15-19 percent of high quality early life stage habitat for blackfin tuna during June and July 2010, 11-14 percent for mahi-mahi (dolphinfish), and 5-7 percent for sailfish (Rooker et al. 2013). Similarly, Muhling et al. (2012) reported that, on a weekly basis, up to 5 percent of bluefin tuna spawning habitat was likely impacted by the surface oil.

2.2.2 Injury to Sea Turtles

The DWH Trustees evaluated injuries to sea turtles as part of the injury assessment (PDARP/PEIS, Section 4.8), which is incorporated by reference here. The Trustees quantified injury resulting from the DWH oil spill to four of the five species of sea turtles that inhabit the Gulf of Mexico and were injured by the DWH oil spill (loggerhead, Kemp's ridley, green, and hawksbill). Leatherbacks were also determined to have been injured, but the injury could not be quantified. All these species are listed as threatened or endangered under the Endangered Species Act (ESA). They are long-lived, migrate widely, and use a variety of habitats across the Gulf of Mexico and beyond.

Sea turtles were injured by oil or response activities in open ocean, nearshore, and shoreline environments. The resulting mortalities spanned multiple species and life stages. The Trustees estimated that between 4,900 and up to 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hard-shelled sea turtles not identified to species) and between 55,000 and up to 160,000 small juvenile sea turtles (Kemp's ridleys, green turtles, loggerheads, hawksbills, and hard-shelled sea turtles not identified to species) were killed by the DWH oil spill.

Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and green turtles) were injured by response activities, and thousands more Kemp's ridley and loggerhead hatchlings were lost due to unrealized reproduction of adult sea turtles that were killed by the DWH oil spill.

2.2.3 Injury to Marine Mammals

The DWH Trustees evaluated injuries to marine mammals as part of the injury assessment (PDARP/PEIS, Section 4.9), which is incorporated by reference here. The diverse number of species and geographic range of marine mammals affected by the spill is unprecedented. All marine mammals are federally protected under the Marine Mammal Protection Act (MMPA) of 1972. Sperm whales, currently the only endangered cetacean species that inhabits the Gulf of Mexico, have additional protection under ESA. The DWH oil spill resulted in the contamination of prime marine mammal habitat in the nearshore and offshore waters of the northern Gulf of Mexico. After inhaling, ingesting, aspirating, and potentially absorbing oil components, animals suffered from physical damage and toxic effects to a variety of organs and tissues, including lung disease, adrenal disease, poor body condition, suppression of the immune system, and a suite of other adverse health effects.

Animals that succumbed to these adverse health effects contributed to the largest and longest marine mammal unusual mortality event (UME) on record in the northern Gulf of Mexico. The dead, stranded dolphins in the UME included near-term fetuses from failed pregnancies. Nearly all of the marine mammal stocks that overlap with the DWH oil spill footprint have demonstrable, quantifiable injuries. For example, of the shelf and oceanic marine mammal stocks for which the RP/EA is focused, Gulf of Mexico Bryde's whales were the most affected, with 17 percent excess mortality, 22 percent excess failed pregnancies, and an 18 percent higher likelihood of having adverse health effects (DWH MMIQT 2015).

2.2.4 Injury to Mesophotic and Deep Benthic Communities

The DWH Trustees evaluated injuries to MDBC resources as part of the injury assessment (PDARP/PEIS, Section 4.5 and 4.6), which is incorporated by reference here. MDBC include hard and soft ground habitats, as well as their associated fish and invertebrates. Rare corals, fish, crabs, and other small animals and microbes live in these habitats on the sea floor and are part of the foundation of life and food webs in the northern Gulf of Mexico.

The DWH Trustees documented a footprint of over 770 square miles (2,000 square kilometers) of injury to deep-sea benthic habitat surrounding the wellhead and extending up the continental slope (depths greater than 1000 feet [greater than 300 meters]), within zones of varying impact. In the three inner zones (approximately 386 square miles [1,000 square kilometers]), injuries included oil toxicity to organisms, smothering of organisms with drilling muds, reductions in the diversity of sediment-dwelling animals, and mortality and other health impacts to corals. Within the outermost zone (approximately 463 square miles [1,200 square kilometers]), the chemical quality of the seafloor habitat was adversely affected by contamination and the food chain was fouled. Outside of the zones noted above, significant losses to resident corals and fish occurred across an injury footprint encompassing just over 4 square miles (10 square kilometers) of mesophotic reef habitat on the continental shelf edge. An additional approximately 97 square miles (250 square kilometers) of area surrounding the high-relief reef habitat was identified as an area of additional potential exposure and injury to mesophotic reef resources. An even larger area, between 3,280 and 17,375 square miles (8,500–45,000 square kilometers), of potential exposure extends beyond and between the areas where the Trustees have quantified injury in mesophotic and deep benthic areas. Injuries to the deep-sea and mesophotic soft sediment benthic community were documented to numerous small invertebrates such as worms, crustaceans, and mollusks that dwell in or on the bottom sediments (referred to generally as infauna or epifauna depending on their location either in or on the sediment) and play an important role in the mesophotic and deep-sea food webs (Montagna et al. 2013).

While the full suite of ecosystem functions of the unique deep-sea corals are still only beginning to be understood, the three-dimensional structure provided by deep-sea coral habitats is associated with increased biodiversity (Buhl-Mortensen et al. 2010). Their long-lived, slow growing nature makes them important sentinels for natural and anthropogenic impacts that cannot be detected for many shorter-lived, mobile deep-sea species (Fisher et al. 2014a, 2014b). They also represent important reservoirs of biodiversity in the deep-sea (Buhl-Mortensen et al. 2010; Cordes et al. 2008).

The dominant structure-forming biota in the mesophotic (low-light) depth zone (~150-1,000 feet [50-300 meters]) are coral, sponge, and algal species. Mesophotic coral communities provide food, refuge, and reproductive opportunities for multiple species of fish and invertebrates, which are critical for successful fisheries. Corals may also play a unique role in the reproduction of some fish species (Sulak and Dixon 2015). The seafloor biota plays an essential role in overall productivity in the deep-sea, as organisms living in the seafloor bottom, infauna, consume detritus from the water column (Danovaro et al. 2008). In turn, larger benthic organisms higher in the food chain, such as red crabs, prey on the infauna (Danovaro et al. 2008). Changes in the abundances of individual species associated with spill-contaminated sediment were documented, and this shift in species composition resulted in a loss of species diversity (Demopoulos et al. 2016; Montagna et al. 2013).

2.3 Screening for Reasonable Range of Alternatives

In developing a reasonable range of alternatives suitable for addressing the injuries caused by the oil spill, the Open Ocean TIG reviewed the Trustee programmatic restoration goals and Restoration Type specific goals in the PDARP/PEIS. Consistent with Section 9.4.1.4 of the Trustee Council SOP, the Open Ocean TIG considered project ideas submitted by the public. The TIG screened project ideas based on factors in OPA regulations (15 CFR §990.54), the current and future availability of funds under the DWH NRDA settlement payment schedule, projects already funded or proposed to be funded by other DWH TIGs or other DWH restoration funding sources (e.g., NFWF GEBF and RESTORE Act), and projects already funded or proposed to be funded by other sources. Additional information about the screening process applied by the Open Ocean TIG to generate a reasonable range of alternatives for this RP/EA is described below.

2.3.1 Open Ocean TIG Screening Process

On March 31, 2017, the Open Ocean TIG began soliciting project ideas for the six Restoration Types included in the Open Ocean Restoration Area: Birds, Sturgeon, Sea Turtles, Marine Mammals, Fish and Water Column Invertebrates, and MDBC. The public notice soliciting project ideas provided priorities for each Restoration Type that were established by the Open Ocean TIG based on the injury assessment and restoration priorities outlined in the PDARP/PEIS[12].

As stated in the request for project ideas, the Open Ocean TIG is responsible for restoration for wide-ranging and migratory species at important points during their life cycles and geographic ranges, including inland, coastal, and offshore areas. Some open ocean species are highly migratory so some restoration outside of the Gulf of Mexico is anticipated.

The Open Ocean TIG reviewed the PDARP/PEIS Programmatic Trustee goals and developed a set of selection criteria for identifying project ideas to develop a reasonable range of alternatives for restoration in this RP/EA. The OPA regulations specify that Trustees consider a reasonable range of restoration alternatives before selecting preferred alternatives (15 CFR §990.53(a)(2)). The Open Ocean TIG has prioritized four Restoration Types described in the PDARP/PEIS for inclusion in this RP/EA: Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and MDBC.

The Open Ocean TIG reviewed more than 1,600 restoration project ideas[13] proposed by members of the public, NGOs, and state, federal, and local agencies using the screening process below (Table 2-2). Project review and screening were based on criteria to develop a reasonable range of alternatives for restoration in the Open Ocean Restoration Area. Details of each stage of screening are in subsequent sections.

2.3.1.1 Initial Screening

In the initial stage of screening, project ideas submitted to the DWH project portal by the requested deadline were sorted by the six Open Ocean Restoration Types identified in the request for project ideas (Birds, Sturgeon, Sea Turtles, Marine Mammals, Fish and Water Column Invertebrates, and MDBC). Projects were considered for more than one Restoration Type where appropriate. Project ideas were then reviewed and removed if they were already funded, were required to meet legal obligations, duplicated other project ideas, or if they did not provide sufficient information for evaluation.

2.3.1.2 Consistency with PDARP/PEIS

The DWH Trustees determined that the reasonable range of restoration alternatives and subsequent restoration plans and projects must be consistent with the Trustee programmatic restoration goals outlined in Section 5.3.1 of the PDARP/PEIS and with the Restoration Types goals described in Section 5.5, Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative).

Initially, the Open Ocean TIG screened project ideas based on the extent to which the project idea met the goals of one or more Restoration Types identified for the Open Ocean Restoration Area

[12] Full web-based announcement and description of priorities for the Open Ocean Restoration Types can be found here: http://www.gulfspillrestoration.noaa.gov/2017/03/open-ocean-trustee-implementation-group-welcomes-public-input-project-identification?

[13] All submitted project ideas that were reviewed can be found in the Administrative Record at http://www.doi.gov/deepwaterhorizon/adminrecord

(Birds, Sturgeon, Sea Turtles, Marine Mammals, Fish and Water Column Invertebrates, and MDBC). Project ideas needed to be consistent with at least one of these Restoration Types in order to be considered beyond this stage of the screening process. In addition, the Open Ocean TIG decided to proceed with restoration planning for two restoration plans.

Table 2-2: Overview of screening stages and criteria applied by the Open Ocean TIG for this RP/EA.

Stage of Screening	Criteria Considered
Initial Screening	Project idea was removed if it: • Had insufficient information for evaluation. • Was already required under local, state, or federal law. • Had already been fully funded. • Duplicated other project ideas.
Consistency with PDARP/PEIS	Project idea is consistent with one or more of the PDARP/PEIS Programmatic goals (Table 2-1) and Restoration Type goals (Table 2-3). In addition, the goals of the Restoration Types identified in this RP/EA were considered: Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and Mesophotic and Deep Benthic Communities.
Consistency with Strategic Frameworks	Project idea is consistent with the appropriate Strategic Frameworks for Sea Turtles and Marine Mammals.
Additional Open Ocean TIG criteria	Project ideas were evaluated against additional criteria determined by the Open Ocean TIG for Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, Mesophotic and Deep Benthic Communities: • Consistent with priorities identified in the public notice. • Meets the PDARP/PEIS goals with an innovative approach or technique. • Complies with applicable laws and regulations. • Supports existing long-term management objectives or species management plans.
OPA-based Criteria	Project ideas were screened using criteria based on the evaluation factors identified in OPA regulations (15 CFR §990.54(a)): • The cost to carry out the alternative. • The extent to which each alternative is expected to meet the Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses. • The likelihood of success of each alternative. • The extent to which each alternative would prevent future injury as a result of the incident and avoid collateral injury as a result of implementing the alternative. • The extent to which each alternative benefits more than one natural resource and/or service. • The effect of each alternative on public health and safety.

The first Open Ocean restoration plan focused on the Birds and Sturgeon Restoration Types. This RP/EA, the second Open Ocean restoration plan, focuses on four Restoration Types (i.e., Fish and Water Column Invertebrates, Sea Turtles, Marine Mammals, and MDBC). The sections below describe the screening process conducted for these four Restoration Types. Trustee goals for these Restoration Types are provided in the PDARP/PEIS and summarized in Table 2-3.

Table 2-3: Goals of each Restoration Type as found in the PDARP/PEIS.

Restoration Type	Restoration Goals
Fish and Water Column Invertebrates	• Restore injured fish and invertebrate species across the range of coastal and oceanic zones by reducing direct sources of mortality. • Increase the health of fisheries by providing fishing communities with methodologies and incentives to reduce impacts to fishery resources.
Sea Turtles	• Implement an integrated portfolio of restoration approaches to address all injured life stages (hatchling, juvenile, and adult) and species of sea turtles. • Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats. • Restore sea turtles in the various geographic and temporal areas within the Gulf of Mexico and Atlantic Ocean that are relevant to injured species and life stages. • Support existing conservation efforts by ensuring consistency with recovery plans and recovery goals for each of the sea turtle species.
Marine Mammals	• Implement an integrated portfolio of restoration approaches to restore injured bay, sound, estuary, coastal, shelf, and oceanic marine mammals across the diverse habitats and geographic ranges they occupy. • Identify and implement restoration activities that mitigate key stressors in order to support resilient populations. Collect and use monitoring information, such as population and health assessments and spatiotemporal distribution information. • Identify and implement actions that support ecological needs of the stocks; improve resilience to natural stressors; and address direct human-caused threats such as bycatch in commercial fisheries, vessel collisions, noise, industrial activities, illegal feeding and harassment, and hook-and-line fishery interactions.
Mesophotic and Deep Benthic Communities	• 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 mesophotic and deep-sea communities to protect against multiple threats and provide a framework for monitoring, education, and outreach. • Improve understanding of mesophotic and deep-sea communities to inform better management and ensure resiliency.

2.3.1.3 Consistency with Strategic Frameworks (Sea Turtles and Marine Mammals)

In June 2017, the DWH Trustees released the Strategic Framework for Sea Turtle Restoration Activities[14] and the Strategic Framework for Marine Mammal Restoration Activities[15]. These documents were produced as part of the DWH oil spill NRDA, and include four Modules: 1) Summary of information from the PDARP/PEIS, including an overview of the injury, restoration goals, restoration approaches and techniques, and monitoring considerations, 2) Biological and ecological information, including geographic distribution, life history, and key threats, 3) Overview of related activities, including recent and ongoing conservation, restoration, management, and monitoring activities related to sea turtles or marine mammals in the northern Gulf of Mexico, and 4)

[14] Sea Turtle Strategic Framework can be found here: http://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/Sea_Turtle_Strategic_Framework_6.23.17.pdf

[15] Marine Mammal Strategic Framework can be found here: http://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/Marine_Mammal_Strategic_Framework_06.23.17.pdf

Considerations for restoration, includes a comprehensive review of the Restoration Approaches and evaluation of potential restoration projects, activities and monitoring needs.

As part of this stage of the screening process, the Trustees considered whether sea turtle and marine mammal restoration project ideas were consistent with the restoration goals, approaches, and techniques identified in these documents. Project ideas needed to be consistent with the appropriate Strategic Framework in order to be considered beyond this stage of the screening process.

2.3.1.4 Consistency with Additional Open Ocean TIG Criteria

OPA allows the Trustees to develop additional criteria for the screening process to ensure identification of project alternatives that meet the goals of the Trustees to address injury. According to the Trustee Council's SOP, "TIGs will screen initial project ideas to hone in on potential projects and alternatives that will continue to be developed for consideration. Screening will adhere to project selection criteria consistent with OPA regulations, the PDARP/PEIS, and any additional evaluation criteria established by a TIG and identified in a restoration plan or public notice (DWH Trustees 2016b)." The Open Ocean TIG took into account several practical considerations that were useful in helping to screen the large number of potentially qualifying projects.

The following additional criteria were applied by the Open Ocean TIG:

- Project meets the PDARP/PEIS goals (Table 2-3) with an innovative approach or technique.
- Project is consistent with priorities identified in the public notice (Table 2-4).
- Project complies with applicable laws and regulations.
- Project supports existing long-term management objectives or species management plans (e.g. Fisheries Management Plan; Recovery Plans for ESA-listed species).

2.3.1.5 Consistency with OPA-based Criteria

Following the above screening steps, the Open Ocean TIG identified projects for which only a subset of activities should continue through screening based on the criteria described above. These activities were either developed into revised projects or combined with other project ideas and included in the next screening steps.

The Open Ocean TIG reviewed individual project ideas that made it through the previous screening stages using criteria based on the evaluation factors in OPA regulations (15 CFR §990.54(a)).

The criteria used include:

- The cost to carry out the alternative.
- The extent to which each alternative is expected to meet the goals and objectives of returning the injured natural resources and services to baseline and/or compensating for interim losses.
- The likelihood of success of each alternative.
- The extent to which each alternative would prevent future injury as a result of the incident and avoid collateral injury as a result of implementing the alternative.
- The extent to which each alternative benefits more than one natural resources and/or service.
- The effect of each alternative on public health and safety.

Table 2-4: The restoration priorities and geography/populations identified in the call for project ideas for the four Restoration Types in this RP/EA.

Restoration Type	Geography	Prioritized Restoration Approaches
Fish and Water Column Invertebrates	Populations: Reef fish (e.g., snappers, groupers), highly migratory species (HMS) other than sharks (e.g., tunas, billfish, swordfish), and coastal migratory pelagic species (e.g., mahi-mahi, cobia, mackerels)	• Reduce bycatch and bycatch mortality (e.g., through mechanisms such as quota banks, barotrauma mitigation tools, circle hook distributions, shrimp trawl bycatch reduction devices). • Monitoring and adaptive management activities to fill data gaps and information needs relevant to restoration, as well as outreach and education efforts.
Sea Turtles	Gulf of Mexico and northwest Atlantic waters	• Reduce sea turtle bycatch in commercial fisheries through development and implementation of conservation measures. • Enhance sea turtle hatchling production and restore and conserve nesting beach habitat. • Reduce sea turtle bycatch in recreational fisheries (specifically pier and shore-based) through development and implementation of conservation measures. • Monitoring and adaptive management activities to address relevant data gaps to inform restoration.
Marine Mammals	Stocks/populations: Continental shelf and oceanic stocks in the Gulf of Mexico	• Increase marine mammal survival through better understanding of causes of illness and death as well as early detection and intervention for anthropogenic and natural threats. • Measure noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals. • Reduce injury and mortality of marine mammals from vessel collisions. • Protect and conserve marine, coastal, estuarine, and riparian habitats. • Monitoring and adaptive management activities to address relevant data gaps to inform restoration.
Mesophotic and Deep Benthic Communities	Northern Gulf of Mexico	• Protect and manage MDBC. • Place hard ground substrate and transplant coral. • Monitoring and adaptive management activities to improve understanding of mesophotic and deep-sea communities to inform better management and ensure resiliency.

Common reasons project ideas were removed from consideration at this stage included (but were not limited to):

- The project would cause significant collateral damage or would cause future injury to natural resources.
- Similar projects or methodologies had been previously implemented with limited or no success.
- The project would result in significant negative effects on human health and safety or any ongoing or anticipated remedial actions.
- The anticipated benefits of project activities would take an unreasonable amount of time to come to fruition.

2.3.1.6 Additional Screening Considerations

In order to develop a reasonable range of alternatives, the Open Ocean TIG also considered the level of priority for implementation or to fill data gaps, the availability of funds over time for each Restoration Type, project readiness and potential challenges, opportunities to leverage proposed work, and the need to allocate funds for restoration across the various species and their geographic range to effectively address the injury. Consistent with the PDARP/PEIS, the Open Ocean TIG considered projects with different implementation approaches, including phasing, from what was originally proposed. Priority was placed on projects that had a high technical feasibility and that could result in the greatest restoration benefit in light of the available funding.

2.4 Summary of Screening Process

2.4.1 Fish and Water Column Invertebrates

There were 189 project ideas identified for the Fish and Water Column Invertebrates Restoration Type. This included projects for other Restoration Types that could provide benefits to meet the Fish and Water Column Invertebrates restoration goals. After screening for consistency with PDARP/PEIS Programmatic goals and Restoration Type specific goals, 134 project ideas remained. The Trustees then applied the additional TIG criteria to these project ideas resulting in 76 project ideas remaining for further screening. The 76 project ideas were then grouped by the categories below, which were developed based on the Fish and Water Column Invertebrates priorities identified in the call for project ideas for this RP/EA (Table 2-4):

- Activities to reduce post-release mortality of red snapper and other reef fishes in the Gulf of Mexico.
- Activities to reduce commercial red snapper or other reef fish discards.
- Activities to reduce mortality among highly migratory species and other oceanic fishes.
- Activities to incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship.
- Activities to reduce impacts of ghost fishing through gear conversion and/or removal of derelict fishing gear.
- Monitoring and adaptive management activities to fill data gaps and information needs relevant to restoration, as well as outreach and education efforts.

The Trustees then identified project ideas and activities that would best meet the Trustees' goals and priorities using OPA-based criteria (Table 2-2). This included combining some project ideas and selecting activities from across multiple project idea submissions. This resulted in nine project concepts:

- Reduction of post-release mortality from barotrauma in reef fish recreational fisheries.
- Reduction of fish bycatch in trawl fisheries by using better bycatch reduction devices.
- A demonstration project to reduce bluefin and sea turtle bycatch by increasing the set depth in the Gulf of Mexico pelagic longline fishery.
- Mapping species distributions and bycatch hotspots using a comprehensive survey database and geostatistical models.

- Removal of derelict gear and marine debris.
- Expansion and enhancement of the Gulf of Mexico recreational fishery monitoring.
- Enhanced observing capacity including use of electronic monitoring.
- Broad scale fish habitat mapping and monitoring of the northern Gulf of Mexico.
- Investigation of programmatic development of tagging programs.

These project concepts were further reviewed, and in some cases combined, to identify projects that were the highest priority for continued development and technical review. The projects concepts to support restoration monitoring were determined to need further planning to identify monitoring priorities for the Fish and Water Column Invertebrates Restoration Type and to identify opportunities to leverage existing monitoring programs. This resulted in the development of five Fish and Water Column Invertebrates Restoration Type projects which were further developed and ultimately identified by the Open Ocean TIG for inclusion in the reasonable range of alternatives for this RP/EA.

2.4.2 Sea Turtles

There were 134 project ideas identified for the Sea Turtles Restoration Type. This included projects for other Restoration Types that could provide benefits to meet restoration goals for Sea Turtles. After screening for consistency with PDARP/PEIS Programmatic goals and Restoration Type specific goals, and consistency with the Strategic Framework for Sea Turtle Restoration Activities, 65 project ideas remained for further screening. The 65 project ideas were then grouped by the categories below, which reflect the priorities for Sea Turtles identified in the call for project ideas for this RP/EA (Table 2-4), as well as the technique proposed and the sea turtle species that would benefit:

- Activities to reduce sea turtle bycatch in commercial fisheries through development and implementation of conservation measures.
- Activities to reduce sea turtle bycatch in recreational fisheries (specifically pier and shore-based) through development and implementation of conservation measures.
- Enhance sea turtle hatchling production and restore and conserve nesting beach habitat.
- Monitoring and adaptive management activities to address relevant data gaps to inform restoration.

The Trustees also considered the following factors to further prioritize project ideas:

- Does the project idea closely align with the purpose of the Open Ocean Restoration Area?
- Is the project idea highly time sensitive?
- Does the project propose to leverage with other (non DWH NRDA) funding sources or have matching funds available/in place?
- Does the project present a unique opportunity or a critical area to the population for an injured species?

The Trustees then identified project ideas and activities that would best meet the Trustees' goals and priorities using the OPA-based criteria (Table 2-2). This included combining some project ideas and selecting activities from across multiple project idea submissions. This resulted in 13 project concepts:

- Bottom longline commercial fishing bycatch reduction through a reduction in gear soak time.
- Development of an effective methodology to observe the Gulf of Mexico Menhaden Purse Seine Fishery for sea turtle interactions.
- Reducing sea turtle bycatch in the southeast otter trawl shrimp fishery through development of reduced bar spacing turtle excluder devices.
- Development of a Gulf of Mexico Sea Turtle Atlas.
- Developing a comprehensive regional plan for in-water sea turtle data collection.
- Shore-based and pier-based recreational fisheries bycatch reduction through the removal of marine debris.
- Investigating factors that may contribute to bycatch of sea turtles at fishing piers and exploring mechanisms to reduce that bycatch.
- Baseline surveys of vessel-based interactions of recreational fishing activities and sea turtles.
- Expansion and enhancement of the NOAA Fisheries Gear Monitoring Team in the southeast Atlantic.
- Improved understanding of Gulf of Mexico inshore shrimp fishery effort through the use of E-logbooks to inform bycatch reduction efforts.
- Less-than-fee beachfront acquisition strategies to protect and enhance sea turtle nesting habitat.
- Strategic land acquisition of nesting beach habitat for sea turtles at Archie Carr National Wildlife Refuge.
- Increasing survivorship of a globally-important leatherback nesting population in Central America that was directly impacted by the DWH oil spill.

These project concepts were further reviewed, and in some cases combined, to identify projects that were the highest priority for continued development and technical review. This resulted in the development of eight Sea Turtles Restoration Type projects which were further developed and ultimately identified by the Open Ocean TIG for inclusion in the reasonable range of alternatives for this RP/EA.

2.4.3 Marine Mammals

There were 112 project ideas identified for the Marine Mammals Restoration Type. This included projects for other Restoration Types that could provide benefits to meet the restoration goals for Marine Mammals. After screening for consistency with PDARP/PEIS Programmatic goals and Restoration Type specific goals, and consistency with the Strategic Framework for Marine Mammal Restoration Activities, 57 project ideas remained for further screening. The 57 project ideas were then grouped by the categories below, which reflect the priorities for Marine Mammals identified in the call for project ideas for this RP/EA (Table 2-4):

- Activities to reduce injury and mortality of marine mammals from vessel collisions.
- Activities to increase marine mammal survival through better understanding of causes of illness/death as well as early detection/intervention for anthropogenic and natural threats.
- Activities to measure noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals.

- Activities to protect and conserve marine, coastal, estuarine, and riparian habitats.
- Monitoring and adaptive management activities to address relevant data gaps and inform restoration.

The Trustees then identified project ideas and activities that would best meet the Trustees' goals and priorities using the OPA-based criteria (Table 2-2). This included combining some project ideas and selecting activities from across multiple project idea submissions. This resulted in 10 project concepts:

- Reduce and mitigate vessel strike mortality of marine mammals.
- Reduce impacts of anthropogenic noise on marine mammals.
- Develop an acoustic early detection network.
- Develop forensic techniques to establish baseline levels of threats.
- Establish appropriate response activities for disasters of all types, including mass strandings.
- Enhance data and other resources available to the Marine Mammal Health and Stranding Response Program network to respond to and learn from future marine mammal strandings.
- Enhance knowledge, monitoring, and health assessments of large whale species in offshore waters of the Gulf of Mexico.
- Assessment of northern Gulf of Mexico shelf small cetacean health, habitat use, and movement patterns.
- Model open-ocean marine mammal habitats to guide their protection and conservation.
- Assessing and modeling the impacts of anthropogenic stressors on injured cetacean populations using the population consequences of disturbance tool.

These project concepts were further reviewed, and in some cases combined, to identify projects that were the highest priority for continued development and technical review. This resulted in the development of five Marine Mammals Restoration Type projects which were further developed and ultimately identified by the Open Ocean TIG for inclusion in the reasonable range of alternatives for this RP/EA.

2.4.4 Mesophotic and Deep Benthic Communities

There were 102 project ideas identified for the MDBC Restoration Type. There were 54 project ideas that advanced through screening for consistency with PDARP/PEIS Programmatic goals and Restoration Type specific goals. The 54 project ideas were grouped by the categories below, which reflect the MDBC priorities identified in the call for project ideas for this RP/EA (Table 2-4):

- Activities to protect and manage MDBC.
- Activities to place hard ground substrate and transplant coral.
- Monitoring and adaptive management activities to improve understanding of MDBC to inform better management and ensure resiliency.

Within the category of activities to improve the understanding of MDBC, the Trustees also categorized project ideas by the type of priority data gaps potentially addressed using the following categories:

- Map and ground-truth distributions.
- Document threats, impacts, recovery, and recovery rates.

- Characterize community, document growth rates, aging, diversity, and abundances (define high density at different depths).
- Develop and validate predictive modeling (e.g., habitat suitability) capabilities.
- Characterize physical/oceanographic factors influencing recruitment, growth, and reproduction.
- Develop propagation methods and techniques.
- Characterize regional ecological and genetic connectivity.
- Develop socioeconomic impact analyses for proposed actions.
- Document effectiveness of protections and management.

The Trustees then identified project ideas and activities, many of which proposed similar activities that would best meet the Trustees' goals and priorities using the OPA-based criteria (Table 2-2). These seven project concepts were developed, in part, by combining separate project idea submissions and/or specific activities within a submission:

- Mapping and ground-truthing MDBC in the northern Gulf of Mexico.
- Predictive habitat modeling to inform mesophotic and deep coral restoration.
- Habitat assessment and evaluation of MDBC.
- Age dating and growth rates of deepwater and mesophotic corals to inform restoration planning.
- Use of population genetic methods to maximize effectiveness of mesophotic and deep coral community restoration and protection.
- Active management and protection of known MDBC in the northern Gulf of Mexico.
- Development of techniques to directly restore MDBC.

These project concepts were further reviewed and in some cases combined, to identify projects that were the highest priorities for continued development and technical review. This resulted in the development of five MDBC Restoration Type projects, which were fully developed and ultimately identified by the Open Ocean TIG for inclusion in the reasonable range of alternatives for this RP/EA.

2.5 Alternatives Not Considered for Further Evaluation in this RP/EA

The reasonable range of alternatives considered for this RP/EA were identified from project ideas that made it through the screening steps outlined above. Project ideas that were screened out are not considered further in this RP/EA. In some cases, project ideas screened favorably, but were eliminated for reasons such as: 1) needed further technical development, 2) did not align as closely with the initial priorities of the Open Ocean TIG, or 3) aligned more closely with the priorities of other DWH settlement restoration programs. Below are some examples of project concepts not considered for further evaluation in this RP/EA.

- Broadscale fish habitat mapping and monitoring: alternatives for this project concept were not considered further as a Fish and Water Column Invertebrates Restoration Type project because mapping activities were being evaluated for the MDBC Restoration Type that would provide important fish habitat information and inform future fish habitat mapping needs and requirements.

- Expanding and enhancing NOAA Fisheries Gear Monitoring Teams to the southeast Atlantic: alternatives for this project concept were not considered further for evaluation in this RP/EA because technical information is currently being gathered in a DWH Early Restoration project that would better inform implementation of these activities in the future.
- Improve understanding of Gulf of Mexico inshore shrimp fishery effort through use of E-Logbooks to inform bycatch reduction efforts: alternatives for this project concept were not considered further for evaluation in this RP/EA due to need for additional feasibility analysis and coordination with state fisheries management agencies required to increase the likelihood of success.
- Enhance knowledge, monitoring, and health assessments of large whale species in offshore waters of the Gulf of Mexico: alternatives for this project concept were not considered further for evaluation in this RP/EA because technical information is currently being gathered in a RESTORE Science Program project that would better inform implementation of these activities in the future.

Other projects needed further planning and technical development to ensure they would meet priorities for monitoring and adaptive management for the Open Ocean Restoration Area. For example, several resource monitoring, biological sampling, modeling, mapping, and species tagging projects were considered during the screening process. However, the Open Ocean TIG determined that due to the extensive monitoring needs, and the importance of evaluating opportunities to leverage existing monitoring programs, an evaluation of science and data needs to most effectively and efficiently restore injured resources should be completed prior to investing in these projects. The Open Ocean TIG initiated this process based on the Monitoring and Adaptive Management goal in the PDARP/PEIS and by incorporating the related project ideas considered during the screening process for this RP/EA.

Project ideas not included in the reasonable range of alternatives for this RP/EA may be evaluated and potentially selected in a future restoration plan.

2.6 Reasonable Range of Restoration Alternatives Considered

Based on the process described above, the Open Ocean TIG developed a reasonable range of alternatives for further consideration and evaluation. Alternatives include three categories of proposed activities: 1) Preliminary phase restoration, 2) Long-range activities, and 3) Projects proposed for full implementation. As discussed in Chapter 6 of the PDARP/PEIS, a TIG may propose funding a planning phase (e.g., initial engineering and design) in one plan for a conceptual project, or for studies needed to maximize restoration planning efforts. This would allow the TIG to develop needed information leading to sufficient project development to conduct a more detailed analysis in a subsequent restoration plan, or for use in the restoration planning process.

In this RP/EA, a number of planning phase projects were evaluated under OPA and are proposed primarily for restoration efforts that require additional planning and data collation. Alternatives also include projects that have been developed as long-range actions structured to include a full lifecycle of activities such as initial project design and assessment, tool design, and tool testing through long-term site-specific project implementation. For these projects OPA and NEPA evaluation are addressed in this restoration plan through a programmatic lens.

Alternatives also include projects for full implementation. Full implementation is defined as alternatives that are fully evaluated under OPA in Chapter 3 and NEPA in Section 4.4. These projects describe in detail all actions necessary to fully implement the project and are likewise fully evaluated for environmental compliance in this RP/EA.

Summaries of each restoration project considered in this RP/EA are in the subsections below by Restoration Type. OPA and NEPA evaluations of these projects are provided in Chapters 3 and 4 of this document, respectively.

2.6.1 Fish and Water Column Invertebrates

The Open Ocean TIG screened potential Fish and Water Column Invertebrates restoration alternatives resulting in the identification of five projects (Table 2-5).

Table 2-5: Fish and Water Column Invertebrates projects included in the reasonable range of alternatives.

Reasonable Range of Alternatives	Implementation Approach	Estimated Project Cost
Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries	Full implementation	$30,011,000
Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery	Full implementation	$17,171,000
Communication Networks and Mapping Tools to Reduce Bycatch – Phase 1	Preliminary phase restoration	$4,416,000
Restoring for Bluefin Tuna via Fishing Depth Optimization	Full implementation	$6,175,000
Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats	Full implementation	$6,128,000

Implementation of these projects would contribute to the following Fish and Water Column Invertebrates restoration goals from the PDARP/PEIS (Section 5.5.6):

- Restore injured fish and invertebrate species across the range of coastal and oceanic zones by reducing direct sources of mortality.
- Increase the health of fisheries by providing fishing communities with methodologies and incentives to reduce impacts to fishery resources.

The projects selected for inclusion in the reasonable range of alternatives propose activities related to the following restoration approaches identified in PDARP/PEIS:

- Reduce post-release mortality of red snapper and other reef fishes in the Gulf of Mexico recreational fishery using fish descender devices.
- Voluntary fisheries-related actions to increase fish biomass.
- Incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship.
- Reduce mortality among highly migratory species and other oceanic fishes.
- Reduce impacts of ghost fishing through gear conversion and/or removal of derelict fishing gear to reduce impacts of ghost fishing.

2.6.1.1 Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries

Barotrauma occurs when fish are rapidly brought to the surface from deep water and gases in the fish's tissues and organs expand and in some cases rupture. When fish suffering from barotrauma are released they can struggle to descend back into the water column to deeper depths, becoming easy prey to predators. Barotrauma can cause other physiological effects such as bulging eyes. Injuries due to barotrauma can result in mortality. This project would restore recreationally important reef fish populations by reducing mortality from barotrauma. To reduce barotrauma-related mortality rates in recreational fisheries, this project would promote the use of fish descender devices (FDDs) and other tools, targeting reef species such as red snapper, red grouper, vermillion snapper, and gag grouper. This project would focus on the development of best practices for FDDs through the distribution of FDDs and providing information on their use to recreational anglers. Surveys on attitude changes, use, and effectiveness of FDDs would be conducted to track project success. Supplying fishermen with the tools and knowledge to minimize barotrauma-related mortality would result in increased survival of fish released during recreational fishing activities. The project would be adaptively managed throughout its seven-year timeframe and is estimated to cost $30,011,000.

2.6.1.2 Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery

The Gulf of Mexico shrimp fishery is a trawl-based fishery for brown, white, and pink shrimp. However, shrimp trawls are a less selective fishing gear and can result in high catch of non-targeted species, or bycatch, of commercially, recreationally, and ecologically important species. This project would restore fish through voluntary programs to reduce finfish bycatch in the commercial shrimp trawl fishery. This project proposes to identify and partner with fishermen to implement better bycatch reduction devices (BRDs), with a focus on reducing finfish bycatch. Project activities would include identifying innovative BRDs, validation of BRD effectiveness, outreach workshops, and dockside trainings. Reducing bycatch of finfish would increase overall fishery health for commercially and recreationally important species. This project would be adaptively managed throughout its seven-year timeframe and is estimated to cost $17,171,000.

2.6.1.3 Communication Networks and Mapping Tools to Reduce Bycatch—Phase 1

Bycatch can have substantial biological and economic impacts and prevent or delay the recovery of species injured during the spill. This project would reduce bycatch in the Atlantic and Gulf of Mexico by developing a bycatch hotspot identification system and communication network to avoid bycatch. This phased project would develop a system to create near-real time, spatial maps of bycatch hotspots coupled with a communication tool to inform fishermen of the high bycatch potential in those areas. This initial phase would include activities such as, conducting scoping workshops to identify fisheries, regions, and ports that would benefit from a bycatch identification system, the development of maps to identify areas of potentially high bycatch, and a workshop to discuss the issues surrounding a voluntary communication network to avoid bycatch. This project would be adaptively managed throughout its five-year timeframe and is estimated to cost $4,416,000.

2.6.1.4 Restoring for Bluefin Tuna via Fishing Depth Optimization

Atlantic bluefin tuna can be caught as bycatch in the pelagic longline (PLL) fishery that targets yellowfin tuna and swordfish. Data collected from recent studies suggest that increasing the PLL fishing depth may reduce bycatch of bluefin tuna. This project would restore Western Atlantic bluefin tuna by identifying and sharing fishing practices that reduce bycatch in the PLL fishery. This project would involve conducting a pilot study to better define an optimal PLL fishing depth to reduce bluefin tuna bycatch. Results from the pilot study would be shared with the PLL fishery. Anticipated benefits of identifying optimal depths in the PLL fishery include positive economic benefits to fishermen from increased target catch per unit effort (CPUE) and positive benefits to bluefin tuna stocks and possibly other bycatch species by reducing fishing mortality. The project would be adaptively managed throughout its ten-year timeframe and is estimated to cost $6,175,000.

2.6.1.5 Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats

Ghost fishing occurs when organisms become trapped or entangled in lost or discarded fishing gear that is no longer under a fisherman's control. Examples of derelict gear include gill nets, longlines, and crab traps. This project would reduce the amount of bycatch and mortality associated with derelict fishing gear across the Gulf of Mexico. Derelict blue crab traps are a useful focus for removal activities because they are present in high numbers, are easy to find, and can result in the bycatch and mortality of a large number of fish and invertebrate species. This project proposes to survey locations for high densities of derelict fishing gear, such as blue crab traps, and implement volunteer removal programs in these locations. The project would be adaptively managed throughout its five-year timeframe and is estimated to cost $6,128,000.

2.6.2 Sea Turtles

The Open Ocean TIG screened potential Sea Turtle restoration alternatives resulting in the identification of eight projects (Table 2-6). These eight projects are described below.

Table 2-6: Sea Turtles projects included in the reasonable range of alternatives.

Reasonable Range of Alternatives	Implementation Approach	Estimated Project Cost
Gulf of Mexico Sea Turtle Atlas	Preliminary phase restoration	$5,700,000
Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery	Preliminary phase restoration	$290,000
Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection	Preliminary phase restoration	$655,000
Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery	Full implementation	$3,000,000
Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices	Full implementation	$2,153,000
Long-term Nesting Beach Habitat Protection for Sea Turtles	Full implementation	$7,000,000
Reducing Sea Turtle Entanglement from Recreational Fishing Debris	Full implementation	$1,113,600
Reducing Sea Turtle Bycatch at Recreational Fishing Sites	Preliminary phase restoration	$1,329,000

Implementation of these projects would contribute to the following restoration goals for Sea Turtles from the PDARP/PEIS (Section 5.5.10):

- Implement an integrated portfolio of restoration approaches to address all injured life stages (hatchling, juvenile, and adult) and species of sea turtles.
- Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats.
- Restore sea turtles in the various geographic and temporal areas within the Gulf of Mexico and Atlantic Ocean that are relevant to injured species and life stages.
- Support existing conservation efforts by ensuring consistency with recovery plans and recovery goals for each of the sea turtle species.

The projects selected for inclusion in the reasonable range of alternatives propose activities related to the following restoration approaches and data needs identified in PDARP/PEIS:

- Reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures.
- Reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures.
- Enhance sea turtle hatchling productivity and restore and conserve nesting beach habitat.
- Monitoring and adaptive management activities to address relevant data gaps to inform restoration.

2.6.2.1 Gulf of Mexico Sea Turtle Atlas

During the response and assessment phase of the DWH oil spill, gaps were identified in available information on sea turtle distributions, important habitats, and other factors to understand restoration requirements within the northern Gulf of Mexico. This project would develop a central platform to access and view existing and future sea turtle data that are currently dispersed across various agencies, such as species distributions, habitats, populations, threats, etc. It would provide a public, web-based interface that is available to stakeholders, restoration planners, and restoration managers to inform restoration planning and facilitate prioritization of restoration needs and activities. This would be accomplished by supporting a collaborative community of data providers and efficient means to share data. The project would be adaptively managed over a 15-year timeframe to ensure accessibility and effectiveness as the dataset expands. The estimated cost for this project is $5,700,000.

2.6.2.2 Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery

Sea turtle bycatch in the Gulf of Mexico reef fish bottom longline (BLL) fishery has been documented by NOAA’s Observer Program since 2005. Interactions between sea turtles and longlines can occur with sea turtles either feeding directly on bait or becoming entangled in the line, causing serious injuries and mortality. This project would work to identify the factors contributing to sea turtle bycatch and identify opportunities for conservation measures through future restoration actions. A fisheries observer program has been established in the reef fish BLL fishery since 2005, and the resulting data would be thoroughly analyzed and compared to other existing data sets to identify environmental factors and fishing practices that are associated with sea turtle bycatch. This project would inform future restoration to reduce bycatch in this fishery. The project would be adaptively managed over its two-year timeframe and is estimated to cost $290,000.

2.6.2.3 Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection

This project would develop a comprehensive plan for coordinated in-water data collection efforts across the Gulf and would establish standardized monitoring protocols. Assessing the status of sea turtle populations across broad areas and multiple life stages is difficult. Aerial surveys are used to count turtles at the ocean surface, but they cannot detect small turtles and they do not provide information such as size, sex, or genetic identity. As a result, data gaps exist regarding sea turtle distribution, abundance, and survival rates. This project would develop a statistically sound plan for a coordinated, Gulf-wide network for the in-water collection and compilation of critical sea turtle abundance, demographic, and biological information on all sizes and life stages of sea turtles. This project focuses on development of a systematic approach to in-water collection of sea turtle data. It would involve convening experts to develop a standardized data collection strategy, identify data collection protocols that would be used, coordinate between various stakeholders, and develop an adaptive management strategy. The project would be adaptively managed throughout its two-year timeframe and is estimated to cost $655,000.

2.6.2.4 Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery

Fisheries observers help to characterize bycatch by observing where, when, and how many protected species become hooked, entangled, or entrapped in fishing gear so that bycatch reduction measures can be developed. Observers are professionally trained biological scientists gathering first-hand data used to inform fisheries management. Once bycatch reduction measures are implemented, observers also help to monitor their success. The menhaden purse seine fishery currently lacks an effective observer methodology to assess its interaction with sea turtles. This project would work with the Gulf of Mexico menhaden industry to develop an effective methodology for monitoring sea turtle bycatch in the fishery. Through proof-of-concept testing, the project would identify the most viable means of sea turtle detection from aboard commercial menhaden vessels. A pilot observer project would then be implemented to evaluate the conceptual methods during commercial fishery operations in order to determine the most effective way to observe the fishery. The project would fill knowledge gaps to inform future restoration to reduce bycatch in this fishery. The project would be adaptively managed throughout its four-year timeframe and is estimated to cost $3,000,000.

2.6.2.5 Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices

Sea turtle mortality in the shrimp trawl fishery has been greatly reduced with use of turtle excluder devices (TEDs). A TED is a metal grid that fits into the cod end of the trawl, with a top or bottom escape opening covered with a flap. Sea turtles encounter the TED grid when they pass through the trawl net and are able to escape through the adjacent opening. Small animals, such as shrimp, pass through the bars of the TED and are caught in the cod end of the net. Otter trawls are federally required to use TEDs to reduce bycatch of sea turtles, however current TED configurations are less successful in excluding juvenile sea turtles. Unfortunately, small juvenile turtles, due to their size, can still pass through the bars or may become trapped and unable to escape through the flap opening. This project would develop new TED prototype configurations, with smaller-bar spacing, for otter trawls that would be evaluated and certified via the National Marine Fisheries Service (NMFS) small sea turtle TED testing protocol. Results of sea turtle evaluations would provide a measure of the sea turtle restoration potential of each new TED prototype. New TED prototypes would then be evaluated for target catch shrimp retention on commercial fishing grounds. Collectively, these results would inform future restoration projects that may seek to implement new bycatch reduction technology through incentive programs. The project would be adaptively managed throughout its four-year timeframe and is estimated to cost $2,153,000.

2.6.2.6 Long-term Nesting Beach Habitat Protection for Sea Turtles

Sea turtles face a variety of threats during nesting periods of their lifecycle. Females and their hatchlings can be impacted by artificial lighting, coastal armoring, or habitat loss altogether. This project would protect valuable, high-density sea turtle nesting habitat through acquisition of nesting habitat near the Archie Carr National Wildlife Refuge (ACNWR) on the Florida Atlantic coast. The female adult sea turtles that nest on these beaches and resulting hatchlings utilize the Gulf of Mexico. Through acquisition of land from willing sellers, the project would seek to protect approximately 20 miles (32 kilometers) of essential nesting habitat in perpetuity; reduce future land-based threats from development; and enhance sea turtle hatchling productivity. The project would be adaptively managed throughout the three-year timeframe and is estimated to cost up to $7,000,000.

2.6.2.7 Reducing Sea Turtle Entanglement from Recreational Fishing Debris

Discarded or lost recreational fishing gear, such as monofilament line or cast net material, is a common form of marine debris. Such marine debris are especially problematic for sea turtles who can ingest the materials or become entangled in the discarded line. The project would focus on removal of recreational fishing-based marine debris from selected hot spot areas, such as around popular fishing piers or artificial reefs, as well as prevention. Prevention would be accomplished through public outreach and education to the recreational fishery sector, and coordination of efforts to keep debris out of the water. The project would address threats stemming from recreational fishing and reduce injury as a result of sea turtle interactions with discarded gear. The project would be adaptively managed throughout its five-year timeframe and is estimated to cost $1,113,600.

2.6.2.8 Reducing Sea Turtle Bycatch at Recreational Fishing Sites

Unintentional capture during hook and line fishing can lead to sea turtle injury or death though gear ingestion or entanglement. This project would implement a Gulf-wide survey effort to collect data on recreational fishing practices and sea turtle interactions at various shore-based recreational fishing sites. The project would then evaluate the data collected to identify co-factors contributing to sea turtle interactions with the recreational hook and line fishery. If factors are identified that can be modified, such as fishing practices, the project would then engage with the public through outreach and education, to promote voluntary changes to fishing practices to reduce sea turtle captures. This project would fill knowledge gaps, address threats to several sea turtle species, and support existing conservation efforts to reduce recreational fishing bycatch and restore sea turtle populations. The project would be adaptively managed throughout its five-year timeframe and is estimated to cost $1,329,000.

2.6.3 Marine Mammals

The Open Ocean TIG screened potential Marine Mammals restoration alternatives resulting in the identification of five projects (Table 2-7). These five projects are described below.

Table 2-7: Marine Mammals projects included in the reasonable range of alternatives.

Reasonable Range of Alternatives	Implementation Approach	Estimated Project Cost
Reducing Impacts to Cetaceans during Disasters by Improving Response Activities	Long-range activities	$4,287,000
Compilation of Environmental, Threats, and Animal Data for Cetacean Population Health Analyses (CETACEAN)	Preliminary phase restoration	$5,808,500
Reduce Impacts of Anthropogenic Noise on Cetaceans	Long-range activities	$8,992,200
Reduce and Mitigate Vessel Strike Mortality of Cetaceans	Long-range activities	$3,834,000
Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns	Full implementation	$4,620,000

Implementation of these projects would contribute to the following restoration goals for Marine Mammals from the PDARP/PEIS (Section 5.5.11):

- Implement an integrated portfolio of restoration approaches to restore injured bay, sound, and estuary; coastal; shelf; and oceanic marine mammals across the diverse habitats and geographic ranges they occupy.
- Identify and implement restoration activities that mitigate key stressors in order to support resilient populations. Collect and use monitoring information, such as population and health assessments and spatiotemporal distribution information.
- Identify and implement actions that support ecological needs of the stocks; improve resilience to natural stressors; and address direct human-caused threats such as bycatch in commercial fisheries, vessel collisions, noise, industrial activities, illegal feeding and harassment, and hook-and-line fishery interactions.

The projects selected for inclusion in the reasonable range of alternatives propose activities related to the following restoration approaches and data needs identified in the PDARP/PEIS:

- Reduce injury and mortality of marine mammals from vessel collisions.
- Increase marine mammal survival through better understanding of the causes of illness and death as well as early detection and intervention for anthropogenic and natural threats.
- Measure noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals.
- Monitoring and adaptive management activities to address relevant data gaps to inform restoration.

2.6.3.1 Reducing Impacts to Cetaceans during Disasters by Improving Response Activities

NOAA Fisheries authorizes organizations and their volunteers, under the MMPA, to respond to marine mammal strandings. The Southeast Region Stranding Network consists of these authorized organizations, and includes trained responders and veterinarians who respond to and rehabilitate live stranded marine mammals and investigate dead stranded marine mammals. NOAA Fisheries and the Stranding Network coordinate responses to stranding events, monitor stranding rates, monitor human-caused mortalities, maintain a stranding database, and conduct investigations to determine the cause of stranding events (single and mass strandings) and UME. One of the more direct opportunities to benefit cetaceans is through improvement and enhancement of response and assessment activities during those times when large numbers of animals are threatened by anthropogenic and natural disasters in the Gulf of Mexico. Specific enhancement activities proposed by this project would include conducting a Gulf-wide gap analysis and risk assessment of disaster response capacity. Activities would also include improving planning and protocol development for disaster response and investigation, and developing new tools and techniques to minimize or reduce injury and mortality. Overall, restoration goals would be met by the implementation of disaster response and preparedness measures that would improve the survival and health outcomes of cetacean populations in the Gulf of Mexico. The project would be adaptively managed throughout its 10-year timeframe and is estimated to cost $4,287,000.

2.6.3.2 Compilation of Environmental, Threats, and Animal Data for Cetacean Population Health Analyses (CETACEAN)

Current information on cetaceans of the Gulf of Mexico is collected by a variety of organizations and is stored using different databases. To coordinate critical data for restoration, this project proposes to develop a platform that would provide user-friendly, web-based access to datasets that would assist the Trustees, restoration planners, responders, and conservation managers in the restoration and protection of marine mammals. It would also develop protocols to better integrate data collected across multiple partners. Technical experts would identify key datasets, parameters, analyses, and partners for the project. The CETACEAN platform would be released over the first three years of the project and include training to inform users and data collectors of standardized data collection protocols. The CETACEAN platform would support restoration planning, prioritization, and implementation by making key data available to decision makers in a centralized platform. This project would be adaptively managed throughout the five-year timeframe and is estimated to cost $5,808,500.

2.6.3.3 Reduce Impacts of Anthropogenic Noise on Cetaceans

The acoustic environment in the Gulf of Mexico includes a spectrum of noise sources, including a variety of human-made sounds from, for example, seismic airguns, explosives, pile driving, and propeller noise. Cetaceans rely on sound for vital life functions and increased anthropogenic noise levels may mask important biological sounds, disturb or displace vital behaviors, and cause direct physiological harm. Many strategies and technologies for reducing noise impacts to cetaceans have been developed; however, further development and effective implementation are still needed. This project would leverage existing recommendations and studies to identify activities to reduce noise levels in the Gulf of Mexico; convene experts to learn more about the status of new technologies and identify mechanisms for applying new and existing techniques in the Gulf of Mexico; and work with groups to identify partnership opportunities to advance noise reducing technologies for testing and implementation. A noise risk assessment would be conducted to identify the highest risk areas in the northern Gulf of Mexico where restoration actions could most effectively prevent or reduce the negative effects of anthropogenic noise on cetaceans. In addition, the project would use passive acoustic monitoring (PAM) arrays to continue baseline data collection to inform restoration and monitor noise reduction outcomes. This project would be adaptively managed throughout the six-year timeframe and is estimated to cost $8,992,200.

2.6.3.4 Reduce and Mitigate Vessel Strike Mortality of Cetaceans

Vessel collisions are one of the main anthropogenic sources of mortality for large whales around the world and are a threat to cetaceans in the Gulf of Mexico, particularly to large whales such as Gulf of Mexico Bryde's whales. While there are a number of potential actions to reduce the risk of whale-vessel interactions, there is insufficient information to implement one set of measures across the Gulf of Mexico and to know what measures would be most effective. In order to appropriately focus vessel strike risk reduction activities, this proposed project would first conduct analyses to identify locations of highest volume vessel activity in the Gulf, consolidate data for characterizing offshore cetacean distribution, and then combine vessel and cetacean data to identify areas of relative concern for collision risk. Once the project establishes and prioritizes high-risk areas, the project would identify and develop partnerships, cultivate buy-in from other stakeholders, and implement the most effective and efficient activities to reduce and mitigate vessel strike mortality for each high-risk area. By implementing measures to reduce vessel strikes on cetaceans in prioritized restoration areas, this project would increase survival of individuals and populations for injured species such as the Gulf of Mexico Bryde's whale. This project would be adaptively managed throughout the four-year timeframe and is estimated to cost $3,834,000.

2.6.3.5 Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns

Little is known about the health, habitat use, and movement patterns of small cetaceans that reside in coastal, continental shelf, and open oceans waters of the northern Gulf of Mexico. This project would collect and analyze health data to understand current and emerging stressors (e.g. disease, injuries) and to develop a better understanding of habitat use and movement patterns necessary for designing effective restoration strategies. Health assessments and satellite tagging, where possible, would be conducted on 60-90 dolphins over a three-year period. These activities are useful tools in identifying the impact and geographic scope of stressors on marine mammals and provide invaluable data on their habitat use and movement patterns. Furthermore, health assessment data would help to identify potential disease issues and associated risk factors and establish current population health baselines for these marine mammal species. This project would be adaptively managed throughout the five-year timeframe and is estimated to cost $4,620,000.

2.6.4 Mesophotic and Deep Benthic Communities

The Open Ocean TIG screened potential MDBC restoration alternatives resulting in the identification of five projects (Table 2-8). These five projects are described below.

Table 2-8: Mesophotic and Deep Benthic Communities projects included in the reasonable range.

Reasonable Range of Alternatives	Implementation Approach	Estimated Project Cost
Mapping, Ground-Truthing, and Predictive Habitat Modeling	Long-range activities	$35,909,000
Habitat Assessment and Evaluation	Long-range activities	$52,639,000
Coral Propagation Technique Development	Long-range activities	$16,951,000
Active Management and Protection	Long-range activities	$20,689,000
Habitat Characterization at Known High Priority Sites	Long-range activities	$21,500,000

Implementation of these projects would contribute to the following restoration goals for MDBC from the PDARP/PEIS (Section 5.5.13):

- 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.

The projects selected for inclusion in the reasonable range of alternatives propose activities related to the following restoration approaches and the robust resource-level monitoring and adaptive management to address critical uncertainties as identified in PDARP/PEIS:

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

2.6.4.1 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 and to evaluations of DWH injuries and recovery. This proposed 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 species-specific data on depth ranges, densities, and distributions of specific coral species. The data collected in this project would provide fundamental information to prioritize and support MDBC protection and management activities and to identify potential locations for direct restoration activities. This project would be adaptively managed throughout its seven- to eight-year timeframe and is estimated to cost $35,909,000.

2.6.4.2 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 support and inform restoration planning and implementation for MDBC through strategically designed field surveys, with subsequent laboratory-based analyses of MDBC components and interactions. The surveys would yield the types of samples that support 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) following the DWH spill. This project would be adaptively managed throughout its seven to eight-year timeframe and is estimated to cost $52,639,000.

2.6.4.3 Coral Propagation Technique Development

The most direct approach to restoring MDBC is to facilitate the growth of new corals. As described in the PDARP/PEIS, the creation of interim habitat and active transplantation of corals would help to accelerate an otherwise protracted natural recovery due to the slow natural growth rate and low recruitment of mesophotic and deep benthic corals. The objective of this pilot scale 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 substrates as potential coral colonization substrates and to test a variety of coral transplant techniques. Although some preliminary testing of substrates in laboratory settings may be necessary, this project would primarily test substrates and techniques *in situ* (in the natural location), in mesophotic and deep-water coral habitats. Additional lab work would be conducted to develop coral cultivation techniques. Development of these methods and techniques would ultimately be applied at scales necessary for effective enhancement of coral recruitment and growth. This project would be adaptively managed throughout its seven to eight-year timeframe and is estimated to cost $16,951,000.

2.6.4.4 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 development of 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 MDBC 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. This project would be adaptively managed throughout its seven to eight-year timeframe and is estimated to cost $20,689,000.

2.6.4.5 Habitat Characterization at Known High Priority Sites

Many significant MDBC sites are currently known across the northern Gulf of Mexico but are not adequately characterized. This habitat characterization project entails performing small-scale and short duration (three years), yet comprehensive and detailed site characterizations including high resolution mapping, ground-truthing, biological inventory, predictive habitat modeling, and habitat assessment. This work would be performed at sites containing known high-priority MDBC in the northern Gulf of Mexico, including sites currently designated as protected or under consideration for protected area designation. The outcomes of this characterization would facilitate, support, and evaluate performance of management, protection, and restoration activities (e.g., substrate placement, coral propagation). A full suite of available technologies for geological and biological sampling, acoustic mapping, robotic visual surveys, ground-truthing, predictive habitat suitability modeling, and quantitative habitat assessment and evaluation would be utilized to achieve the project goals. This project would be adaptively managed throughout its three-year timeframe and is estimated to cost $21,500,000.

Chapter 3: OPA Evaluation of Alternatives

This chapter provides project information and OPA analysis of the proposed alternatives (Section 2.6). To avoid redundancy, a summary of the evaluation standards (Section 3.1), overview of monitoring requirements (Section 3.2), description of estimated project costs (Section 3.3), and best management practices (Section 3.4) are provided at the beginning of the Chapter. These sections are followed by the alternative-specific restoration project section which begin with a general description of the project and relevant background information followed by a discussion of the project's consistency with OPA evaluation standards. This analysis is organized by Restoration Type: Fish and Water Column Invertebrates (hereafter referred to as Fish); Sea Turtles; Marine Mammals; and MDBC. The last section provides summary and conclusions of the OPA evaluation of all alternatives.

3.1 Summary of OPA Evaluation Standards

Under the OPA NRDA regulations, Trustees are to consider a reasonable range of restoration alternatives (15 CFR §990.53(a)(2)) before selecting their preferred alternative(s) in accordance with the OPA evaluation standards (15 CFR §990.54). Chapter 2 describes the screening and identification of a reasonable range of alternatives. Chapter 3 describes the Trustees' evaluation of the reasonable range of alternatives to identify preferred restoration alternatives based on, at a minimum, the following factors found in 15 CFR 990.54(a):

- The cost to carry out the alternative.
- The extent to which each alternative is expected to meet the Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses.
- The likelihood of success of each alternative.
- The extent to which each alternative would prevent future injury as a result of the incident, and avoid collateral injury as a result of implementing the alternative[16].
- The extent to which each alternative would benefit one or more natural resource and/or service.
- The effect of each alternative on public health and safety.

If the Trustees conclude that two or more alternatives are equally preferable, the most cost-effective alternative is to be chosen (15 CFR §990.54(b)).

3.2 Monitoring Requirements

When developing a draft restoration plan, NRDA Trustees establish restoration objectives that are specific to the natural resources that were injured (15 CFR §990.55(b)(2)). These objectives should clearly specify the desired project outcome and the performance criteria by which successful restoration under OPA will be determined (15 CFR §990.55(b)(2)). The monitoring component of a restoration plan is further described in 15 CFR §990.55(b)(3).

[16] None of the alternatives considered in this RP/EA prevent future injuries from the DWH oil spill. For the OPA analysis, the Open Ocean TIG's analysis focuses on whether the restoration alternative has the potential to cause direct or indirect collateral environmental injuries. For non-planning/data collection projects, these considerations are covered in detail in the "Environmental Consequences" sections of this RP/EA (Chapter 4).

The DWH Trustee's identified monitoring, adaptive management, and administrative oversight as one of the programmatic restoration goals in the PDARP/PEIS. As described in Chapter 5, Appendix E of the PDARP/PEIS, the Trustee Council committed to a NRDA MAM Framework to support restoration activities. The MAM Framework ensures best available science is incorporated into project planning and design, identifying and reducing key uncertainties, tracking and evaluating progress toward restoration goals, determining the need for adaptive management and corrective actions, and supporting compliance monitoring. The DWH NRDA MAM Framework provides a flexible, science-based approach to effectively and efficiently implement restoration over several decades that provides long-term benefits to the resources and services injured by the DWH oil spill.

Project MAM plans identify the monitoring needed to evaluate progress toward meeting project-specific restoration objectives and to support corrective action and adaptive management of the restoration project where applicable. The plans are consistent with the requirements and guidelines set forth in the PDARP/PEIS, the Trustee Council SOPs, and the Trustees MAM Manual. They include descriptive information regarding monitoring goals, objectives, parameter details (e.g. methodology and timing/frequency), potential corrective actions, and monitoring schedules. The project MAM plans are intended to be living documents and will be updated and revised as needed to reflect changing conditions and to incorporate new information. For example, the plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design is inadequate, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any future revisions to individual project MAM plans as well as updates and additional details concerning the status of monitoring activities will be made publicly available through the Trustee Council Restoration Portal[17].

Project MAM plans relevant to this RP/EA are included in Appendix A of this document. MAM plans are developed for alternatives that the Trustees identify as preferred – consistent with the SOPs, MAM plans have not been prepared for projects that are non-preferred alternatives in this restoration plan. However, a MAM plan will be developed for any alternative selected for implementation.

3.3 Project Costs

The cost provided for each restoration alternative is the estimated cost to implement the specific restoration project. This cost reflects current cost estimates developed from the most current designs and information available to the Open Ocean TIG at the time of drafting this restoration plan. Estimated costs reflect all costs associated with implementing the project, potentially including but not limited to revising/finalizing E&D, permitting, pilot studies, monitoring, Trustee oversight, and contingencies.

3.4 Best Management Practices

Federal regulatory agencies provide guidance on best management practices (BMPs) as part of the environmental compliance process. BMPs include design criteria, lessons learned, expert advice, tips from the field, and more. DWH Trustees use appropriate BMPs to avoid or minimize impacts to natural resources, including protected and listed species and their habitats. Specific project designs for all project types must include BMPs and other mitigation measures to avoid or minimize adverse

[17] DWH Trustee Council Restoration Portal can be found here: https://www.habitat.noaa.gov/storymap/dwh/

effects to sensitive natural resources. BMPs identified in required permits, consultations, or environmental reviews, including those described in Appendix 6.A of the PDARP/PEIS that are relevant to a project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

3.5 OPA Evaluation of Alternatives for the Fish Restoration Type

The Open Ocean TIG screening process resulted in the identification of five alternatives (four preferred alternatives and one non-preferred) for the Fish Restoration Type. A description of each alternative is provided below followed by the OPA evaluation of that alternative.

3.5.1 Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries

3.5.1.1 Project Description

This project would restore recreationally important reef fish populations adversely affected by the DWH oil spill by reducing mortality from regulatory discards (e.g. releases due to catches out of season, bag limits, or size requirements) and catch-and-release fishing. Reducing post-release mortality, which is a large contributor to overall fishing mortality among reef fish, would contribute to restoration. One cause of post-release mortality, barotrauma, occurs when fish are rapidly brought to the surface from deep water and gases in the fish's tissues and organs expand and in some cases rupture. When fish suffering from barotrauma are released they may die from the injuries or may struggle to descend back into the water column, becoming easy prey to predators. Barotrauma can cause other physiological effects such as bulging eyes. Injuries due to barotrauma can result in mortality. The goal of this project is to restore recreationally important reef fish populations by reducing mortality from barotrauma. Venting tools, which are hollow needles, are currently used by some anglers to release the gases from the swim bladder; however, their use can cause further injury to a released fish because venting tools require handling of the fish and can result in additional injury if an angler is unfamiliar with fish anatomy. To reduce barotrauma-related post-release mortality rates in recreational fisheries, this proposed project would promote the use of FDDs and train and encourage the use of best release practices. FDDs are weighted devices that help fish return to depth and recover from barotrauma associated with the catch-and-release process. Examples of descenders include clamps designed to release fish at depth; inverted, barbless hooks; and inverted, weighted milk crates. Reef fish species that commonly experience barotrauma in recreational fisheries include adult red snapper, red grouper, vermillion snapper, and gag grouper.

Project objectives include increasing the effective use of FDDs to reduce post-release mortality among recreational anglers and the angling community; measuring the use of FDDs in the fishery; and validating effectiveness of FDDs in a range of oceanographic conditions and across affected species. This project would focus on the development of best practices for FDDs and educating recreational anglers on their use. Supplying anglers with the tools and knowledge to minimize barotrauma-related mortality in reef fishes would result in increased reef fishery health. In addition, increased survival of released fish may then contribute to the recovery of a population. High priority areas selected for project implementation would be based on the density of recreational fishing effort. For example, coastal Alabama and the Florida panhandle would be considered as initial areas for implementation based on recreational snapper fishing concentrations and landings. Project activities would be expanded to additional areas of the Gulf based upon concentration of reef fish anglers and other project implementation considerations. Post-release mortality validation studies would proceed across the northern Gulf of Mexico. Project planning would take place during years one and two; years two through seven would include distribution of FDDs and education and outreach efforts; years one through eight would involve attitude and opinion surveys; and validation studies would be conducted to improve estimates of post-release mortality in years one through four. This project would be fully implemented and has an estimated project duration of seven years. The estimated project cost is $30,011,000.

3.5.1.2 Project Activities

Major activities proposed by this project include the distribution of FDDs, education and outreach on the use of FDDs, monitoring FDD use, measuring the efficacy of the devices by the fishing public, and validating the effectiveness of the FDDs. The project proposes developing best practices for FDD use and a detailed strategy to distribute educational material on the available tools and methods, along with the distribution of training materials, and the tools themselves. A baseline survey would be conducted on the use of existing release practices and FDDs across the Gulf of Mexico to inform outreach and to locate high priority areas for FDD distribution. Appropriate incentives to increase and maintain use of FDDs (e.g., training and tools, etc.) would be researched and implemented to increase participation. Monitoring would include surveys of attitudes and opinions towards the use of FDDs to design outreach and education materials and overcome barriers to implementation. Monitoring of FDD use would be conducted by surveys and observers to inform and evaluate project implementation. Observers on participating boats would monitor the use of FDDs and collect related information to quantify the long-term effects of these actions and evaluate the success of training and outreach efforts. Collaborative validation studies would be conducted to establish FDD effectiveness. These studies would involve gathering data through a variety of means potentially including tag-recapture, telemetry, underwater video, and other techniques onboard charter boats, headboats, and private anglers' boats. Data collected from monitoring and validation studies would be shared with stakeholders at outreach events to support proper FDD usage, create greater and more widespread knowledge of available BMPs, and ultimately decrease post-release mortality rates of reef fishes.

3.5.1.3 OPA Evaluation

The OPA evaluation of the proposed project Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries using the factors established by the OPA regulations in 15 CFR §990.54(a), is described below.

3.5.1.3.1 Cost-Effectiveness

Costs estimates for this alternative were developed based upon similar activities that have been conducted in the past. This project is designed to improve cost effectiveness over time by considering stakeholder input, project monitoring, and evaluating effectiveness of restoration activities. These factors would inform the selection of areas for implementation over the duration of the project. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.5.1.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goals to restore injured fish species and provide fishing communities with methodologies and incentives to increase the health of fisheries (Table 2-3). The project does this by supplying communities with tools and knowledge to reduce the effects of barotrauma. This project has a strong nexus to the injuries caused by the DWH oil spill and response activities, particularly by restoring red snapper, red grouper, vermillion snapper, gag grouper, and other reef fish. If implemented properly, it can help restore injured fish by decreasing post-release mortality of reef fish that are caught but not retained due to regulatory or other reasons. It would reduce mortality caused by barotrauma for discarded fish species by increasing the use of FDDs and proper use of descending tools. This project is consistent with Open Ocean TIG goals and would contribute to the Fish Restoration Type-specific goals outlined in the PDARP/PEIS.

3.5.1.3.3 Likelihood of Success

This alternative has a high likelihood of successfully reducing post-release mortality rates associated with barotrauma. The project is technically feasible and uses best available science, proven techniques, and established methods. In addition, it addresses the implementation considerations identified in the PDARP/PEIS by proposing outreach, incentives, and education to encourage participation by the recreational fishing community. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.5.1.3.4 Avoid Collateral Injury

This project would avoid collateral injury to other resources by evaluating environmental consequences of techniques during the project planning and design activities and by identifying the BMPs to minimize potential collateral injury. Unintended impacts to marine mammals could result, however, measures to avoid such impacts would be part of project design development and implementation. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.5.1.3.5 Benefits Multiple Resources

This alternative would benefit multiple fish species. Benefited fishery resources may include red snapper, red grouper, vermillion snapper, gag grouper, and other reef fish. Expected benefits to these species would include reductions in post-release mortality from barotrauma. In addition, this alternative would benefit bottlenose dolphins by reducing scavenging behavior (Shippee et al. 2017). Outreach and education would include information about which FDDs and release methods are most effective in reducing scavenging behavior.

3.5.1.3.6 Public Health and Safety

The Open Ocean TIG finds that negative impacts to public health and safety from this alternative are not likely. However, relevant safety measures and practices would be followed during project implementation. For example, proper use of FDDs would be taught through outreach programs to ensure operational safety when working with these tools.

3.5.2 Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery

3.5.2.1 Project Description

Shrimp trawls are a less selective fishing gear and catch some non-target species at a high rate. For instance, in 2010, the shrimp trawl fishery in federal waters resulted in a bycatch of approximately 229 million pounds, which exceeded shrimp landings by a factor of 1.76 (NMFS 2013). Finfish bycatch in the shrimp trawl fisheries is a concern as many of these species are commercially, recreationally, and ecologically important. Fish species caught as bycatch in the shrimp trawl fishery include juvenile red snapper, croaker, porgy, pinfish, and Gulf menhaden. The goal of this project is to restore fish biomass by reducing finfish bycatch in the commercial shrimp trawl fishery. The project aims to reduce bycatch rates of finfish by using better BRDs – these devices attach to shrimp trawls allowing non-target species to escape while retaining target shrimp species. Currently, federal regulations require one certified BRD per trawl to be used in offshore federal waters. BRDs must demonstrate a 30 percent reduction in total weight of finfish bycatch, when compared to a control net, to be certified by the National Marine Fisheries Service (NMFS) for use in the Gulf of Mexico shrimp trawl fishery. However, BRDs can reduce finfish bycatch even further. For instance, testing of new BRDs in North Carolina shrimp trawl fisheries showed a 40 percent reduction of finfish bycatch with minimal shrimp loss relative to a control net (Brown et al. 2017).

Project objectives include identifying new advances in BRD technology, validating the effectiveness of improved BRDs, and maximizing the use of these BRDs through dockside outreach and incentives. The proposed project area would include the northern Gulf of Mexico off the coasts of Texas, Louisiana, Mississippi, and Alabama. Outreach activities would be conducted at concentrated shrimping fleet locations along the Gulf Coast. Year one would focus on surveying and information gathering, and proof-of-concept and certification testing would be conducted in years two through four. Outreach and incentive-based engagement would be multi-faceted and conducted throughout the seven-year project timeline. This project would be fully implemented and has an estimated project duration of seven years. The estimated project cost is $17,171,000.

3.5.2.2 Project Activities

The initial activity of the project would be to conduct a BRD innovation survey within the Gulf shrimp fishery to identify industry-based innovations in BRD technology that are currently in use. The project would engage with U.S. and international entities that are actively involved in shrimp trawl bycatch reduction development to identify BRDs for testing. The survey would include BRD innovations in the white shrimp fishery off western Louisiana and eastern Texas. Surveys would be performed at industry meetings and through dockside interviews, and would be conducted using existing programs, such as the NOAA Fisheries Gear Monitoring Team. The project would then conduct proof-of-concept tests on identified prototypes using diver evaluations and paired trials. Designs with the most favorable characteristics (i.e. bycatch reduction, shrimp retention, simplicity and ease of use) would go on to full certification testing on commercial shrimp trawling vessels. Certification testing on new BRDs would be conducted following the requirements described in the Bycatch Reduction Device Testing Manual (NMFS 2008a). BRDs that pass the certification test would be evaluated as candidates for the proposed voluntary BRD use program. BRDs selected for this part of the project must demonstrate a bycatch reduction rate that exceeds that of the Fisheye BRD, which is the BRD most commonly used in the fishery. Following scientific and comparative testing, a list of certified BRDs for use in shrimp trawl fisheries would be compiled. Outreach workshops and trainings would be used to promote the use of these BRDs and help fishermen install and use them correctly. Incentives may be offered to voluntary participants. Participation may require onboard observers to collect information on BRD installation and utilization. Experts on gear modification with longstanding working relationships with fishermen would be engaged to help develop these incentives and maximize project participation.

3.5.2.3 OPA Evaluation

The OPA evaluation of the proposed project Better BRDs for the Gulf of Mexico Commercial Shrimp Trawl Fishery using the factors established by the OPA regulations in 15 CFR §990.54(a), is described below.

3.5.2.3.1 Cost-Effectiveness

Estimated costs for this alternative are based on estimates using previous projects that were refined to reflect the proposed activities. This project uses cost effective approaches, such as using existing programs to take advantage of existing expertise, program infrastructure, and partnerships for effective implementation of the proposed activities. For example, the comprehensive BRD innovation survey associated with this project would use the NOAA Fisheries Gear Monitoring Team to collect data. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.5.2.3.2 Trustee Restoration Goals and Objectives

This alternative would contribute to the Trustees' goals to restore injured fish species and provide fishing communities with methodologies and incentives to increase the health of fisheries (Table 2-3). The project does this by identifying and implementing better BRDs. If implemented properly, this alternative can restore injured natural resources by creating incentives for the use of more effective BRDs in shrimp trawl practices. This approach would help compensate for interim lost services to fishery resources by reducing total bycatch of non-target species common in the commercial shrimp trawl fishery. The data collected from project monitoring are expected to provide useful insights into potentially more effective BRDs and would allow the Open Ocean TIG to target restoration measures more effectively. This project is consistent with Open Ocean TIG goals and would contribute to the Fish Restoration Type-specific goals outlined in the PDARP/PEIS.

3.5.2.3.3 Likelihood of Success

This alternative has a high likelihood of successfully reducing finfish bycatch through the identification and implementation of better BRDs. The project is technically feasible, uses best available science, proven techniques, and established methods. For instance, recent collaborative testing of new BRD combinations in North Carolina shrimp trawl fisheries identified several BRD combinations that exceed 40 percent reduction of finfish bycatch relative to a control net. Additionally, this alternative addresses the implementation considerations identified in the PDARP/PEIS by providing incentives, outreach, and training to encourage fishermen to adopt new BRDs, and, if appropriate, assist with any increased costs associated with their conversion or use. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.5.2.3.4 Avoid Collateral Injury

Proposed activities would be conducted through long-term existing programs, such as the NOAA Fisheries Gear Monitoring Team, with successful regulatory requirements, permits, and best practices to avoid collateral injury. Further, BMPs described in environmental compliance documents would be implemented to minimize impacts on species and critical habitat. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.5.2.3.5 Benefits Multiple Resources

This project would benefit multiple fish species including juvenile red snapper, croaker, porgy, pinfish, and Gulf menhaden. Additionally, combinations of BRDs and TEDs may also benefit other species such as sea turtles and marine mammals. Expected benefits would include reduced bycatch rates and therefore reduced mortality.

3.5.2.3.6 Public Health and Safety

The Open Ocean TIG finds that negative impacts to public health and safety from this alternative are not likely. However, relevant safety measures and practices would be followed during project implementation. For example, the use of outreach and training programs would be employed to ensure operational safety when using the identified BRDs.

3.5.3 Communication Networks and Mapping Tools to Reduce Bycatch – Phase 1

3.5.3.1 Project Description

Bycatch can have substantial biological effects on affected species as well as economic impacts on fisheries. Despite ongoing technical innovation, bycatch within U.S. and international fisheries remains high and includes some species for which there was injury from the DWH oil spill such as blue marlin, white marlin, bluefin tuna, yellowfin tuna, sailfish, greater amberjack, triggerfish, red snapper, speckled hind, warsaw grouper, and snowy grouper. For example, shrimp fishery vessels generally create 1.76 pounds of bycatch for every pound of shrimp caught (NMFS 2013). Voluntary hotspot and communication programs in trawl fisheries in the northeast U.S. and elsewhere have shown promise as methods to reduce bycatch. For example, these programs were credited with reducing the need to close herring and squid fisheries (Bethoney et al. 2017). By identifying areas where bycatch is high, fishermen can redirect effort to other areas, avoiding higher bycatch and potentially improving efficiency in retaining allowable catch. The goal of this project is to reduce the amount of bycatch and mortality of injured species by the identification of bycatch hotspots and developing tools to avoid bycatch. It would rely heavily on close coordination with fishermen, stakeholders, and state and federal fishery managers. Phase 1 is a feasibility study that would focus on designing a system to create near-real time, spatially explicit maps of bycatch hotspots in fisheries selected for this project. These maps would be coupled with a communication tool that informs fishermen of the high bycatch potential in those areas.

The objective of this project is to determine the feasibility of a system that could reduce bycatch in Gulf of Mexico and Atlantic fisheries. Priority fisheries for the proposed feasibility study would be identified based on factors such as benefits to injured species, current fishery bycatch challenges, fishery bycatch data availability, existing fishery management, and industry characteristics. For example, injured species groups may include juveniles and adults of billfish, swordfish, tunas, and reef fishes. The selection of priority species and fisheries would be determined in coordination with the fishing industry to take advantage of perceived opportunities for success. In this phased restoration project, initial work would establish a functional system that, after field testing, would be ready for full roll out and commercial implementation in a later phase(s). Workshops would be conducted in the Gulf of Mexico. Year one would focus on development of an implementation plan, with year two through three focused on preliminary development of predictive maps and holding workshops with the fisheries. Years four through five would include identification of requirements for specific bycatch communication networks to inform future implementation of the project. This project would implement initial planning activities and has an estimated project duration of five years. The estimated project cost is $4,416,000.

3.5.3.2 Project Activities

This project would include activities such as conducting scoping workshops, developing maps to identify areas of potentially high bycatch and high fish densities (e.g. at spawning aggregation sites), and holding a workshop to discuss the use of a communication network to avoid bycatch. Workshops with fishermen and fishery groups, management experts, communication network administrators, and other stakeholders would be used to identify priority fisheries and species for the development of hotspot analyses and communications networks. Workshops would provide a better understanding of those fisheries with the best opportunities for reducing bycatch of injured species through the use of a communication network. They would also help to identify fishery-specific characteristics that may be important in determining the structure of contracts required for participation, among other things. Once fleets, fisheries, and/or ports have been identified via a scoping workshop and once preliminary predictive maps have been developed, a multi-day, workshop would be convened to determine implementation requirements for one or more bycatch communication networks. This workshop would include fishery representatives, administrators of current bycatch communication networks, state and federal managers, and other stakeholders. Data would then be compiled on the physical environment, existing habitat, fishery-dependent data, independent data, and other environmental data to estimate species distribution, population density, and size frequencies of populations. These data would be used in developing habitat/geospatial predictive models (as in Hazen et al. 2018). The primary anticipated outcome from this project would be the creation of designs for communication networks, hotspot mapping technology, and evaluation of options for implementation. This project would stop short of implementation which would be accomplished in future phases. The project would coordinate with fishermen, stakeholders, and state and federal fishery managers.

3.5.3.3 OPA Evaluation

The OPA evaluation of the proposed project Communication Networks and Mapping Tools to Reduce Bycatch—Phase 1 using the factors established by the OPA regulations in 15 CFR §990.54(a), is described below.

3.5.3.3.1 Cost-Effectiveness

Estimated costs for this alternative are based on estimates using similar activities that were refined to reflect the proposed activities. The proposed phased approach would help to refine the project's methodology with fishing industries and based on best available information. By implementing this alternative in phases, the Open Ocean TIG expects to increase the cost effectiveness and efficiency of subsequent actions to implement a communication network. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.5.3.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goal of increasing the health of fisheries by providing fishing communities with methodologies and incentives (Table 2-3). The project does this by developing a communication network to decrease bycatch. The data collected from Phase 1 are expected to assess the feasibility of a bycatch avoidance system, which would allow the Open Ocean TIG to target future restoration measures more effectively. The project is consistent with Open Ocean TIG goals and would contribute to the Fish Restoration Type-specific goals outlined in the PDARP/PEIS.

3.5.3.3.3 Likelihood of Success

This alternative has a high likelihood of successfully evaluating the feasibility of developing a bycatch hotspot avoidance tool and evaluating the feasibility of such a tool to reduce bycatch. The project is technically feasible and uses best available science, proven techniques, and established methods. For instance, voluntary hotspot identification and bycatch avoidance systems have been successfully used as a tool to limit bycatch since about 1976 (Little et al. 2015). This project has been designed in phases to ensure that key questions about the effectiveness of a bycatch avoidance system would be answered prior to future implementation. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.5.3.3.4 Avoid Collateral Injury

This alternative is not expected to cause any collateral injuries to natural resources because it would focus on planning, data compilation, and analysis activities that pose no direct or indirect risk of injury to the environment.

3.5.3.3.5 Benefits Multiple Resources

This alternative, if it leads to future implementation, could benefit multiple fish species. Expected benefits would include a reduction in bycatch and increased population health. Benefited species may include blue marlin, white marlin, bluefin tuna, yellowfin tuna, sailfish, greater amberjack, triggerfish, red snapper, speckled hind, warsaw grouper, and snowy grouper, but would be dependent upon the fisheries that participated in the project. Benefits from this proposed project would be information gained on opportunities to reduce bycatch for fisheries resources.

3.5.3.3.6 Public Health and Safety

This planning and design alternative is not expected to affect public health and safety.

3.5.4 Restoring for Bluefin Tuna via Fishing Depth Optimization

3.5.4.1 Project Description

Atlantic bluefin tuna are caught incidentally in the directed yellowfin tuna PLL fishery (NMFS 2018a). PLL fishing gear is primarily composed of a mainline that is 5 to 40 miles (8 to 64 kilometers) long and has approximately 20 to 30 hooks per mile. Data collected by NOAA show that about 70 percent of the PLL fishery effort in the Gulf of Mexico occurs at depths of 195 to 330 feet (60 to 100 meters). However, data have also shown that PLL gear deployed at depths greater than 360 feet (110 meters) may have the potential to reduce bluefin tuna interaction with PLL gear and thus decrease bluefin tuna bycatch mortality. The goal of this project would be to conduct a pilot study to better define an optimal PLL depth to reduce bycatch of Atlantic bluefin tuna.

Project objectives include evaluating the effects of setting PLL gear deeper than typically fished; determining the restoration benefit of this pilot fishing practice; disseminating results to encourage voluntary adoption if the fishing practice is successful; and gaining a better understanding of the Mexican PLL fishery for future restoration efforts. The Mexican fleet would be included in the outreach efforts to encourage voluntary adoption in recognition that bluefin tuna are a shared resource throughout the Gulf. The proposed pilot study would take place in the northern Gulf of Mexico off Texas, Louisiana, Mississippi, Alabama, and Florida. Outreach workshops would be held along the U.S. Gulf Coast in Texas, Louisiana, Florida panhandle, and south Florida as well as two locations in Mexico. Project design and outreach planning would be conducted in year one, with years two through six being dedicated to the pilot study and data analysis on bluefin tuna bycatch. Years seven through 10 would focus on implementation of the outreach plan. This project would be fully implemented and has an estimated project duration of 10 years. The estimated project cost is $6,175,000.

3.5.4.2 Project Activities

A pilot study would be conducted for an estimated four years in cooperation with voluntarily participating commercial PLL vessels. Vessels would fish with industry standard gear, alternating setting it between normal PLL fishing depth (generally 230-295 feet [70-90 meters]) and deeper depths (between 360-395 feet [110 - 120 meters]), and using paired longline sets. All fishing practices would conform to existing federal fishing regulations including required sea turtle mitigation tools. Onboard observers would collect data on catch rates at normal and deeper PLL depth, fish interaction time, fishing depth, and temperature; pop-up satellite archival tags (PSAT) would also be deployed on caught bluefin and yellowfin tuna to evaluate distribution and migration and to provide additional behavioral information on these species. Data would also be collected on possible effects to other species from a deeper PLL fishing depth. This may include bycatch rates of yellowfin tuna, dolphinfish, skipjack tuna, wahoo, swordfish, sea turtles, and marine mammals. Data would be analyzed and the results would be provided to the fishery through outreach workshops held across the U.S. Gulf Coast as well as in Mexico to educate attendees on techniques to reduce bycatch. Additional outreach efforts through various outlets such as industry meetings would be conducted to increase awareness of benefits of the techniques studied in this project and to encourage voluntary adoption by commercial fishermen.

3.5.4.3 OPA Evaluation

The OPA evaluation of the proposed project Restoring for Bluefin Tuna via Fishing Depth Optimization using the factors established by the OPA regulations in 15 CFR §990.54(a), is described below.

3.5.4.3.1 Cost-Effectiveness

Estimated costs for this alternative were developed from budgets of similar activities. The use of existing programs proposed for conducting pilot projects takes advantage of current expertise, program infrastructure, and fisheries partnerships for effective implementation. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.5.4.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goals to restore injured fish species and provide fishing communities with methodologies and incentives to increase the health of fisheries (Table 2-3). The project does this by testing an optimal PLL fishing depth that aims to decrease bluefin tuna bycatch. This project has a strong nexus to injuries caused by the DWH oil spill and response activities particularly by restoring injured bluefin tuna populations. This project is consistent with Open Ocean TIG goals and would contribute to the Fish Restoration Type- specific goals outlined in the PDARP/PEIS.

3.5.4.3.3 Likelihood of Success

This alternative has a high likelihood of successfully identifying an optimal PLL fishing depth that decreases bluefin tuna bycatch. The project is technically feasible and uses best available science, proven techniques, and established methods. The proposed pilot studies are based on scientific data related to the optimization of fishing gear set depth to reduce bycatch. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.5.4.3.4 Avoid Collateral Injury

This project is not expected to cause collateral injury to natural resources. Proposed activities would be conducted with voluntary participation from the PLL fleet, which operate under limited-access permits. Best practices would be used to avoid collateral injury. Should any potential effects be identified during monitoring of the project, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.5.4.3.5 Benefits Multiple Resources

This alternative would benefit bluefin tuna and may also benefit sea turtles, marine mammals or other fish species. In addition, the study would evaluate catch rates of species other than bluefin tuna, which would help to evaluate the potential effects that changing fishing depths may have on those other species. Expected benefits would include reduced bycatch rates and therefore reduced mortality.

3.5.4.3.6 Public Health and Safety

The Open Ocean TIG finds that negative impacts to public health and safety from this alternative are not likely. However, relevant safety measures and practices would be followed during project implementation. BMPs would be employed during implementation to ensure operational safety when implementing pilot studies.

3.5.5 Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats

3.5.5.1 Project Description

Ghost fishing occurs when organisms become trapped or entangled in lost or discarded fishing gear that is no longer under a fisherman's control. This lost or discarded gear is known as derelict gear. Derelict gear traps and kills fish, crustaceans, marine mammals, sea turtles, and seabirds. Derelict gear can include both floating (e.g., gill nets, long lines) and fixed (e.g. crab traps and pots) fishing gear. Derelict blue crab traps are present in high numbers in the Gulf of Mexico and catch estuarine-dependent finfish species. At least 23 species of fish and five species of invertebrates have been observed in blue crab traps (Guillory et al. 2001a). The goal of this project is to reduce ghost fishing by removing derelict gear, with a focus on crab traps.

The objective of this project is to organize events to remove derelict fishing gear in at least six priority areas within Gulf of Mexico bays and estuaries. Removal activities would occur in areas with a high density of derelict fishing gear as determined by pre-assessment surveys within nearshore coastal waters in the northern Gulf of Mexico. Years one through four of the project would involve education and outreach on the prevention and removal of derelict fishing gear. Years two through four would be focused on identification of high density derelict fishing gear locations and then implementation of gear removal. The final year of the project would assess and monitor the results of the project activities. This project would be fully implemented and has an estimated project duration of five years. The estimated project cost is $6,128,000.

3.5.5.2 Project Activities

This project would develop an outreach program for commercial and recreational fishermen across the northern Gulf of Mexico to increase their awareness of the impacts of derelict fishing gear and techniques to reduce the loss of gear. In addition, training events would be held for participants in removal activities. These training events would review safety instructions, communication protocols, the roles of each removal team member, the state regulations related to derelict gear, data sheet protocols, and examples of derelict gear in various stages of degradation. Although efforts have been conducted by state and federal resource agencies to survey where derelict fishing gear occurs, more information is needed to assess the overall extent of where derelict fishing gear accumulates. To efficiently implement removal activities throughout the Gulf of Mexico, the project would determine which locations contain the highest densities of derelict fishing gear. This would be accomplished by conducting field surveys before removal operations and by collaborating with state agencies and other fisheries programs to assist with identifying and prioritizing locations for removal activities. Fishermen would be engaged and volunteers trained to conduct both visual assessments and side-scan sonar and/or magnetometer surveys to map hotspots of derelict gear and narrow project focus to priority areas where removal programs are likely to be successful. Annual or twice-annual gear removal events would take place based on the estimated need, cost effectiveness, and positive restoration outcome. Monitoring and targeted assessment of areas following removal activities would be conducted to evaluate success. At selected sites, additional monitoring by biologists would be conducted to identify derelict crab traps with side-scan sonar before and after removal events. At priority sites this project would remove and characterize identified derelict gear, assess abundance and species entrapped in derelict gear, and conduct crab trap accumulation surveys.

3.5.5.3 OPA Evaluation

The OPA evaluation of the proposed project Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats using the factors established by the OPA regulations in 15 CFR §990.54(a), is described below.

3.5.5.3.1 Cost-Effectiveness

Estimated costs for this alternative are based on estimates using previous projects that were refined to reflect the proposed activities. This project is designed to increase efficiency and effectiveness of restoration actions over the project duration through development of a prioritization process during initial planning activities. This prioritization process would identify locations with high densities of derelict fishing gear through surveys. Removal targets would be set within priority areas to balance the effort expended and expected benefits. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate; however, uncertainties remain with regard to identification of the most cost-effective methods and locations for removal activities.

3.5.5.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goals to restore injured fish species and provide fishing communities with methodologies and incentives to increase the health of fisheries (Table 2-3). The project does this by removing derelict gear that contributes to ghost fishing. This alternative has a nexus to the injuries caused by the DWH oil spill and response activities, particularly by reducing mortality caused by ghost fishing and by improving fisheries habitat. The project would benefit a range of injured fish and invertebrate resources; however, compared to other proposed projects, the nexus to injured resources prioritized for this RP/EA is low (Table 2-4). This project is consistent with Open Ocean TIG goals and would contribute to the Fish Restoration Type-specific goals outlined in the PDARP/PEIS.

3.5.5.3.3 Likelihood of Success

It is likely that the project objectives would be achieved by the proposed activities. However, the project would benefit from additional development of partnerships and leveraging of existing programs.

3.5.5.3.4 Avoid Collateral Injury

This project may result in minor collateral injury to natural resources such as benthic organisms in the sediment or that have colonized the derelict fishing gear. BMPs would be applied to avoid collateral injury during the removal of derelict gear. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.5.5.3.5 Benefits Multiple Resources

This alternative would benefit multiple fish species. An estimated 23 species of fish and five species of invertebrates have been observed as bycatch in crab traps (Guillory et al. 2001a). Expected benefits would include reduced bycatch and improved benthic habitat. Removal of derelict crab taps may also reduce entanglements of bottlenose dolphins and sea turtles.

3.5.5.3.6 Public Health and Safety

The Open Ocean TIG finds that negative impacts to public health and safety from this alternative are not likely. However, relevant safety measures and practices would be followed during project implementation. Participants would be made well aware of the potential for injury in collecting marine debris through disclaimers and waivers (as necessary) and the use of appropriate protective gear would be employed during implementation to ensure operational safety during removal activities by volunteer groups.

3.5.6 Fish Restoration Type OPA Conclusions

The Open Ocean TIG completed the OPA evaluation of the reasonable range of alternatives. In total, five alternatives were evaluated. The four preferred projects (Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries; Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery; Communication Network and Mapping tools to Reduce Bycatch – Phase 1; and Restoring for Bluefin Tuna via Fishing Depth Optimization) are anticipated to satisfy the all the OPA evaluation factors. The Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats project does not meet the Trustees current restoration priorities and is not preferred at this time.

3.6 OPA Evaluation of Alternatives for the Sea Turtles Restoration Type

The Open Ocean TIG screened a number of potential Sea Turtle restoration alternatives that resulted in the identification of eight restoration alternatives (six preferred alternatives and two non-preferred). A description of each alternative is provided below followed by the OPA evaluation of that alternative.

3.6.1 Gulf of Mexico Sea Turtle Atlas

3.6.1.1 Project Description

During the response and assessment phase for the DWH oil spill, the Trustees identified information gaps in sea turtle distributions, important habitats, and other factors to understand restoration requirements in the northern Gulf of Mexico. Restoration planning and implementation would greatly benefit from having all relevant information available in one place, in an easy-to-use, standardized format to facilitate prioritization of restoration needs and activities. This would also improve the implementation of restoration actions as well as restoration planning efforts by making it possible to view and evaluate all data sets and projects in a common geographic framework. The goal of the project is to develop a Gulf of Mexico Sea Turtle Atlas that would provide restoration planners, resource managers, and responders with key spatial datasets for understanding sea turtle presence, abundance and/or density, and habitat use. This Atlas would integrate and display available datasets including nesting data, aerial survey, in-water capture, telemetry, and strandings data. It would also include available data on relevant environmental conditions, distribution and intensity of anthropogenic threats, and status and summaries of existing monitoring and restoration projects. The task of identifying relevant data sets and keeping the Atlas data up-to-date would fall to a steering committee that would maintain relationships with data providers in the larger sea turtle community.

Project objectives include provision of a centralized location for relevant biogeographical information for all species of sea turtles occurring in the Gulf of Mexico; support efforts to enhance mortality investigations and emergency response; and development of the Atlas in collaboration with existing data providers and managers to ensure the Atlas' role as a data resource that addresses restoration needs and complements existing repositories. The geographic area of focus for this project includes the entire Gulf of Mexico and would engage partners from all Gulf states. Years one and two would focus on development of an Atlas framework, years two through three would involve data processing, standardizing, and public deployment, and years four through 15 would be spent tracking usage, updating data, and maintaining the Atlas. This project would implement initial planning activities and has a project duration of 15 years. The total estimated project cost is $5,700,000.

3.6.1.2 Project Activities

This project would coordinate among numerous entities to ensure effective development of the Gulf of Mexico Atlas. A steering committee would be established to identify, locate, and prioritize data needs. The steering committee would also develop strategies to partner with existing data holders and address technical requirements. Following data acquisition and development of the interface, data would be processed, standardized, and incorporated into the database. The Atlas would not necessarily serve as the repository of any raw data, but rather as a central platform to view data summaries or data products contributed by several sources. Once the Atlas is populated with priority data types and the user interface is constructed, it would be beta-tested with a sample of potential users, such as restoration planners, resource managers, and spill responders. Beta testing would ensure an efficient and user-friendly form. The Atlas would be publicly launched with continued refinement, monitoring, and management. Annual surveys of users would be conducted to provide opportunities to evaluate the efficacy of the Atlas project and to adaptively manage its execution. Maintenance of the Atlas would include troubleshooting technical issues, continued incorporation of new datasets, updating existing datasets, and supporting external uses of datasets available through the Atlas. The Atlas would be adaptively managed to provide applications that support restoration planning and evaluation. As knowledge gaps are filled by implementation of NRDA projects, that information would be integrated into the Atlas to support restoration and conservation efforts.

3.6.1.3 OPA Evaluation

The OPA evaluation of the Gulf of Mexico Sea Turtle Atlas project, using the factors established by the OPA regulations in 15 CFR §990.54(a), is described below.

3.6.1.3.1 Cost-Effectiveness

The costs for this alternative are based on estimates using past experience and knowledge from experts in the field. By testing beta versions with potential users and by acquiring and refining data over time, the Open Ocean TIG expects to increase the cost effectiveness and efficiency of the Gulf of Mexico Sea Turtle Atlas development. Data needs would be assessed and prioritized to allow for concentrated efforts. Any information gained during planning would be used to improve methods and cost-effectiveness, where applicable. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.6.1.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to all four of the Trustees' goals listed in Table 2-3 for Sea Turtles. The project does this by improving tools to monitor and adaptively manage restoration decisions among multiple restoration approaches and across restoration areas. The Atlas would also support implementation of restoration projects focused on enhanced mortality investigation as well as response to anthropogenic threats and emergency events. This alternative has a strong nexus to injuries caused by the DWH oil spill and response activities. Particularly, it would provide effective data and planning tools that contribute to appropriate and effective restoration of sea turtles. This project is consistent with Open Ocean TIG goals, the Sea Turtle Strategic Framework, and would contribute to the Sea Turtles Restoration Type-specific goals outlined in the PDARP/PEIS.

3.6.1.3.3 Likelihood of Success

This alternative has a high likelihood of successfully developing a Gulf of Mexico Sea Turtle Atlas. The project is technically feasible and uses best available science, proven techniques, and established methods. This project would build upon prior collaborations, data sharing agreements, and existing tools and data products. Examples of existing tools include the Online Sea Turtle Research and Monitoring Information System, managed by the Florida Fish and Wildlife Commission, and the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP), managed by the Marine Geospatial Ecology Lab at Duke University. Project implementation would involve a thorough planning phase and the proposed methodology is highly feasible. The highly collaborative approach would also increase the likelihood of providing data that inform stakeholders and improve the implementation of future sea turtle restoration activities. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.6.1.3.4 Avoid Collateral Injury

This alternative is not expected to cause any collateral injuries to natural resources because it focuses on planning, data collection, data analysis, and development of a data management system. These activities pose no direct or indirect risk of injury to the environment.

3.6.1.3.5 Benefits Multiple Resources

Future implementation of restoration developed under this alternative is expected to benefit multiple species of sea turtles. Expected benefits of the proposed project would include a framework that provides key spatial datasets for understanding sea turtle presence, abundance and/or density, and habitat use. It would also include available data on relevant environmental conditions, distribution and intensity of anthropogenic threats, and status and summaries of existing monitoring and restoration projects. These actions would help to inform future restoration efforts.

3.6.1.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. The project consists of planning, data collection, data analysis, and development of a data management system and these activities would not pose a risk to the public.

3.6.2 Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery

3.6.2.1 Project Description

Sea turtle interaction with BLL fishing gear can lead to serious injury or death through entanglement or ingestion of gear. A number of studies have investigated factors affecting the capture of sea turtles in commercial fishing gear, with focus on trawls (Brewer et al. 1998), gill nets (Gilman et al. 2010; Murray 2009), and PLLs (Gilman et al. 2007; Kot et al. 2010; Watson et al. 2005). Fewer studies have focused on sea turtle bycatch in the BLL fishery, and there is a critical data gap in understanding which factors, if any, influence the bycatch of loggerhead sea turtles. The goal of this project is to restore loggerhead sea turtles by reducing sea turtle bycatch and bycatch mortality in the Gulf of Mexico reef fish BLL fishery. This project would inform future restoration by completing a full assessment of available data to identify factors involved in the bycatch of sea turtles in the reef fish BLL fishery and filling critical data gaps. Future restoration may include any subsequent data collection needs, stakeholder outreach, gear testing, and/or the implementation of voluntary programs to reduce sea turtle bycatch based on the factors identified.

Project objectives include conducting a robust analysis of existing data from the Gulf of Mexico reef fish BLL fishery to evaluate environmental variables and fishing practices associated with sea turtle bycatch and developing a framework for designing future restoration efforts. The proposed two-year project would use existing data from observations of federally permitted BLL vessels which operate in the eastern Gulf of Mexico, with the major ports being found in west Florida and Louisiana (SERO 2018). Years one and two would focus on project planning, data analysis, and development of the framework for future efforts. This project would implement initial planning activities and has an estimated project duration of two years. The estimated project cost is $290,000.

3.6.2.2 Project Activities

This project would provide a foundation for a potential multi-phased approach to reduce sea turtle bycatch in the reef fish BLL fishery in the Gulf of Mexico. All existing data from the Gulf of Mexico BLL fishery would be evaluated to determine the environmental variables and fishing practices associated with sea turtle bycatch. Monitoring data has been collected from the reef fish BLL fishery by on-board scientific observers since 2005 by two separate monitoring programs using the same sampling scheme (Gulak et al. 2013; Scott-Denton et al. 2011). This data would be analyzed to evaluate the factors that could influence the bycatch of loggerhead sea turtles in the eastern Gulf of Mexico. Using the combined data sets, generalized linear models would be used to determine which factors influence the probability of catching a loggerhead sea turtle. Factors such as latitude, season, depth, number of hooks, hook type and size, bait used, soak time, and sea surface temperature would be considered. The findings of this project would then be used to recommend actions that should be considered in future projects.

3.6.2.3 OPA Evaluation

The OPA evaluation of the proposed project Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.6.2.3.1 Cost-Effectiveness

The costs for this alternative are based on estimates using past experience and knowledge by experts in the field. By implementing this alternative in phases, the Open Ocean TIG expects to increase the cost effectiveness and efficiency of future restoration activities. Information gathering and initial analysis would be completed to better inform and structure those activities. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.6.2.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goal of restoring sea turtles by addressing primary threats such as bycatch in commercial fisheries. The project does this by informing and developing conservation strategies and voluntary bycatch reduction programs for sea turtles negatively impacted by the reef fish BLL fishery. The data analyses are expected to provide useful insights into the factors and variables associated with sea turtle bycatch and would allow the Open Ocean TIG to target future active restoration measures more effectively. This project is consistent with Open Ocean TIG goals, the Sea Turtle Strategic Framework, and would contribute to Sea Turtles Restoration Type-specific goals outlined in the PDARP/PEIS.

3.6.2.3.3 Likelihood of Success

This alternative has a high likelihood of successfully identifying the factors and variables associated with sea turtle bycatch in the reef fish BLL fishery and developing a framework for future restoration efforts. The project is technically feasible and uses best available science, proven techniques, and established methods. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.6.2.3.4 Avoid Collateral Injury

This alternative is not expected to cause any collateral injuries to natural resources because it focuses on data analysis and framework development activities that pose no direct or indirect risk of injury to the environment.

3.6.2.3.5 Benefits Multiple Resources

Future implementation of restoration methods developed under this alternative is expected to benefit multiple species of sea turtles. Expected benefits of the proposed project would include identification of factors and variables that influence sea turtle bycatch to guide more informed future restoration planning efforts.

3.6.2.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. The project consists of data analysis and framework development, work that would not involve the public.

3.6.3 Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection

3.6.3.1 Project Description

Sea turtles exhibit complex life histories, highly migratory behavior, delayed maturity, and long lifespans. To aid in restoration project design and to assess project success and long-term effectiveness of restoration activities, data are needed regarding status, trends, and spatiotemporal distributions, as described in the PDARP/PEIS and the Sea Turtle Strategic Framework (DWH NRDA Trustees 2017a). This project would develop a statistically sound plan to support coordinated Gulf-wide collection and compilation of critical abundance, demographic, and biological information on all sizes and life stages of turtles. Coordinated Gulf-wide monitoring of sea turtle populations and the implementation of standardized monitoring protocols would provide important context for project-level monitoring and allow comparisons across multiple projects. There are numerous data gaps with respect to sea turtle distribution, abundance, and survival rates. Though aerial surveys are occasionally performed, they are only useful for evaluating larger sea turtles that are visible from aircraft. Direct capture in-water surveys allow for a more thorough assessment of individual sea turtles at any size, including direct measurements, sample collection, and tagging for continued observation. This project would be used to guide the formation of future coordinated sea turtle in-water monitoring to fill critical data gaps.

Project objectives include identifying and prioritizing a scientifically and statistically appropriate data collection strategy to provide abundance and demographic data in inshore, nearshore, and offshore habitats of the Gulf of Mexico, to allow a more comprehensive evaluation of the status and trends of sea turtle populations. This project would target all sea turtle species across the Gulf of Mexico. The project would involve selection of a working group, facilitation of stakeholder meetings, and completion of a comprehensive in-water survey plan. This project would implement initial planning activities and has an estimated project duration of two years. The estimated project cost is $655,000.

3.6.3.2 Project Activities

This project would be initiated by the steering committee selecting and convening a small working group of study design experts with statistical expertise in large-scale studies. This working group would design an in-water index of sea turtle abundance, trends, and demographics and create a scientifically and statistically appropriate study design to monitor populations at large scales (e.g., Gulf of Mexico-wide). Standardized methods and data collection would be central to the design. The project would also identify data gaps and associated data needs through evaluation of existing surveys and databases. The working group would also identify opportunities to form a network of partners for data collection and to leverage cross-taxa restoration benefits (e.g., using acoustic monitoring to detect multiple aquatic species). A finalized strategic plan would provide guidance for sea turtle abundance and demographic data collection and compilation. It would also describe field data collection methods, database structure, and data management. The project would conduct outreach to engage stakeholders such as state, academic, federal, and NGO partners with data and ongoing in-water research across the Gulf of Mexico. This plan would be available to the public and would include an adaptive management strategy. Future restoration projects may be proposed to implement data collection based on the Gulf-wide sea turtle monitoring plan.

3.6.3.3 OPA Evaluation

The OPA evaluation of the proposed project Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.6.3.3.1 Cost-Effectiveness

The costs for this alternative are based on estimates using past experience and knowledge by experts in the field. The project would take advantage of study design experts with statistical expertise and the alternative would be implemented in phases. By using specialists and implementing this alternative as a preliminary phase restoration project, the Open Ocean TIG expects to increase the cost effectiveness and efficiency of future projects. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.6.3.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to all four of the Trustees' goals for Sea Turtles listed in Table 2-3. The project does this by implementing monitoring and scientific support to increase understanding of resource status, trends, and distributions. Future restoration projects that may be proposed to implement data collection based on the outcomes of this project would fill knowledge gaps, address threats, and encourage consistency with sea turtle recovery plans. This alternative has a strong nexus to injuries caused by the DWH oil spill and response activities, particularly, it would provide critical data needed to effectively restore sea turtles injured by the DWH oil spill. This project is consistent with Open Ocean TIG goals, the Sea Turtle Strategic Framework, and would contribute to the Sea Turtles Restoration Type-specific goals outlined in the PDARP/PEIS.

3.6.3.3.3 Likelihood of Success

This alternative has a high likelihood of successfully developing a strategic plan for in-water sea turtle data collection. The project is technically feasible and uses best available science, proven techniques, and established methods. In-water surveys are an established, standardized practice that is performed regularly, and this project would build on existing expertise to develop a comprehensive survey plan. Several examples of similar design-based survey and monitoring efforts for highly mobile species can be drawn from for developing this project (NAS 2017; Weist et al. 2016). Furthermore, the project would employ study design experts. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.6.3.3.4 Avoid Collateral Injury

This alternative is not expected to cause any collateral injuries to natural resources because it focuses on planning and analysis activities that pose no direct or indirect risk of injury to the environment.

3.6.3.3.5 Benefits Multiple Resources

Future implementation of restoration methods developed under this alternative is expected to benefit multiple species of sea turtles. Additionally, a project objective would be to identify opportunities for cross-taxa benefits during data collection. Expected benefits would be identification of information gaps critical to assist in the development, implementation, and monitoring of sea turtle restoration projects.

3.6.3.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. The project consists of planning and analysis activities that would not involve the public.

3.6.4 Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery

3.6.4.1 Project Description

Menhaden purse seine fishing involves deployment of a carrier vessel and purse boats that run the purse seine around schools of menhaden. The bottom of the seine is then closed, and all the contents are pulled onto the carrier vessel. A suction hose is then lowered into the purse seine and the contents are vacuumed into the carrier vessel's hold. Given the general methodology of the fishery, and the overlap of the fishing season with the presence of sea turtles, there is potential for sea turtle bycatch to occur. Although pilot efforts have been conducted in the past, no effective observer program is present in the fishery and the extent of sea turtle bycatch is not well documented or understood. The goal of this project is to develop an effective observer methodology, building on past pilot efforts, for the Gulf of Mexico menhaden purse seine fishery to allow for data collection to better understand the extent of sea turtle bycatch in the fishery. An effective observer program would collect data necessary to support efforts to reduce sea turtle bycatch in the commercial menhaden fishery and could inform future restoration projects to reduce bycatch. The project would benefit Kemp's ridley, loggerhead, and green sea turtles, and may also benefit dolphins. The project would be coordinated with fishery representatives, appropriate science and fisheries organizations, and with individuals who have knowledge and experience related to monitoring equipment and its application in research.

Project objectives include working with the menhaden fishery to improve observer approaches for monitoring sea turtle bycatch during fishing operations; evaluate and test observer methodologies; implement a two-year pilot monitoring program within the Gulf of Mexico menhaden purse seine fishery for sea turtle bycatch; and recommend next steps for bycatch reduction based on data collected. The project is expected to span four years with the majority of efforts being concentrated in areas of the Gulf of Mexico where the fishery operates. The majority of the fishing effort is concentrated in Louisiana, Mississippi, and Texas bays, sounds, and nearshore coastal waters; however, lesser effort also occurs in Alabama waters. Year one would involve planning, coordination, and concept development, years two through three would include proof-of-concept testing and a pilot observer program, and year four would focus on review of the final methodologies. This project would be fully implemented and has an estimated project duration of four years. The estimated project cost is $3,000,000.

3.6.4.2 Project Activities

Major activities would include coordination and development of scientific observing methods with the menhaden fishery, including proof-of-concept testing and implementation of a pilot observer program. An initial outreach phase involving fishery representatives would be used to inform potential methodologies and protocols with both human observers and video cameras, and/or other technology. The proposed measures would then undergo testing during regular fishing operations to determine feasibility in real-time operations. If the frequency of actual interactions with protected species is insufficient to allow proof-of-concept testing to be completed in a timely manner, testing could be augmented with species replicas incorporated in various locations/times during the fishing operations. The replicas would be deployed without informing the participants to avoid biasing their success in detecting the replicas. The results of the proof-of-concept testing would then be reviewed to determine viable methods for observing the fishery and to design a pilot observer program.

The NMFS Observer Program would then run a two-year observer pilot program in cooperation with industry to collect initial monitoring data and to assess the feasibility and effectiveness of the program. Throughout the pilot program modifications during the trial runs would allow for adjustment and fine-tuning of methodologies to increase ability to detect protected species and ensure methods do not substantially interfere with fishing operations. The pilot observer program would also work with video monitoring companies (if video monitoring is determined to be feasible) that have the capabilities to provide, install, and maintain video camera systems on the boats, and to review and analyze the footage obtained. Additionally, if the pilot program identifies specific fishing practices that could be modified to reduce sea turtle bycatch, that information would be shared with the industry, and the methods to reduce those interactions would be developed to potentially inform future restoration projects.

3.6.4.3 OPA Evaluation

The OPA evaluation of the proposed project Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.6.4.3.1 Cost-Effectiveness

The costs for this alternative are based on estimates using past experience and knowledge by experts in the field. The project would involve appropriate expertise and coordination with the fishery. By employing these measures, the Open Ocean TIG expects to increase the cost effectiveness and efficiency of subsequent actions to reduce sea turtle bycatch in the fishery. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.6.4.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goal of restoring sea turtles by addressing primary threats such as bycatch in commercial fisheries. The project does this by reducing uncertainties about bycatch and providing information needed to plan and implement restoration projects to reduce sea turtle bycatch in menhaden purse seine fishery. Understanding the potential for interactions between the fishery and sea turtles, and the mechanisms of those interactions during the fishing process, would allow industry and managers to devise methods to reduce potential impacts to sea turtles within the fishery. The data collected from the study are expected to provide useful insights into sea turtle bycatch and would allow the Open Ocean TIG to target future restoration measures. This project is consistent with Open Ocean TIG goals, the Sea Turtle Strategic Framework, and would contribute to the Sea Turtles Restoration Type-specific goals outlined in the PDARP/PEIS.

3.6.4.3.3 Likelihood of Success

This alternative has a high likelihood of successfully identifying and testing feasible concepts for an effective sea turtle observation program in the Gulf of Mexico menhaden purse seine fishery. The project is technically feasible, uses the best available science, proven techniques, and established methods. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.6.4.3.4 Avoid Collateral Injury

This alternative is not expected to cause any collateral injuries to natural resources. This project would not change fishing practices or effort, and the activity is not expected to pose direct or indirect risk of injury to the environment. Pilot studies would be conducted during ongoing fishing efforts and consistent with ongoing fishing methodologies, thus no additional fishing effort would result from this alternative and no collateral injury would result from the practices tested during in-field testing.

3.6.4.3.5 Benefits Multiple Resources

Future implementation of restoration methods developed under this alternative is expected to benefit multiple species of sea turtles. Additionally, the same observation methods used to identify sea turtles could potentially be employed to observe dolphin interactions. Expected benefits would include collection of valuable data necessary for planning and implementing restoration projects to reduce sea turtle bycatch in the menhaden purse seine fishery.

3.6.4.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. The project would involve data collection and analysis activities that include field monitoring by trained scientists, with no involvement of the public.

3.6.5 Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices

3.6.5.1 Project Description

This project is focused on reducing bycatch of small sea turtles (body depths less than four inches) in Gulf of Mexico shrimp otter trawls. Otter trawl vessels are required to install TEDs in their nets. A TED is a grid that fits into the cod end of the trawl, with a top or bottom escape opening covered with a flap. Sea turtles encounter the TED grid when they pass through the trawl and are able to escape through the adjacent opening. Small animals, such as shrimp, pass through the bars of the TED and are caught in the cod end of the net. The majority of sea turtle bycatch documented by the observer program on otter trawls are juvenile turtles that were small enough to pass through the bars of the TED or otherwise unable to lift the flap to escape. Based on this information, the development of new TED prototypes designed to allow small turtles to escape otter trawls would provide a restoration benefit. Optimizing the dimensions and mechanisms of TEDs could lead to reduced sea turtle bycatch, ultimately leading to decreased sea turtle mortality. The project would target juvenile Kemp's ridley, loggerhead, and green sea turtles. Results of this project could inform future restoration projects including voluntary incentivized use programs and foreign technology transfer to countries with shrimp fisheries that encounter early life stages of sea turtles.

Project objectives include developing TEDs with reduced bar spacing designed to exclude small sea turtles in the shrimp otter trawl fishery and certifying successful designs through NMFS for use in the Gulf of Mexico. Loggerhead sea turtle hatchlings required for testing would be collected by experienced and permitted staff from designated nesting beaches following established collection protocols. Turtles would be reared to the size required for testing at a permitted facility, using established protocols. TED prototype and proof-of-concept testing would take place in suitable near shore waters in the Gulf of Mexico. The collection of loggerhead hatchlings and captive-rearing to target size would take place during years one through three. Iterative development of TED prototypes would occur in years one through three. Testing of selected TED prototypes for sea turtle exclusion and target catch retention rates would occur in years three and four of the project. This project would be fully implemented and has an estimated project duration of four years. The estimated project cost is $2,153,000.

3.6.5.2 Project Activities

Initial project activities include the collection and captive rearing of loggerhead hatchlings for approximately one year to a size appropriate for TED prototype testing. Turtles would be released upon completion of TED prototype testing. This project involves testing for each TED prototype, including testing the exclusion of small turtles, and target catch retention.

Small turtle exclusion testing would be completed on a research vessel. For each test, three divers deployed on the trawl would release each turtle into the trawl and monitor its passage. A turtle would be scored as a 'capture' if it had not escaped through the TED after 5 minutes. Captured turtles would be removed from the trawl by a diver and sent to the surface where they would be collected and returned to a research vessel. Data recorded during each exposure would include: video record, total time in the trawl, turtle activity level, and turtle disposition (escape or capture). The relative efficiency of the candidate TED design would be compared to that of a control TED tested under the same conditions. The prototypes that meet the escape rate criteria would be recommended for fishery-independent proof-of-concept and commercial target catch retention and bycatch testing.

Catch retention testing would be implemented after turtle exclusion testing is complete. Each TED protype would be tested aboard a twin-rigged research vessel against a currently approved TED design to determine any differences in the target catch. Each TED would be exchanged from each side of the vessel on a daily basis to eliminate vessel side bias. Total shrimp weight would be collected for each net along with samples of the total catch of each net. Samples would be divided into catch categories including shrimp, finfish, non-shrimp crustaceans, other invertebrates, and debris. Data would be analyzed for significant differences in target shrimp catch and bycatch by major catch category.

Prototype TEDs that meet minimum shrimp loss criteria would be recommended for dependent commercial trials aboard contracted commercial vessels. Experimental and sampling design would be identical to those used for proof-of-concept testing. The data collected would be used to assess the restoration potential of each TED design.

3.6.5.3 OPA Evaluation

The OPA evaluation of the proposed project Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.6.5.3.1 Cost-Effectiveness

The costs for this alternative are based on estimates using past experience and knowledge by experts in the field. By implementing this alternative, the Open Ocean TIG expects to increase the cost effectiveness and efficiency of certifying TEDs designed to exclude sea turtles at various life stages. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.6.5.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goal of restoring sea turtles by addressing primary threats such as bycatch in commercial fisheries. The project does this by certifying new TEDs that can provide restoration benefits to juvenile sea turtles through reductions in incidental mortality associated with the Gulf of Mexico shrimp fishery. The data collected from the study are expected to provide useful insights into sea turtle/TED interactions and the factors that influence TED performance for both bycatch reduction and target catch retention. This would allow the Open Ocean TIG to target future restoration. This project is consistent with Open Ocean TIG goals, the Sea Turtle Strategic Framework, and would contribute to Sea Turtles Restoration Type-specific goals outlined in the PDARP/PEIS.

3.6.5.3.3 Likelihood of Success

This alternative has a high likelihood of successfully certifying TEDs designed to exclude sea turtles at various life stages. The project is technically feasible, uses best available science, proven techniques, and established methods. NMFS has long-standing experience in gear testing, and this action would be closely coordinated with those gear experts as well as fishing industry. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.6.5.3.4 Avoid Collateral Injury

Proposed activities would be conducted under long-term existing programs, including the NOAA Fisheries Harvesting Systems Unit and Sea Turtle Stranding and Salvage Program with successful regulatory requirements, permits, and best practices to avoid collateral injury. Further, BMPs described in environmental compliance documents would be implemented to minimize impacts on species and critical habitat. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.6.5.3.5 Benefits Multiple Resources

Future implementation of restoration methods developed under this alternative is expected to benefit multiple species of sea turtles. Expected benefits of the proposed project would include collection of valuable data used to fill data gaps in conservation gear effectiveness and reduce sea turtle bycatch and mortality.

3.6.5.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. The project would involve data collection and analysis activities that include field monitoring by trained scientists, with no involvement of the public.

3.6.6 Long-term Nesting Beach Habitat Protection for Sea Turtles

3.6.6.1 Project Description

The ACNWR is located at Melbourne Beach along Florida's central east coast and consists of four segments, spanning 20.5 miles (Figure 3-1). The Archie Carr Refuge partnership is a unique multiagency partnership dedicated to integrating endangered species and ecosystem protection with sustainable development and human recreation use. The conservation land ownership and management within the area of the refuge represent an integrated partnership with federal, state, and local governments and private entities under multiple jurisdictions (Refuge partnership). Hence, the larger Refuge partnership extends beyond the ACNWR's management and acquisition boundaries throughout the barrier island ecosystem. In response to the substantial development pressures experienced by this area, these partnering entities participate in a coordinated land acquisition effort, which has resulted in the purchase of approximately 1,324.77 acres within the Refuge's acquisition boundary and 2,668.56 acres within the larger Refuge partnership (as of 2007). In 1994, a formal partnership called the Archie Carr Working Group was formed to enhance coordination, cooperation, and communication among these diverse interest groups involved in the refuge and the barrier island protection effort. Representing land acquisition and management agencies, conservation groups, nonprofit organizations, educational and research institutions, homeowner associations, and the local community, the Archie Carr Working Group provides a forum to guide and coordinate current and future management needs of the larger Refuge partnership.

ACNWR, hosts the highest density nesting beach habitat in the western hemisphere for loggerhead sea turtles, is the most significant area for green sea turtle nesting in North America, and serves as increasingly important nesting habitat for leatherback sea turtles (USFWS 2008). These sandy shorelines at ACNWR serve as nesting habitat for sea turtles that spend a portion of their lives in the Gulf of Mexico. Studies have shown that a portion of the nesting sea turtles using beaches outside the Gulf of Mexico migrate into the Gulf of Mexico for foraging (Ceriani et al. 2012, 2015; Evans et al. 2011; Foley et al. 2008, 2013; Hardy et al. 2014; Sasso et al. 2011). Ceriani et al. (2015) recorded that about one-third of 330 post-nesting loggerheads from ACNWR resided on the southwest Florida continental shelf in the eastern Gulf of Mexico. ACNWR is a mosaic of public and private lands. However, rapid development and increasing land costs are occurring within the acquisition boundary, highlighting the need for protection of available parcels.

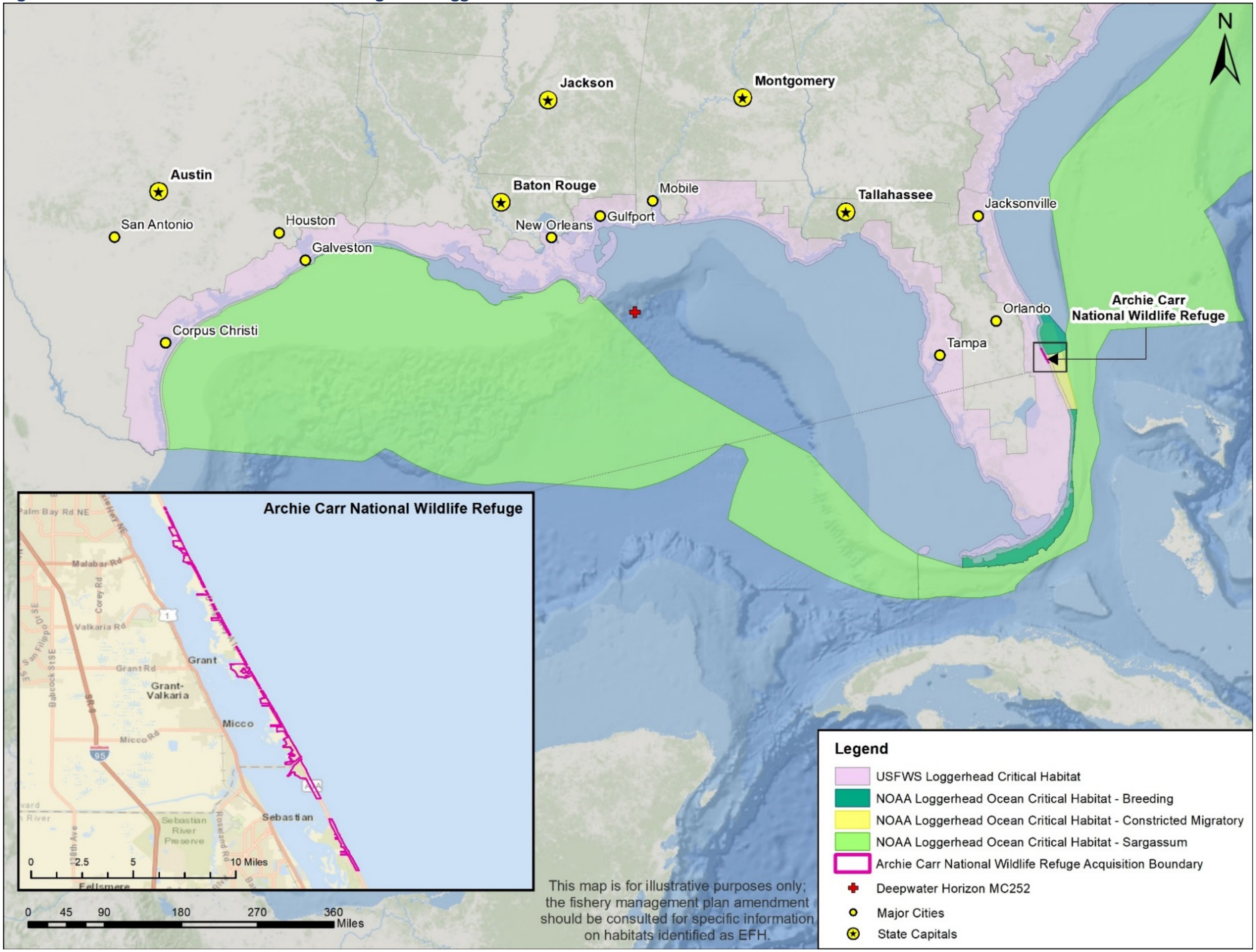
The goal of the project is to protect high-density nesting beach habitat and enhance sea turtle hatchling productivity and survival. Strategic protection of priority parcels by working with willing sellers would help minimize fragmentation, reduce risk of additional coastal armoring (e.g. rip rap, rock walls, sheet metal pilings) and contribute to overall sea turtle protection, conservation and management objectives. Approximately 47 parcels (~54 acres) have been identified for protection. Of these 47, there are 17 high priority parcels that meet the goals of this project. The Trustees would work with multiple partners to implement the project. It is anticipated that additional funding sources would be leveraged to meet overall ACNWR protection goals.

Acquisition of priority parcels would be pursued through either fee-simple acquisition or less-than-fee easement acquisition from willing sellers. Conservation of this valuable habitat would reduce anthropogenic disturbances, lessen future threats, and support sea turtle hatchling survival. The project would target green and loggerhead sea turtles but would benefit an abundance of coastal resources. Years one through three activities would focus on property acquisition including property appraisals, due diligence tasks, and negotiations with willing sellers. It is anticipated that land acquisition would occur as funding and properties become available throughout the project timeline of three years. The final number of properties acquired would be dependent upon individual parcel pricing. This project would be fully implemented and has an estimated project duration of three years. The estimated project cost is up to $7,000,000.

3.6.6.2 Project Activities

Through a willing seller approach, priority parcels would be acquired to ensure the highest density sea turtle nesting beaches are protected in perpetuity. Seventeen high priority tracts have been identified for acquisition by the USFWS and its conservation partners. A third-party land trust would be utilized to engage and cultivate relationships with landowners, conduct appraisals, and acquire property. The Trustees would conduct due diligence tasks to evaluate parcels, including environmental assessments, property surveys and title searches to ensure the property is not contaminated, boundaries are clear, and that titles are clear. The Refuge partners would work with a third-party land trust to convey the tracts from the trust to ACNWR, the State of Florida, or Brevard or Indian River Counties as donations for their long-term protection and management.

Figure 3-1: Archie Carr National Wildlife Refuge and loggerhead sea turtle critical habitat.



3.6.6.3 OPA Evaluation

The OPA evaluation of the proposed project Long-term Nesting Beach Habitat Protection for Sea Turtles using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.6.6.3.1 Cost-Effectiveness

The estimated costs for this project are based on best available estimates of market value for high priority parcels to meet the Trustees' goals. Appraisals would be performed to establish a fair market value for each parcel purchased. The prevention of habitat loss is generally more cost-effective than restoration. The parcel or parcels purchased would be protected from further development, preventing additional loss of habitat. In addition, the opportunity to leverage other funding would result in a greater level of protection than would be possible through this project alone. Overall the Open Ocean TIG finds the cost of the proposed alternative reasonable and appropriate.

3.6.6.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would meet all four of the Trustees' goals for Sea Turtles listed in Table 2-3. The project would prevent the loss of high density sea turtle nesting beaches and establish long-term protection and conservation of valuable habitat. This alternative has a strong nexus to injuries caused by the DWH oil spill and response activities. Through habitat conservation, the project would restore sea turtles which were impacted by the spill. This project is consistent with Open Ocean TIG goals, the Sea Turtle Strategic Framework, and would contribute to Sea Turtles Restoration Type-specific goals outlined in the PDARP/PEIS.

3.6.6.3.3 Likelihood of Success

The project would have a high likelihood of success given the Trustees' documented success of previous land acquisition projects and subsequent transfer of those tracts to the USFWS and other cooperating entities. Trustee agencies and associated conservation partners have successfully implemented projects similar to this restoration alternative. These include land acquisition projects that were ultimately deeded to non-profits, state, or federal government agencies. There is also an established partnership of state and county governments and non-governmental conservation groups known as the Archie Carr Working Group, which has successfully protected over 2,600 acres of sea turtle nesting habitat (USFWS 2008). Additionally, the process may involve a third-party land trust with both an established relationship with the implementing Trustee and established protocols. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.6.6.3.4 Avoid Collateral Injury

This project is not expected to cause any collateral injuries to natural resources because it focuses on land acquisition and conservation and these activities pose no direct or indirect risk of injury to the environment. The acquisition and conservation of the property would prevent future development, thereby preventing any habitat loss or injury, species loss or displacement, or other potential impact that would result from unabated development of this property.

3.6.6.3.5 Benefits Multiple Resources

This project would conserve habitat, reduce fragmentation, and provide protection from light pollution. This would benefit multiple species of sea turtles, birds, and terrestrial species. The land acquisition would provide habitat for these species in perpetuity, protecting habitats from impacts associated with development. This protection would enhance long-term requirements for many species of plants and animals, and would help meet habitat and population objectives of endangered species recovery plans.

3.6.6.3.6 Public Health and Safety

This project is not expected to affect public health and safety. The project would consist of planning, land acquisition, and monitoring activities that would not impact public health and safety.

3.6.7 Reducing Sea Turtle Entanglement from Recreational Fishing Debris

3.6.7.1 Project Description

Sea turtle entanglement in discarded or lost recreational fishing gear, such as monofilament line and cast net material, is an important and growing problem. Monofilament line is a prevalent form of marine debris and pollution, and entanglement in marine debris is a global problem affecting at least 200 marine species (NOAA 2014). As described in Carr (1987), sea turtles are "peculiarly prone to…tangle themselves in lines and netting discarded by fishermen." Such interactions can lead to gastrointestinal issues, strandings, and death. The goal of the project is to reduce sea turtle injury and mortality from capture in discarded or lost recreational fishing gear. Areas targeted for project activities may include fishing piers, jetties, reefs (both natural and artificial), or any other in-water structure that accumulates recreational fishing gear debris that has the potential to entangle sea turtles.

Project objectives include identifying and prioritizing problem hotspots for sea turtle entanglement at the state and regional levels across the Gulf of Mexico and reducing entanglement incidents at priority hotspots. The project would target Kemp's ridley, loggerhead, green turtle, and hawksbill sea turtles. Attention would be focused on Gulf of Mexico hotspots in the U.S. coastal waters where sea turtles are likely to occur. Project planning to identify and prioritize hotspots for turtle entanglement would begin in year one and continue throughout the project. Working to prevent additional recreational marine debris and administering clean up events would occur in years two through five and would be adaptively managed throughout the five-year project timeline. This project would be fully implemented and has an estimated project duration of five years. The estimated project cost is $1,113,600.

3.6.7.2 Project Activities

The project would begin by identifying hotspots and problem areas for sea turtle interactions with discarded/lost recreational fishing gear across the Gulf of Mexico. This includes reviewing stranding data to identify areas where problems have been documented; determining where sea turtle habitats intersect with high-use recreational fishing areas; reviewing information and reports from local governments and organizations; conducting outreach to local NGOs, dive operators, and other stakeholders to ask for information on areas where recreational fishery debris is known to be a problem; and reviewing other information sources as appropriate. Areas would be prioritized based on fishing intensity, prevalence of sea turtles, and frequency of entanglement/ingestion-related strandings. Existing debris would be addressed through in-water cleanup efforts around structures that accumulate recreational fishing gear debris and has the potential to entangle sea turtles. Cleanup efforts may be one-time events or require multiple clean ups and be implemented through grants to state or local governments, nongovernmental organizations, or other stakeholders. The reduction of future entanglement would be accomplished through education and outreach as well as facilitation of proper debris disposal including monofilament disposal containers and educational materials developed in coordination with partners. The project would require extensive coordination between partners, the local community, and various stakeholders.

3.6.7.3 OPA Evaluation

The OPA evaluation of the proposed project Reducing Sea Turtle Entanglement from Recreational Fishing Debris using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.6.7.3.1 Cost-Effectiveness

The proposed cost for this project, which is based on similar past projects and program activities, are reasonable and appropriate; however, previous efforts have been conducted at a smaller scale. This project would seek to enhance efficiency and cost-effectiveness by implementing a planning phase to assess existing data and identify priority areas for concentrated efforts. Additional planning would further increase cost-effectiveness through an assessment of data availability, identifying potential partners and existing programs that can be leveraged, and estimating the number of potential problem areas across the Gulf of Mexico.

3.6.7.3.2 Trustee Restoration Goals and Objectives

In the PDARP/PEIS, the Trustees identified the goal of restoring for injuries by addressing primary threats to sea turtles such as bycatch in recreational fisheries. This project has a clear nexus to the injuries described in the PDARP/PEIS because it would contribute to the restoration of sea turtles injured by the DWH oil spill with a focus on Kemp's ridley, loggerhead, green turtle, and hawksbill sea turtles. This project would reduce sea turtle injury and mortality from exposure to and entanglement in discarded or lost recreational fishing gear at sites selected as priorities. However, a regional approach to restoration, with partners in each Gulf state, would result in a longer-term benefit to injured species potentially across a wider geographic range than currently proposed with hotspot implementation. This project is consistent with Open Ocean TIG goals, the Sea Turtle Strategic Framework, and would contribute to Sea Turtles Restoration Type-specific goals outlined in the PDARP/PEIS.

3.6.7.3.3 Likelihood of Success

The project is technically feasible and uses established methods and partnerships. However, while the threat to sea turtles from entanglement in, or ingestion of, recreational-based marine debris has been established, there is less documentation on the effectiveness of potential actions to reduce this threat. Incorporating more information about the range of activities that have been implemented in the Gulf of Mexico would help Trustees select the most effective techniques and increase the likelihood of success for this project.

3.6.7.3.4 Avoid Collateral Injury

This project is not expected to cause direct or indirect collateral injury to natural resources. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.6.7.3.5 Benefits Multiple Resources

This project would likely benefit sea turtles, marine mammals, and avian species. Expected benefits would include a reduction in recreational fishing debris that would in turn reduce the risk of entanglement for numerous marine species.

3.6.7.3.6 Public Health and Safety

The Open Ocean TIG finds that negative impacts to public health and safety from this project are not likely. However, relevant safety measures and practices would be followed during project implementation. The project consists of planning, implementation, and monitoring activities that would not involve the public.

3.6.8 Reducing Sea Turtle Bycatch at Recreational Fishing Sites

3.6.8.1 Project Description

Each year the Sea Turtle Stranding and Salvage Network (STSSN) documents and responds to sea turtles that are incidentally caught by recreational fishermen at sites such as piers, bridges, and other shoreline structures. However, these reports likely only represent a portion of the hook and line interactions that are occurring. There are many factors involved in whether or not an incidental capture is reported, including public awareness of who to contact and what to do with the animal. The goal of the project is to identify factors contributing to the incidental capture of sea turtles at shore-based recreational fishing sites, which may inform future restoration projects to reduce recreational bycatch from occurring. This project aims to increase sea turtle survival through enhanced understanding of the influences contributing to recreational bycatch. This restoration project would focus on Gulf-wide data collection with the goal of completing the first comprehensive regional assessment of parameters influencing hook and line capture of sea turtles from piers, and identifying voluntary measures that can be implemented to reduce bycatch. The project would also work to improve public awareness of hook and line captures and inform the public who to contact if they catch a turtle. Ultimately, this project would provide critical information for future restoration projects to implement voluntary measures to reduce sea turtle bycatch at recreational fishing sites.

Project objectives include inventory fishing sites and characterize them by variables that may affect bycatch of sea turtles (e.g., night fishing, fish cleaning stations, bait types, hook types, etc.); collect data to better understand co-factors influencing sea turtle bycatch; and promote reporting of incidental captures to trained responders to reduce injury to bycaught sea turtles. Target species are Kemp's ridley, loggerhead, and green sea turtles. This project would be implemented in each of the five Gulf states. Project planning would occur in year one through an assessment of existing data.

Angler surveys and data analysis would occur in years two through four. Based on the results of the angler survey efforts, pilot efforts may be implemented in years three through five working to educate the public on voluntary changes to fishing practices that may reduce sea turtle bycatch. Project monitoring would occur simultaneously with these activities and a final report would be compiled in year five. This project would implement initial planning activities and has an estimated project duration of five years. The estimated project cost is $1,329,000.

3.6.8.2 Project Activities

Project activities include angler surveys to begin characterization of factors influencing sea turtle incidental capture; data collection and analysis to identify potential bycatch reduction strategies; and implementation of education and outreach to reduce incidental catch at fishing sites. This project would require coordination with fishermen, the STSSN, states, and municipalities. Existing surveys and data regarding sea turtle bycatch and capture reports would be reviewed and an inventory of Gulf of Mexico fishing sites would be created. This inventory would address potential bycatch influences such as time of day, type of fishing site, gear used, etc. Additional angler surveys would be performed, and the cumulative data collection would be applied to generate an outreach and education plan. Thought out the project, education and outreach would conducted to increase reporting of incidental capture and the number of hooked turtles taken to rehabilitation centers for proper treatment and release. Based on the data collected and reviewed, pilot efforts would then be implemented to educate the public on voluntary changes to their fishing practices that may reduce sea turtle bycatch. Together these efforts are expected to result in decreased mortality of sea turtles from bycatch on hook and line gear at recreational fishing locations in the Gulf of Mexico. The information collected by the survey program during this project and analyses of those data, as well as initial pilot outreach on voluntary practices to reduce bycatch, would provide information critical to developing future restoration projects to reduce bycatch of sea turtles at piers across the Gulf of Mexico.

3.6.8.3 OPA Evaluation

The OPA evaluation of the proposed project Reducing Sea Turtle Bycatch at Recreational Fishing Sites using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.6.8.3.1 Cost-Effectiveness

The costs for this alternative are based on estimates using past experience and knowledge by experts in the field. This project is designed to increase efficiency and effectiveness of restoration actions over the project duration through identification of bycatch co-factors and priority areas during initial planning activities. However, cost effectiveness would be improved through increased partnership development to leverage existing information and programs.

3.6.8.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees’ goal of addressing primary threats to sea turtles such as bycatch in recreational fisheries. This project has a strong nexus to the injuries described in the PDARP/PEIS because it would restore sea turtles that were impacted by the DWH oil spill. However, a regional approach to restoration, with partners in each Gulf state, would result in a longer-term benefit to injured species, potentially across a wider geographic range than currently proposed with localized implementation. This project is consistent with Open Ocean TIG goals, the Sea Turtle Strategic Framework, and would contribute to the Sea Turtles Restoration Type-specific goals outlined in the PDARP/PEIS.

3.6.8.3.3 Likelihood of Success

The project is technically feasible and uses established methods and partnerships. However, while the threat to sea turtles from bycatch in the recreational fishery has been established, there is less documentation on the effectiveness of potential actions to reduce this threat. Incorporating more information about the range of activities that have been implemented in the Gulf of Mexico would help Trustees select the most effective techniques and increase the likelihood of success for this project.

3.6.8.3.4 Avoid Collateral Injury

This project is not expected to cause collateral injury to natural resources. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.6.8.3.5 Benefits Multiple Resources

This alternative would benefit multiple species of sea turtles. It is possible that data collected to assess fishing and better understand the incidental capture of sea turtles may reduce other forms of bycatch, but this is not a direct objective of this project. Expected benefits would include enhanced understanding of the co-factors that influence sea turtle bycatch, identification or bycatch reduction measures, and reduced injury to sea turtles through education and outreach.

3.6.8.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. The data collection and analysis activities would not involve the public and the education and outreach activities pose no public risk.

3.6.9 Sea Turtles Restoration Type OPA Conclusions

The Open Ocean TIG completed the OPA evaluation of the reasonable range of alternatives. In total, eight alternatives were evaluated. The analysis indicated that each of the eight alternatives would provide benefits to the Sea Turtles Restoration Type. Six of the alternatives (Gulf of Mexico Sea Turtle Atlas, Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery, Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection, Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery, Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing Turtle Excluder Devices, and Long-term Nesting Beach Habitat Protection for Sea Turtles) are anticipated to satisfy all OPA evaluation factors. These projects are preferred.

Two alternatives (Reducing Sea Turtle Entanglement from Recreational Fishing Debris and Reducing Sea Turtle Bycatch at Recreational Fishing from Piers) are non-preferred at this time. The likelihood of success and ability to meet the Trustees goals and objectives would be improved through further planning and coordination.

3.7 OPA Evaluation of Alternatives for Marine Mammals Restoration Type

The Open Ocean TIG screened a number of potential Marine Mammal restoration alternatives that resulted in the identification of five project alternatives (four preferred and one non-preferred). A description of each alternative is provided below followed by the OPA evaluation of that alternative.

3.7.1 Reducing Impacts to Cetaceans during Disasters by Improving Response Activities

3.7.1.1 Project Description

One of the more direct opportunities for resource managers to benefit Gulf of Mexico cetaceans centers on disasters (natural or anthropogenic) or stranding/mortality events, when larger numbers of animals are at risk. An effective, rapid response can have positive benefits to individuals and populations. In the years since the DWH oil spill, NOAA has developed guidelines for marine mammal oil spill response (Ziccardi et al. 2015), marine mammal NRDA guidelines (PDARP/PEIS), updates to the National Contingency Plan for Response to Unusual Marine Mammal Mortality Events (Wilkinson 1996), and numerous drills. Regional efforts have included development of the Gulf of Mexico Marine Mammal Disaster Response Guidelines (GoMMMDRG) and updates to the Area Contingency Plans. Many of these efforts have been general and not specific to situations or regional needs. Therefore, there is a need for new tools and techniques to enhance our ability to respond to marine mammal disasters and develop response plans for a variety of potential disasters not covered by the GoMMMDRG. The goal of this project is to improve and enhance response and assessment activities for marine mammals threatened by disasters in the Gulf of Mexico, including natural (e.g., hurricanes and harmful algal blooms), anthropogenic (e.g., oil or chemical spills, some freshwater inundation events), and cetacean based events (e.g., mass strandings, UME).

Project objectives include identifying area-specific disaster risks and response capacity gaps to improve planning for marine mammal disaster response and investigation and improving marine mammal disaster response and investigation through planning, protocols, development of new tools and techniques, and mass stranding specific equipment and supplies. The overall focus of this project would primarily be on the species over the continental shelf and in the open ocean of the northern Gulf of Mexico. Based on the gap analysis for all disaster scenarios, specific locations may be targeted for certain issues (e.g., southwest Florida and the panhandle of Florida for mass strandings of pelagic species) and response to specific future disaster scenarios may be prioritized. This project is expected to span 10 years. Disaster response work groups and leadership would be established in the first year followed by response planning; identification and prioritization of data, information, and techniques/tools needed; and initiation of studies to improve situation response and assessment in years two and three. Years three to ten would include continued implementation of studies, operations and analysis of the developed plans and protocols. This project would implement long-range activities and has an estimated project duration of 10 years. The estimated project cost is $4,287,000.

3.7.1.2 Project Activities

This project would implement a series of actions to enhance marine mammal disaster response preparedness across the Gulf of Mexico states and open water. These activities include assessment/identification of risks; development of protocols, tools and techniques; and improving detection, mitigation and prevention. First, the project would establish a disaster response working group for disaster assessment and planning, composed of technical experts representing various types of disaster scenarios and led by a Disaster Response Coordinator. An area specific disaster response gap analysis, risk assessment, and protocol development would be performed to identify areas in the current stranding response network that would benefit from additional support, including staffing, training, equipment, communications, and expertise. This activity would be conducted over the life of the project to evaluate progress in filling gaps and to identify new risks or concerns that may develop.

The second project activity would increase the capacity of the marine mammal stranding network to prevent and respond to mass strandings. This would include addressing capacity needs by purchasing equipment necessary to respond to mass strandings and deploying equipment caches for an effective response. A third activity would enhance the ability to respond, investigate and assess the health of cetaceans during disasters in the Gulf of Mexico through scientific studies and the development or application of tools, techniques, and standard protocols addressing detection, response, assessment, mitigation, and monitoring. The disaster response working group would evaluate and prioritize the needs for tools, techniques, and protocols. A small technical group would then develop annual study plans to perform the studies needed through partnerships and collaborations, with a focus on offshore spill responses and mass stranding response improvements. The third activity would also include a feasibility study of an early warning system for mass strandings using a near real time PAM notification system and potential development of tools to assess the air water interface. These studies may also address topics that would inform oil spill response, improve animal or situation triage and assessment, improve clinical treatment, and identify mechanisms for deterrence.

Participation by the Gulf states would also be sought in disaster response planning and implementation. Potential partners include the Marine Mammal Stranding Network, academic institutions, and other organization involved in conducting response and related research activities. Other programs (e.g., NFWF GEBF) are continuing to fund studies and stranding network capabilities, and it is anticipated that this project would collaborate with those programs by sharing data and leveraging and engaging similar activities. All project activities would be closely coordinated with the U.S. National Response Team, Federal Emergency Management Agency, and other relevant agencies to ensure that activities are consistent with appropriate authorizations.

3.7.1.3 OPA Evaluation

The OPA evaluation of the proposed project Reducing Impacts to Cetaceans during Disasters by Improving Response Activities using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.7.1.3.1 Cost-Effectiveness

The costs for this alternative are based on estimates using past experience and knowledge by experts in the field. This project is designed to increase efficiency and effectiveness of restoration actions over the project duration through development of a risk assessment during initial planning activities. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.7.1.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to all three of the Trustees' goals for Marine Mammals listed in Table 2-3. The project does this by increasing marine mammal survival through a better understanding of the causes of illness and death, as well as early detection and intervention for anthropogenic and natural threats. This alternative has a strong nexus to the injuries caused by the DWH oil spill and response activities, because it would restore bottlenose dolphins and cetacean populations within the continental shelf and open ocean which were injured by the DWH oil spill. This project is consistent with Open Ocean TIG goals, Marine Mammal Strategic Framework, and would contribute to the Marine Mammals Restoration Type-specific goals outlined in the PDARP/PEIS.

3.7.1.3.3 Likelihood of Success

This alternative has a high likelihood of successfully increasing marine mammal survival through a better understanding of the causes of illness and death, as well as early detection and intervention for anthropogenic and natural threats. The data and methods needed to identify area-specific disaster risks and gaps in response capacity, develop new tools and techniques, and expand equipment and supplies specifically needed for effective response to mass strandings are available and widely accepted. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.7.1.3.4 Avoid Collateral Injury

Proposed activities would be conducted under long-term existing programs including the Marine Mammal Health and Stranding Response Program, with successful regulatory requirements, permits, and best practices in place to avoid collateral injury to natural resources. Further, BMPs described in environmental compliance documents would be implemented to minimize impacts on species and critical habitat. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.7.1.3.5 Benefits Multiple Resources

This alternative would benefit multiple species of marine mammals. Expected benefits would include increasing marine mammal survival through better understanding of causes of illness and death as well as early detection and intervention for anthropogenic and natural threats.

3.7.1.3.6 Public Health and Safety

The Open Ocean TIG finds that negative impacts to public health and safety from this alternative are not likely. However, established protocols for safety in handling and responding to marine mammal incidents would be followed. The project would involve data collection and analysis activities that include field monitoring by trained scientists, with no involvement of the public.

3.7.2 Compilation of Environmental, Threats, and Animal Data for Cetacean Population Health Analyses (CETACEAN)

3.7.2.1 Project Description

Currently, information on cetacean populations (e.g., abundance, distribution, and health), anthropogenic threats (e.g., noise, vessel strikes, and bycatch), and natural threats (e.g., harmful algal blooms and natural disasters) is collected and maintained by a variety of organizations using disparate database services (e.g., desktop files, public cloud servers, and private servers) that have little interoperability. Furthermore, the field methods and data entry sheets researchers use to collect data (e.g., photo-identification methodology, contaminant measurements, blood and biopsy analyses) may vary from one institution to another, limiting data integration and comparisons for regional assessments and restoration planning, as well as project level to resource level integration. The goal of this project is to develop user-friendly, web-based access to datasets that would assist the Trustees, restoration planners, responders, and conservation managers in assessing the health of cetacean stocks and the stressors that threaten them over time and space. By making key health, threat, and restoration data available to decision makers in a centralized platform, the application would facilitate the development of restoration activities and would increase the speed and effectiveness of response activities to minimize the impacts of stressors and threats, enhancing population resiliency.

Project objectives include identifying key datasets, parameters, analyses, and partners; developing database solutions for marine mammal-related datasets that are currently inaccessible; creating a centralized web-based application that provides access to these data and is interoperable with other key data repositories; and improving and sustaining the use of standardized data collection protocols, analyses, and training materials by groups working with cetaceans in the Gulf of Mexico. The target species for the project include the Gulf of Mexico Bryde's whales, sperm whales, and continental shelf dolphins (*Tursiops* and *Stenella*). The project would provide a Gulf-wide holistic approach to planning and monitoring cetacean restoration, while a location-based and/or project-specific approach would be provided for assessing cetacean health, threats, and restoration. Priority would be given to the locations with species adversely affected by the DWH oil spill. The proposed project would require approximately five years for full implementation and operation. Project planning would occur in years one and two; development of the database platform would occur in years one through four. The CETACEAN platform would be released over the first three years of the project. Training sessions would be held to inform users and data collectors of standardized data collection protocols. Platform maintenance would occur in years two through five. This project would implement initial planning activities and has an estimated project duration of five years. The estimated project cost is $5,808,500.

3.7.2.2 Project Activities

To ensure that the CETACEAN platform would meet the needs of end users and incorporate the best available information, the project team would carefully plan the platform with the help of key collaborators. A steering committee would be convened to engage with partners, formalize data sharing agreements, and catalog required datasets. They would determine the appropriate infrastructure and identify data collection protocols for standardization. Once the appropriate infrastructure is determined, the project team would work with the custodians of each data set or project to develop and maintain plans for incorporating the data over the life of this project. The CETACEAN platform would be a combination of raw data (when there is no other database to store it) and summarized data (if there is an existing data portal for that dataset). The project team would then develop the infrastructure for the platform including a user-friendly interface for queries, data display, in-application data analysis, and data download. Interoperability with existing partner data portals would also be included. In addition to developing interfaces for existing data portals, the project team would work with data partners holding important datasets that are not already housed in established databases. Based on the data needs identified by the steering committee, the team would work with those data partners to facilitate moving their datasets into a format that can be efficiently integrated into the platform. Once the project team has developed the infrastructure for the CETACEAN platform and populated it with key datasets, they would release a soft launch to a limited set of selected users to test the functionality. After the release, the project team would continue to maintain the CETACEAN platform, keeping the datasets as current as possible, addressing any bugs, and adding user-requested features approved by the steering committee (e.g., additional data analysis features).

The key outcome of the project is a web-based application that provides access to the best available data about the health of Gulf of Mexico cetaceans. The data would be synthesized and displayed based on user-directed queries. In addition to aggregating various input datasets, the platform would also be designed for two-way interoperability i.e., develop output formats to share with other established data portals (e.g., Data Integrations Visualization Exploration and Reporting [DIVER], Environmental Response Management Application, OBIS-SEAMAP).

3.7.2.3 OPA Evaluation

The OPA evaluation of the proposed project CETACEAN using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.7.2.3.1 Cost-Effectiveness

Estimated costs for this alternative are based on costs of similar activities that were refined to reflect the proposed activities. By implementing this alternative, the Open Ocean TIG expects to increase the cost effectiveness and efficiency of future restoration planning activities. This platform would bring together existing data which is likely to reduce duplication of data collection efforts. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.7.2.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to all three of the Trustees' goals for Marine Mammals listed in Table 2-3. The project does this by addressing a critical gap in the availability, consistency, and management of data necessary for effective restoration planning, implementation and evaluation. This alternative has a strong nexus to the injuries caused by the DWH oil spill and response activities because it would support the restoration of Gulf of Mexico Bryde's whales, sperm whales, continental shelf dolphins, and other oceanic odontocetes which were injured by the DWH oil spill. This project is consistent with Open Ocean TIG goals, the Marine Mammal Strategic Framework, and would contribute to the Marine Mammals Restoration Type-specific goals outlined in the PDARP/PEIS.

3.7.2.3.3 Likelihood of Success

This alternative has a high likelihood of successfully addressing a critical gap in the availability, consistency, and management of data necessary for effective restoration planning, implementation and evaluation. The project has been designed in phases to ensure that key data about marine mammal health, stressors, threats, and distribution across the Gulf of Mexico would be collated to inform future restoration planning phases. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.7.2.3.4 Avoid Collateral Injury

This alternative is not expected to cause any collateral injuries to natural resources because it focuses on planning and design tasks, activities that pose no direct or indirect risk of injury to the environment.

3.7.2.3.5 Benefits Multiple Resources

This alternative would benefit multiple marine mammal species by providing data and analysis tools to improve understanding of the resources and informing future restoration activities through access to the best available data about the health of Gulf of Mexico cetaceans.

3.7.2.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. The project would involve desktop data collection and analysis activities by trained scientists, with no involvement of the public.

3.7.3 Reduce Impacts of Anthropogenic Noise on Cetaceans

3.7.3.1 Project Description

Cetaceans in the Gulf of Mexico inhabit an environment with a variety of human-made sounds from sources such as seismic airguns, explosives, pile driving, and large vessels. Cetaceans rely on sound for vital life functions, and increased noise levels may disrupt or displace these functions. Anthropogenic sound has increased in all oceans over the last 50 years (Croll et al. 2001; McDonald et al. 2006; Wenz 1962), and these rising noise levels affect marine animals and ecosystems in complex ways including death, hearing loss, stress, behavioral changes, reduced foraging success, reduced reproductive success, masking of communication and environmental cues, and habitat displacement (Francis and Barber 2013). Many strategies and technologies for reducing noise impacts have been identified; however, further development and effective implementation are still needed. The goal of this project is to reduce the human-caused noise exposure to cetaceans in priority areas of the Gulf of Mexico. It would build upon the results and recommendations of previous efforts such as the 2014 U.S. Bureau of Ocean Energy Management (BOEM) report on quieting technologies, the International Maritime Organization's guidelines for reducing underwater noise for commercial shipping, the NOAA CetSound (Cetacean & Sound Mapping) studies, and other ongoing efforts to better understand the effect of noise on marine mammals. The project would focus on low- and mid-frequency sound sources with the greatest potential for harm to open ocean cetacean populations in the northern Gulf of Mexico.

Project objectives include advancing existing noise reduction technologies towards implementation; identifying high-risk areas for restoration; monitoring soundscape data; and developing and implementing a strategic approach to restoration to prevent and reduce noise in each high-risk area. Priority species include species with known or suspected sensitivity to noise sources, those that were injured by the DWH oil spill, and those that are found in areas of greatest human activity. In particular, the sperm whale, the Gulf of Mexico Bryde's whale, and beaked whales are priority species for the project. The proposed project would be conducted over six years. Implementation and monitoring within already identified priority areas and maintaining and extending PAM arrays can begin immediately (Figure 3-2). Identifying additional priority areas and developing new sound-reduction measures would occur in years one and two. Developing a plan for the newly developed measures would occur in years three and four. Implementation of those measures would occur in years four through six. This information would also inform restoration that may be proposed in future restoration plans. Monitoring would occur throughout the project. This project would implement long-range activities and has an estimated project duration of six years. The estimated project cost is $8,992,200.

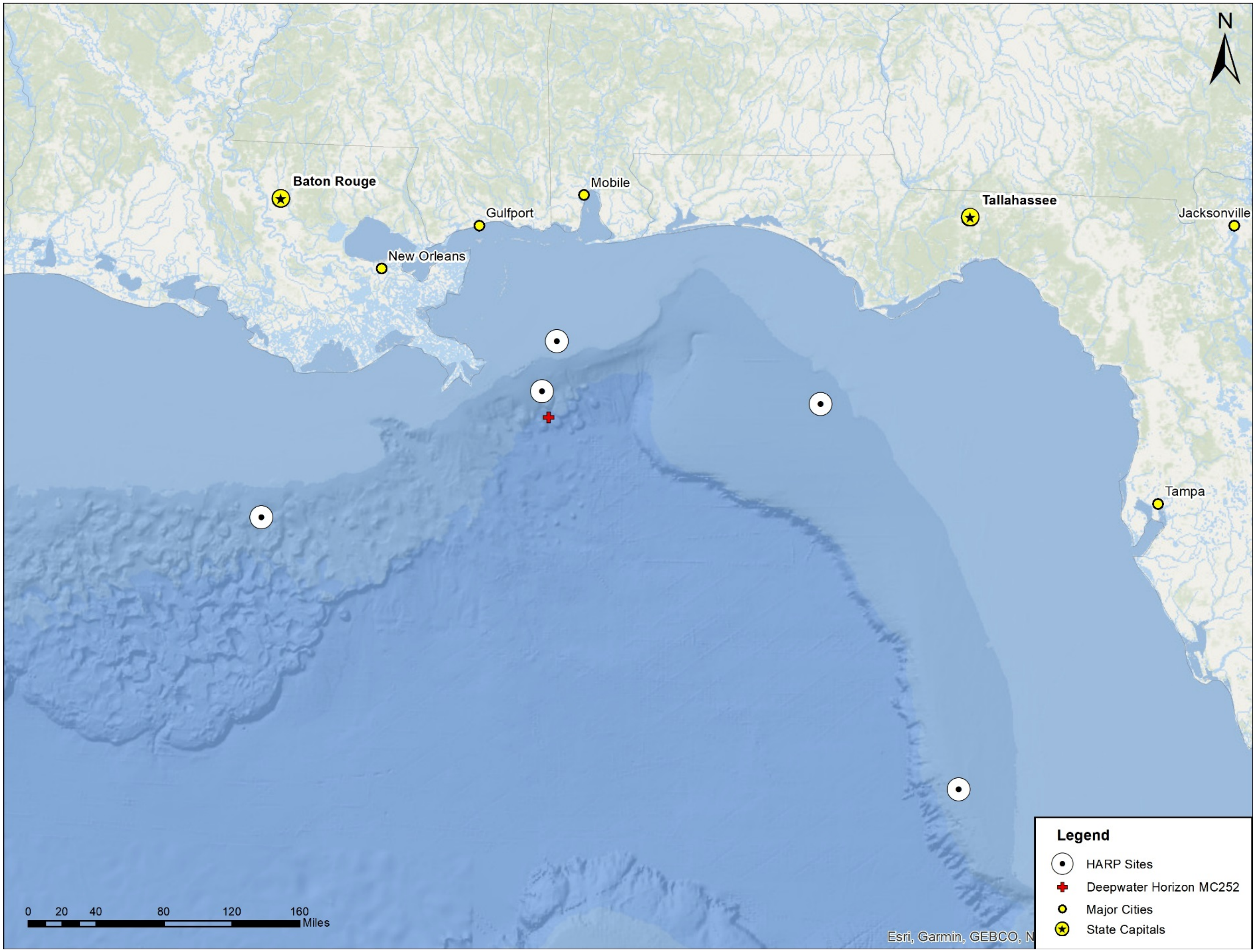
3.7.3.2 Project Activities

This project would have four primary activities. In some cases, there is enough existing information to proceed with moving noise reduction measures forward, but in other cases, more information is needed to identify high-risk areas and strategies for targeted restoration. Project components would be implemented simultaneously when possible, but many activities would be iterative as early activities address data gaps to inform ongoing restoration planning and implementation.

The first activity would focus on moving existing noise reduction technologies and prototypes towards implementation in the Gulf. The project would utilize existing report recommendations, literature, and technical working groups to identify measures that are ready for implementation or trial field studies. For example, NMFS and BOEM have identified several mitigation measures to reduce impacts of seismic airgun surveys on marine mammals. Vessel noise and the decommissioning of oil/gas platforms are also two areas where expediting technique testing and development could be beneficial. This project would work with industries to implement outreach and voluntary programs to reduce vessel noise. Outcomes of this activity include a prioritized list of measures that are ready for implementation, outreach and/or voluntary certification programs, potential partnerships, and incentives for the implementation of each technique/prototype.

The second activity would identify priority areas for implementing restoration actions that prevent or reduce noise impacts to cetaceans by establishing a working group to conduct a risk assessment based on best-available information for noise and cetacean populations in the Gulf of Mexico. Expected outcomes of this activity include a preliminary review of best-available data, including a hierarchy of significant data gaps/needs that should be addressed for the in-depth risk assessment; and the development of lists and descriptions of priority areas in need of restoration actions to address the effects of noise on cetaceans.

Figure 3-2: Locations of existing passive acoustic monitoring equipment in the Gulf of Mexico that would be utilized for this project.



The third activity would maintain several long-term high frequency acoustic recording packages (HARPs) in addition to deploying low frequency acoustic recording packages (LARPs) to collect long-term baseline data for marine mammal distribution and soundscape characterization. An extended PAM array at short-term sites would monitor noise in high-risk areas or priority areas that have significant data gaps. The data and analyses from the PAM arrays (HARPs and LARPs) would help in the selection and development of appropriate restoration activities in Activity 1, be important for validating and improving future iterations of the risk assessment in Activity 2, and would help in project-level (e.g., the change in noise patterns in key areas) and resource-level (e.g., establishing baseline levels of cetacean species abundance/density) monitoring efforts.

The fourth activity would build on what is learned from the initial efforts in order to develop and implement a specific restoration implementation plan for preventing and/or reducing noise in each key area based on the information and knowledge gained from the project. This activity would also provide incentives for testing and/or implementing new technologies identified in the first and second activities in key areas of the Gulf of Mexico.

3.7.3.3 OPA Evaluation

The OPA evaluation of the proposed project Reduce Impacts of Anthropogenic Noise on Cetaceans using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.7.3.3.1 Cost-Effectiveness

The costs for this alternative are based on estimates using past experience and knowledge by experts in the field. The use of existing programs proposed by this alternative is a cost-effective approach that takes advantage of existing expertise, program infrastructure and partnerships for effective implementation of the proposed activities. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.7.3.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to all three of the Trustees' goals for Marine Mammals listed in Table 2-3. The project does this by developing collaborative partnerships to identify, test, and implement strategies and technologies to reduce noise impacts on marine mammals using outcomes from science-based risk assessment and prioritization steps. This alternative has a strong nexus to the injuries caused by the DWH oil spill and response activities. It would restore species that were injured by the DWH oil spill that are found in areas of greatest human activity and with known or suspected sensitivity to noise sources, particularly the sperm whale (listed under the ESA), the Gulf of Mexico Bryde's whale, and beaked whales. This project is consistent with Open Ocean TIG goals, the Marine Mammal Strategic Framework, and would contribute to the Marine Mammals Restoration Type-specific goals outlined in the PDARP/PEIS.

3.7.3.3.3 Likelihood of Success

This alternative has a high likelihood of achieving its objectives to identify, test, and implement strategies and technologies to reduce noise impacts on marine mammals using outcomes from science-based risk assessment and prioritization steps. The likelihood of success would be further increased by developing collaborative partnerships and building upon the results and recommendations of previous efforts to reduce the impacts of noise. The project is technically feasible and uses best available science, proven techniques and established methods. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.7.3.3.4 Avoid Collateral Injury

This project would avoid collateral injury by evaluating environmental consequences of techniques during the project planning and design activities and by identifying BMPs to minimize potential direct or indirect collateral injury. Deployed equipment would be attached to buoys using methods to reduce the risk of entanglement to protected species. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.7.3.3.5 Benefits Multiple Resources

This alternative would benefit marine mammals, sea turtles, fish, and invertebrates. Expected benefits to species would include conservation of the quality of the existing acoustic habitat by designing noise management techniques, minimizing direct adverse physical and behavioral impacts by building new decision support tools, and understanding noise exposure at locations of key importance to marine mammals.

3.7.3.3.6 Public Health and Safety

The Open Ocean TIG finds that negative impacts to public health and safety from this alternative are not likely. However, relevant safety measures and practices would be followed during project implementation. The project would involve data collection and analysis activities that include field monitoring by trained scientists, with no involvement of the public.

3.7.4 Reduce and Mitigate Vessel Strike Mortality of Cetaceans

3.7.4.1 Project Description

Vessel collisions are a known source of anthropogenic mortality for many marine mammal species, especially large whales (Laist et al. 2001). Collisions can result in serious injury or mortality due to either penetrating injuries from propeller cuts or blunt force trauma from collisions with vessel hulls (Andersen et al. 2008). The true numbers of whale interactions with vessels are typically underestimated as stranding records represent minimum counts and cetacean carcasses offshore rarely drift to shore. While vessel collisions may be documented relatively infrequently in some large whale species, they may still be considered a major threat, particularly for small populations. While there are a number of potential actions to reduce whale-vessel interactions (e.g., changing vessel routes and speeds), there is insufficient information regarding measures that can be implemented consistently across the Gulf of Mexico and which measures would be the most effective for the injured species most at risk from vessel strikes. The goal of this project is to decrease the relative risk of vessel collisions with offshore cetacean species injured by the DWH oil spill, especially large whales, in the offshore waters of the Gulf of Mexico.

Project objectives include identifying high-risk areas in the northern Gulf of Mexico and the restoration activities for each of those areas that would most effectively reduce the risk of vessel strikes to large whales and other offshore cetacean populations. This project would target marine mammals such as Gulf of Mexico Bryde's and sperm whales. Other offshore cetacean species would be considered for risk reduction measures, contingent upon the availability of species-specific density, abundance, and distribution data. The project would begin as a Gulf-wide risk assessment but would narrow in focus to specific locations based on the overlap of vessel traffic and marine mammal distributions– particularly large whales and oceanic species. Priority would be given to the locations with animals affected by the DWH oil spill and sources of vessel traffic that overlap with those affected animals. Identifying high-risk areas and restoration options for each identified area would occur in years one through three of the project. Stakeholder coordination, implementation of restoration options, and restoration monitoring would occur in years three and four. This project would implement long-range activities and has an estimated project duration of four years. The estimated project cost is $3,834,000.

3.7.4.2 Project Activities

To appropriately focus vessel strike risk reduction activities, this project would first conduct planning analyses to establish vessel activity in the Gulf, consolidate data for characterizing offshore cetacean distribution, and then combine vessel and cetacean data to identify areas of relative concern for collision risk. Once the project establishes and prioritizes a catalog of high-risk areas, scientists and managers would identify, develop, and cultivate buy-in from other stakeholders, and implement the most effective and efficient restoration actions for each high-risk area.

The first activity would consist of data analysis and characterization of high-risk areas for marine mammal strikes. This activity would focus on aggregating and analyzing existing data (e.g., automatic identification systems and vessel monitoring system [VMS]) on vessel traffic characteristics and marine mammal distributions for the northern Gulf of Mexico. Then a risk assessment (e.g., Conn and Silber 2013; Fonnesbeck et al. 2008) would be conducted to catalog high-risk areas and time of the year where and when vessel collisions are most likely to both occur and result in serious injuries and mortalities. The project team would compare/contrast the risk assessment results to known events and would characterize the vessel activities, traffic patterns, and vessel operators/industries most prevalent in each high-risk area. The team would consider species-specific vessel avoidance behaviors to identify sensitive, more vulnerable species at greater risk of vessel strikes. The team would also identify significant data gaps that prevent a risk assessment for certain locations, times of the year, species, etc., and would obtain expert review of analytical results. This activity would result in a catalog of spatio-temporal areas of concern where there is elevated risk of whale-vessel collisions in the Gulf of Mexico.

The second activity would identify high-risk areas and restoration activities that would sustainably and most effectively reduce the risk of vessel collision for large whales and, to the extent possible, other offshore cetacean populations through collaborative partnerships. This would include using a shipping liaison to work directly with industry to identify, test, and implement potential measures. The goal is to work closely with the shipping industry and other stakeholders throughout this process to gain support and facilitate implementation of effective measures. Through stakeholder and industry meetings and workshops, the project would identify priority areas for implementation, potential partners and other stakeholders, and recommended measures that would be the most effective for risk reduction.

The third activity would be the implementation of the selected risk reduction measures according to the recommendations and priorities developed in partnership with industry. Coordination would continue with stakeholders to maintain awareness and monitor industry developments. Activities would be closely coordinated within NOAA (e.g., charting, law enforcement) and with other agencies (e.g. International Maritime Organization, BOEM, and U.S. Coast Guard [USCG]) to develop and implement preferred measures.

3.7.4.3 OPA Evaluation

The OPA evaluation of the proposed project Reduce and Mitigate Vessel Strike Mortality of Cetaceans using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.7.4.3.1 Cost-Effectiveness

The costs for this alternative are based on estimates using past experience and knowledge by experts in the field. The use of existing programs proposed by this alternative is a cost-effective approach that takes advantage of existing expertise, program infrastructure, and partnerships for effective implementation of the proposed activities. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.7.4.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goal for identifying and implementing actions that address direct human-caused threats to marine mammals such as vessel collisions (Table 2-3). The project would do this by conducting the proposed planning activities and implementing measures to reduce vessel strikes on whales in prioritized restoration areas. This alternative has a strong nexus to the injuries caused by the DWH oil spill and response activities because it would restore large whales including sperm whales and Gulf of Mexico Bryde's whales, which were injured by the DWH oil spill. This project is consistent with Open Ocean TIG goals, the Marine Mammal Strategic Framework, and would contribute to the Marine Mammals Restoration Type-specific goals outlined in the PDARP/PEIS.

3.7.4.3.3 Likelihood of Success

This alternative has a high likelihood of successfully conducting the proposed planning activities and implementing measures to reduce the risk of vessel strikes on whales in prioritized restoration areas. The project is technically feasible and uses best available science, proven techniques, and established methods. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.7.4.3.4 Avoid Collateral Injury

This project would avoid collateral injury by evaluating environmental consequences of techniques during the project planning and design activities and by identifying BMPs to minimize potential direct or indirect collateral injury. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.7.4.3.5 Benefits Multiple Resources

This alternative would benefit multiple resources including marine mammals, sea turtles and other highly pelagic species. By implementing restoration activities that protect marine mammals from vessel strikes, benefits to sea turtles and other highly pelagic species may be realized.

3.7.4.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. Should restoration measures evolve that would intersect with commercial transportation, shipping, or other similar vessel activity, the measures would be developed taking into consideration any risk to public health and safety and would be consistent with any federal or state regulatory safety requirements.

3.7.5 Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns

3.7.5.1 Project Description

Little is known about the health, habitat use, and movement patterns of small cetaceans that reside in coastal, continental shelf, and open ocean waters of the northern Gulf of Mexico. Health assessments are useful tools in identifying the impact and geographic scope of stressors on marine mammals and they provide invaluable data on their habitat use and movement patterns. Furthermore, health assessment data would help to identify potential disease issues and associated risk factors and establish current population health baselines in these marine mammal species. The goal of this project is to collect and analyze health data to understand the current and emerging stressors for small cetaceans. Data collected in this project would also be used to develop a better understanding of habitat use and movement patterns necessary for designing effective restoration strategies. This project would help to refine methods to safely capture, assess, and tag small cetaceans in open water environments.

The objectives of this project are 1) to conduct veterinary assessments on northern Gulf of Mexico coastal and continental shelf small cetaceans to collect data that would help identify potential disease issues and associated risk factors and to establish current population health baselines and 2) to deploy satellite tags on northern Gulf of Mexico coastal and continental shelf small cetaceans to collect data on habitat use and movement patterns. Bottlenose dolphin and Atlantic spotted dolphin stocks off the coastal waters of the Florida Panhandle, Alabama, and eastern Mississippi would be the focus of this project. This project is expected to last five years with field health assessment occurring in years one, three, and five. This project would be fully implemented and has an estimated project duration of five years. The estimated project cost is $4,620,000.

3.7.5.2 Project Activities

The project activities would include health assessments and satellite tagging on bottlenose dolphin and Atlantic spotted dolphin stocks. Health assessments and satellite telemetry are useful tools in identifying the impact and geographic scope of stressors on marine mammals. Sampling would occur on 10-15 dolphins over a two-week sampling period twice per year in years one, three, and five. As a result of this project, health assessments on approximately 60-90 dolphins, and telemetry data, where possible, would be obtained. These data would be analyzed and summarized into a report to provide assessment on the impacts of current and emerging stressors on small cetaceans and refine restoration strategies for these stocks/species. Secondarily, the project would develop and refine alternative methodology to conduct health assessments in deeper water for coastal and shelf cetaceans. Recommendations of refined methods to safely capture, assess, and tag small cetaceans in open water environments would be summarized.

3.7.5.3 OPA Evaluation

The OPA evaluation of the proposed project Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.7.5.3.1 Cost-Effectiveness

The cost of the project is comparable to past projects of a similar scope and is cost-effective in comparison. However, there are projects currently being implemented that would improve potential project techniques and therefore increase cost-effectiveness. Delaying this project would lead to better cost-effectiveness once information is gathered from other efforts over the next several years.

3.7.5.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goal for identifying and implementing restoration activities that mitigate key stresses to support resilient populations. The project does this by filling data gaps to increase marine mammal survival through better understanding causes of illness and death. This alternative has a strong nexus to the injuries caused by the DWH oil spill and response activities because it would result in a better understanding of the health and activities resulting in the restoration of bottlenose and Atlantic spotted dolphins, which were injured by the DWH oil spill. This project is consistent with Open Ocean TIG goals, the Marine Mammal Strategic Framework, and would contribute to the Marine Mammals Restoration Type-specific goals outlined in the PDARP/PEIS.

3.7.5.3.3 Likelihood of Success

There are several other projects currently being implemented that would inform the approaches and methods used to conduct small cetacean health assessments and movement patterns. The likelihood of success of this project would be greater once these other projects are complete and that information can be used to inform methodologies and approaches to study shelf cetaceans.

3.7.5.3.4 Avoid Collateral Injury

This project would avoid collateral injury by evaluating environmental consequences of techniques during the project planning and design activities and by identifying BMPs to minimize potential direct or indirect collateral injury. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.7.5.3.5 Benefits Multiple Resources

This alternative would benefit multiple marine mammal species with a particular focus on collecting and analyzing health and telemetry data for two dolphin species. Expected benefits would include a better understanding of the health, habitats, and movement patterns of northern Gulf of Mexico small shelf cetaceans.

3.7.5.3.6 Public Health and Safety

The Open Ocean TIGs finds that negative impacts to public health and safety from this alternative are not likely. However, relevant safety measures and practices would be followed during project implementation. The project would involve data collection and analysis activities that include field monitoring by trained scientists, with no involvement of the public.

3.7.6 Marine Mammals Restoration Type OPA Conclusions

The Open Ocean TIG completed the OPA evaluation of the reasonable range of alternatives. There are four preferred Marine Mammals project alternatives (Reducing Impacts to Cetaceans during Disasters by Improving Response Activities; CETACEAN; Reduce Impacts of Anthropogenic Noise on Cetaceans; Reduce and Mitigate Vessel Strike Mortality of Cetaceans) that are anticipated to satisfy all the OPA evaluation factors. The Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns project is not preferred for implementation at this time. Its likelihood of success and cost effectiveness would be increased at a later date once several other projects currently being implemented to refine methodologies are complete.

3.8 OPA Evaluation of Alternatives for Mesophotic and Deep Benthic Communities Restoration Type

As described in the PDARP/PEIS, the restoration of MDBC is complicated by a limited understanding of key biological functions, limited experience with restoration at the depths at which they occur and remote locations that limit accessibility. Therefore, the Open Ocean TIG's evaluation of restoration alternatives for these resources determined that projects should include phased implementation to allow for data collection to address critical uncertainties and inform adaptive decision-making.

The proposed projects together create an adaptive management feedback loop by advancing restoration planning, implementing and monitoring initial restoration actions, evaluating and reporting restoration effectiveness, and feeding back information to restoration planning and implementation. In addition, they directly address the following key planning and implementation considerations identified in the PDARP/PEIS:

- The restoration approaches for MDBC are novel, but robust monitoring and adaptive management would improve the likelihood of restoration success by addressing critical scientific uncertainties.
- Monitoring and scientific support are needed to improve understanding of 1) fundamental community characteristics, 2) relevant trophic structures, linkages, and food-web dynamics, and 3) habitat distribution to support the design, implementation, and evaluation of restoration projects for MDBC (Cairns and Bayer 2009; Cordes et al. 2008; Etnoyer et al. 2016; Fisher et al. 2014b; Quattrini et al. 2014; Van Dover et al. 2013).

- Using protective measures and management to reduce threats would help maintain ecological integrity and potentially increase ecosystem resilience (Mumby and Harborne 2010; Selig and Bruno 2010). Many federal statutes and mechanisms govern the use, management, protection, and conservation of marine areas and marine resources. To implement these types of management actions, the Trustees would coordinate with multiple stakeholders.

Implementation of the proposed projects would include an initial one to two year planning and design stage, followed by a five-year field and/or lab-based implementation stage, and then a final stage of one to two years for reporting and project close-out.

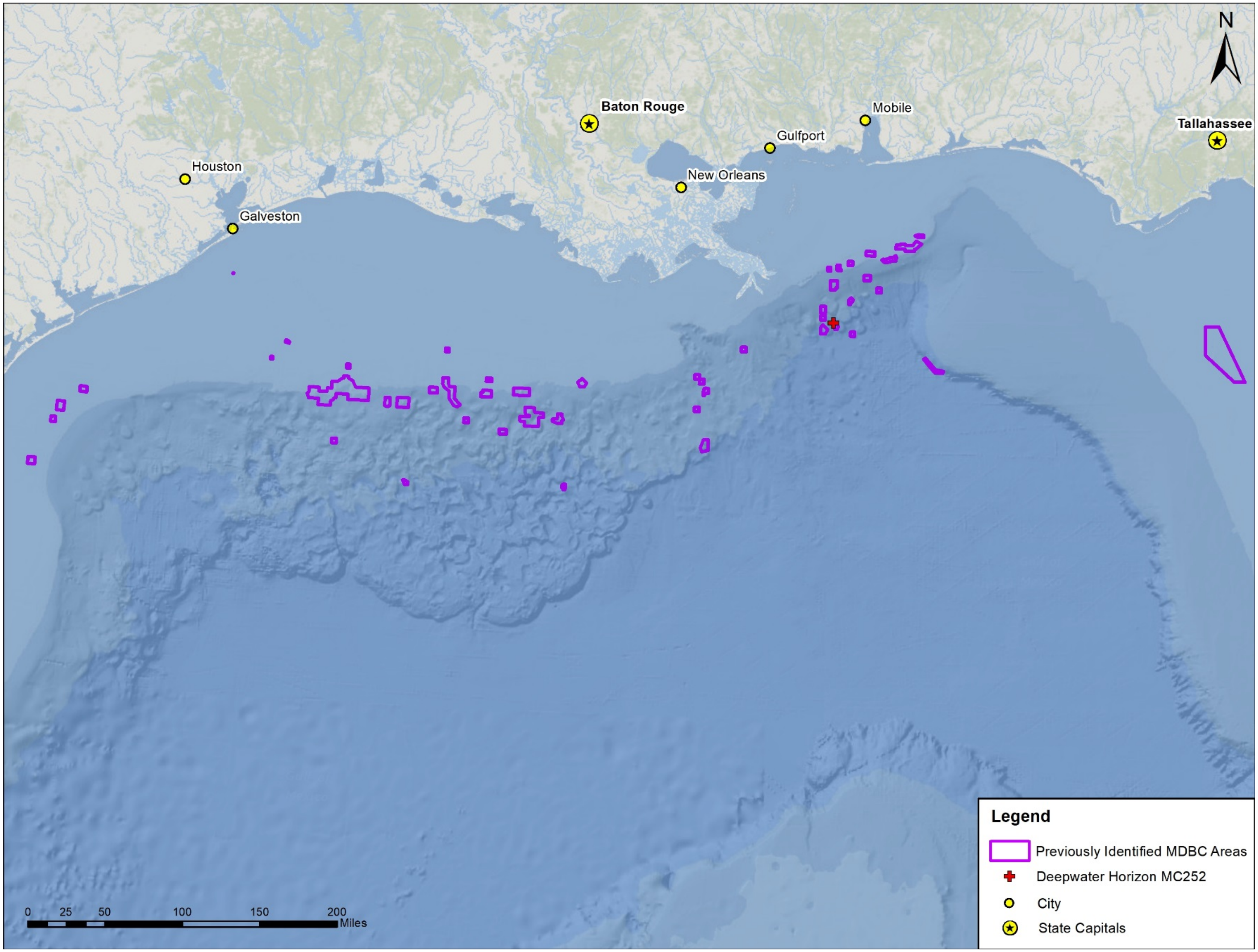
During the planning and design stage, specific geographic areas to conduct proposed activities would be identified and prioritized. For example, Figure 3-3 shows a number of areas that have been previously identified as supporting important MDBC. Once priority areas are identified, implementation work plans and budgets for specific activities would be developed. Work plans would set detailed project objectives and performance criteria; assess existing data and resource requirements; sequence implementation plans; complete data management, mission, and mobilization plans, and complete environmental compliance.

An important aspect of the planning and design stage would also be to ensure transparency in restoration decision-making and establishing effective approaches for stakeholder coordination and engagement, public input, communication of results, and data sharing over time. This would be accomplished, in part, by identifying stakeholder engagement and partnership opportunities, establishing data collection and management standards, and coordinating with resource management agencies to evaluate needs to achieve enhanced protection and management. Evaluation of the proposed projects would also be supported through the development of an adaptive management plan that provides milestones for technical and strategic evaluations to assess progress in meeting project objectives and overall restoration outcomes.

Further, development and implementation of the preferred alternatives would include a coordinated and phased cross-project planning effort. The coordinated management of project infrastructure and capacity requirements (e.g., vessel time, scientific vehicles and instruments, information technology infrastructure, research and education/outreach facilities, and standards for monitoring and data management) would maximize efficiencies and cost-effectiveness in implementing the preferred alternatives. These activities are further detailed in the project descriptions below.

There are five restoration alternatives (four preferred alternatives and one not-preferred) that meet the MDBC Restoration Type goals. A description of each alternative is provided below followed by the OPA evaluation of that alternative.

Figure 3-3: Examples of areas previously identified as supporting important mesophotic and deep benthic communities.



3.8.1 Mapping, Ground-Truthing, and Predictive Habitat Modeling

3.8.1.1 Project Description

Accurate high-resolution bathymetric and habitat maps as well as data on the abundance and distribution of MDBC are nearly universal requirements for efforts to restore these communities. Only small fractions of the mesophotic and deepwater habitats of the Gulf of Mexico have been surveyed and the current distributions of the species inhabiting them are not completely known. This represents one of the foremost challenges to implementing restoration to achieve the goals of the PDARP/PEIS. There are extensive areas of hard substrates across the continental shelf, slope, and abyssal plain in the northern Gulf of Mexico. Jenkins (2011) estimates there is roughly 12,130 square miles (31,419 square kilometers) of hard substrate in the Gulf of Mexico. Its distribution is highly variable from east to west and a large portion occurs on the West Florida Shelf in the eastern Gulf of Mexico. In general, the mapping coverage of the eastern Gulf of Mexico is poor, whereas deeper portions of the central and western Gulf of Mexico have more extensive coverage due in large part to activities associated with oil and gas exploration. Coral injuries were documented along the rocky reefs of the Pinnacles region (Etnoyer et al. 2016; Silva et al. 2016) but this region has not been mapped in detail since it was surveyed by the USGS in 2000 (Gardner et al. 2000).

This project would benefit injured species and other important habitat-forming taxa occurring at these same or intermediate depths in the northern Gulf of Mexico. The goal of this project is to document the abundance and distribution of MDBC and to gain a better understanding of their extent, species composition, and habitat characteristics. The level of effort undertaken through this project would make it possible to characterize a significant proportion of hard substrates in the northern Gulf of Mexico, which would dramatically improve current knowledge of their extent and distribution. Such documentation alone substantially informs and augments ongoing or potential activities to manage, protect, and restore these communities. The project would also build upon existing deep-sea coral predictive models to develop improved northern Gulf of Mexico regional-scale predictive models of habitat suitability for mesophotic and deep water coral species.

Project objectives are to map (e.g., high-resolution surveying, backscatter interpretation, and photomosaic assemblage) and ground-truth (i.e., visually and including sample collections) MDBC at sufficiently high-resolution for habitat characterization, and to refine predictive models to improve the effectiveness and cost efficiency of restoration and mapping efforts. Fieldwork associated with this project would be performed across the northern Gulf of Mexico. However several existing datasets would be used to prioritize locations to conduct mapping. For example, BOEM has recently published an updated deep water bathymetric grid of the northern Gulf of Mexico that provides enhanced resolution compared to previous maps of the region. This dataset, in combination with BOEM's seismic water bottom anomalies datasets, and sites currently designated or under consideration for designation as protected areas (e.g., Habitat Areas of Particular Concern [HAPC] or National Marine Sanctuaries [NMS]), provide a basis for prioritizing higher resolution mapping.

In deeper waters of the central and western Gulf of Mexico, such mapping would require the use of hull-mounted or towed mapping instruments (e.g., multibeam echosounders, side-scan sonars, synthetic aperture sonars) as well as mapping instruments mounted on autonomous underwater vehicles (AUV) or remotely operated vehicles (ROV). Ground-truthing mapping data would require the use of ROV and/or the use of high-resolution downward-looking cameras and strobes mounted on AUV for the assembly of photomosaics (a large-scale detailed picture or composite map created by digitally stitching together photographs of small areas). To the east and in shallower areas across the northern Gulf of Mexico, where there is less existing mapping coverage, the protocols of NOAA's Deep Sea Coral Research and Technology Program would be followed. These protocols entail coarse resolution mapping from surface vessels; targeted high-resolution mapping (i.e., sub-meter resolution or resolution on the scale of 1-2 meters), which would require the use of AUV or ROV; and ground-truthing from visual surveys (i.e., using ROV, saturation divers, and/or human operated vehicles [HOV]). The project timeline incorporates 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. This project would implement long-range activities and has an estimated project duration of seven to eight years. The estimated project cost is $35,909,000.

3.8.1.2 Project Activities

Comprehensive implementation planning would develop detailed work plans and resource requirements. The planning stage would establish performance criteria for each of the specific implementation activities, and site selection criteria, and would include a thorough assessment of existing data. Mission and mobilization plans with project sequencing and a logistics strategy would be developed with the intent to implement field work in a manner designed to minimize environmental consequences. The planning stage of the project would also include an evaluation of the environmental consequences of techniques in the project's fieldwork design and identification of BMPs to minimize injury during mapping and ground-truthing activities. The proposed mapping and ground-truthing activities include surface (i.e., ship-based) operations, subsurface (i.e., ROV, AUV, HOV, or technical diving) operations, and sonar operations, and could also include electromagnetic operations and/or laser operations. Additionally, a programmatic data management scheme would be developed to ensure the integrity and organization of the multi-disciplinary datasets. Establishment and continuous maintenance of data infrastructure, protocols, and management would occur throughout the project. Annual workshops would be conducted to assess current mapping data, prioritize mapping sites, and coordinate data management.

Once the implementation planning stage was completed, a five-year field effort would commence. Over the five years of field- and lab-based project implementation, this project would accomplish mapping (e.g., bathymetric surveying, photomosaic assemblage) and ground-truthing at sufficiently high-resolution for habitat characterization. This project would also ground-truth existing predictive habitat models and produce refined northern Gulf of Mexico regional-scale predictive models of habitat suitability for mesophotic and deep water coral species. Environmental predictor datasets would include existing and new information on seafloor topography, substrate, current regimes, geography, and physical and biological oceanography. Model results would guide mapping surveys, allowing the discovery of new, uninjured communities that may be candidates for protection or sources for colonies or larvae needed for active restoration. Ground-truthing would not only verify acoustic mapping but would also allow for the opportunistic collection of samples in support of biological assessments of genetic connectivity, life history characteristics, health condition, and trophodynamic linkages among ecosystem components. Data collected would provide fundamental information to prioritize and support protection and management activities and to target locations for direct restoration.

Data collection and surveys would be conducted using an iterative process including high-resolution mapping and visual ground-truthing to document the distribution and abundance of MDBC habitats and to improve existing habitat suitability models. The full suite of available technologies would be evaluated for use in mapping: ship-mounted, towed, and AUV-mounted side scan sonars; sub-bottom profilers; synthetic aperture sonars; multibeam echosounders; and high-resolution downward-looking cameras and strobes for the assembly of photomosaics. The best available technologies for ground-truthing activities would also be evaluated including ROV, towed optical sensors, technical divers, and/or HOV.

3.8.1.3 OPA Evaluation

The OPA evaluation of the proposed project Mapping, Ground-Truthing, and Predictive Habitat Modeling using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.8.1.3.1 Cost-Effectiveness

Estimated costs for this alternative are based on experience and knowledge by experts in the field. The costs for the project are based on similar past projects (e.g., NOAA's Southeast Deep Coral Initiative) and are cost-effective in comparison and relative scale. Cost estimates are based on an understanding of the best available, most appropriate technologies and equipment for accomplishing the goals of the project. Cost-effectiveness of the project is also expected to be enhanced by the comprehensive planning stage that would be included at the beginning of the project. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.8.1.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goals to improve the understanding of MDBC to inform management and ensure resiliency (Table 2-3). The project does this by providing fundamental information about the abundance and distribution of MDBC to support their protection and management, as well as to target locations for active restoration activities such as substrate placement and coral propagation. This alternative has a strong nexus to injuries caused by the DWH oil spill, particularly it would provide relevant information for the restoration, management, and protection of MDBC that were impacted by the DWH oil spill. This project is consistent with Open Ocean TIG goals and would contribute to the MDBC Restoration Type-specific goals outlined in the PDARP/PEIS.

3.8.1.3.3 Likelihood of Success

This alternative has a high likelihood of successfully mapping MDBC in the Gulf of Mexico and improving the understanding of these communities. This project is technically feasible and uses best available science, proven techniques and established methods. In addition, the project has been designed in stages to ensure that key questions would be answered prior to full scale implementation of activities. The project includes a plan for ground-truthing existing predictive habitat models and producing refined models that would assist in identifying priority areas for mapping and ground-truthing. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.8.1.3.4 Avoid Collateral Injury

This project would avoid collateral injury by evaluating environmental consequences of techniques during project planning and design activities and by identifying BMPs to minimize potential collateral injury. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and that protective measures are put in place.

3.8.1.3.5 Benefits Multiple Resources

This alternative would indirectly benefit multiple resources by providing a better understanding of MDBC which would lead to improved future direct restoration and management to reduce threats. Expected benefits for marine organisms associated with these communities would occur by maintaining ecological integrity and increasing ecosystem resilience, resulting in improved populations.

3.8.1.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. Field operations associated with this project would be performed in remote offshore areas by experienced, licensed crews applying rigorous safety plans and SOPs. The project would ensure personnel are properly trained, that appropriate equipment and safety standards are employed, and that routine safety inspections are performed. Negative impacts to public health and safety from this proposed project are not likely.

3.8.2 Habitat Assessment and Evaluation

3.8.2.1 Project Description

To effectively plan and implement MDBC restoration, protection, and management approaches, the Trustees must adequately understand the distribution, composition, genetic diversity, and connectivity among the different populations that comprise these communities, as well as their life histories, growth, and reproductive potential. As described in the PDARP/PEIS, numerous gaps in this knowledge currently exist. The goal of this project is to fill critical gaps in our understanding of the health, biodiversity, recovery, and resilience of mesophotic and deep-sea habitats (both hard bottom communities and soft sediment communities) following the DWH oil spill. This project would support and inform restoration planning and implementation for MDBC through analyses of habitat and determination of ages and growth rates of corals. In addition, the project would maximize the effectiveness of restoration and protection efforts using population genetic models.

Specific project objectives include documenting changes to structure and function of MDBC impacted by the DWH oil spill and other threats; establishing environmental baseline conditions and changes over time around impacted and healthy MDBC; and developing dispersal models for coral larvae. This project would benefit species with documented impacts from the DWH oil spill and/or other important habitat-forming taxa occurring at these same or intermediate depths in the northern Gulf of Mexico. Fieldwork associated with this project would be performed at priority locations identified across the northern Gulf of Mexico, with initial high-priority targets to include sites currently designated or under consideration for protected area designations (e.g., HAPC or NMS). The project would operate in mesophotic and deep zones, in coral and sediment communities, in documented sites of injury in the Pinnacles Trend region and Mississippi Canyon region, as well as in reference and active restoration or protection sites in MDBC across the northern Gulf of Mexico. The timeline accounts for 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. This project would implement long-range activities and has an estimated project duration of seven to eight years. The estimated project cost is $52,639,000.

3.8.2.2 Project Activities

In years one through two, the project would begin with development of detailed work plans and assessment of resource requirements. This planning stage would establish performance criteria for each of the specific implementation activities and site selection criteria. It would also include a thorough assessment of existing data (e.g., ROV video transects) and sample archives (e.g., dried and preserved coral tissue samples) from prior mesophotic and deep benthic exploratory efforts in the Gulf of Mexico to minimize the necessity of collecting living specimens. Mission and mobilization plans with project sequencing and a logistics strategy would be developed with the intent to implement field work in a manner designed to minimize potential environmental consequences. The planning stage of this habitat assessment project would also include an evaluation of environmental consequences of techniques in the project's fieldwork design and identification of BMPs to minimize injury during coral and sediment sampling, buoy deployment, and assessment activities.

Habitat assessment and evaluation activities would include surface (i.e., ship-based) operations and subsurface operations (i.e., ROV, AUV, HOV, technical diving, and deployment of instrumented landers and/or moored buoys). A programmatic data management scheme would be developed to ensure the integrity and organization of the multi-disciplinary datasets. Establishment and continued maintenance of data infrastructure, protocols, and management would occur throughout the project. Annual workshops would be conducted to assess current data, prioritize sites to be assessed, and coordinate data management.

Once the implementation planning stage is completed, a five-year field survey effort would commence. Field work would be performed in mesophotic and deep zones, in coral and sediment communities, in documented sites of injury in the Pinnacles Trend region and Mississippi Canyon region, as well as in reference and active restoration or protection sites in MDBC across the northern Gulf of Mexico. The project would include a sufficient number of sites (specific sites to be determined in implementation planning stage) to parameterize healthy coral and sediment communities during monitoring of direct restoration or protection activities.

Data collection and surveys would be conducted in a systematic manner on a quarterly, annual, or bi-annual basis, as appropriate. Multi-disciplinary monitoring and assessment surveys would use state-of the-art techniques (e.g., population genetic techniques combined with dispersal models) to determine diversity and connectivity among spatially separated populations, and potentially larval dispersal patterns. An ecosystem-based approach would also be used to examine the mesophotic and deep benthic 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 surveys would collect data and samples by ROV, AUV, technical divers, HOV, and image-based monitoring. Small samples of corals and other sessile benthic invertebrates, associated mobile invertebrates and fish, and sediment cores and traps would also be collected along with oceanographic conditions using instrumented moorings or landers. Further processing of samples in the lab would include taxonomic (e.g., scanning electron microscopy, sediment core sorting) and genetic analyses (e.g., genome sequencing, marker development), food web and energy flow characterization (e.g., gut contents and stable isotopes), and age dating analyses (e.g., radiocarbon, stable isotope methods). Data collected would provide fundamental information to prioritize and support protection and management activities and to target locations for direct restoration.

3.8.2.3 OPA Evaluation

The OPA evaluation of the proposed project Habitat Assessment and Evaluation using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.8.2.3.1 Cost-Effectiveness

Estimated costs for this alternative are based on experience and knowledge by experts in the field. The costs for the project are based on similar past projects (e.g., NOAA's Southeast Deep Coral Initiative), and are cost-effective in comparison and relative scale. Cost estimates are based on an understanding of the best available, most appropriate technologies and equipment for accomplishing the goals of the project. Cost-effectiveness of the project is expected to be enhanced by the comprehensive planning stage that would be included at the beginning of the project. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.8.2.3.2 Trustee Restoration Goals and Objectives

This alternative contributes to the Trustees' goals of improving understanding of MDBC to inform management and ensure resiliency (Table 2-3). The project does this by performing habitat assessments on MDBC injured by the DWH oil spill. This alternative has a strong nexus to injuries caused by the DWH oil spill, particularly because it would provide relevant information for the restoration, management, and protection of MDBC which were impacted by the DWH oil spill. This project is consistent with Open Ocean TIG goals and MDBC Restoration Type-specific goals outlined in the PDARP/PEIS.

3.8.2.3.3 Likelihood of Success

This project has a high likelihood of successfully improving understanding of MDBC by filling data gaps to evaluate sites for restoration and protection, providing data to detect and quantify trends affecting MDBC habitats, and identifying impacts and assessing threats to these communities. The project is technically feasible and uses best available science, proven techniques, and established methods. In addition, the project has been designed in stages to ensure that regional oceanographic characterization data is compiled in order to determine appropriate deployments of equipment, as well as assess existing image analysis/species recognition tools to determine further tool development and application. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.8.2.3.4 Avoid Collateral Injury

This project would avoid collateral injury by evaluating environmental consequences of techniques during the project planning and design activities and by identifying BMPs to minimize potential direct or indirect collateral injury. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.8.2.3.5 Benefits Multiple Resources

The project would indirectly benefit multiple resources by providing a better understanding of MDBC which would lead to improved future direct restoration and management to reduce threats. This would benefit all marine organisms associated with these communities by maintaining ecological integrity and increasing ecosystem resilience, resulting in improved populations.

3.8.2.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. Field operations associated with this project would be performed in remote offshore areas by experienced, licensed crews applying rigorous safety plans and SOPs. The project would ensure personnel are properly trained, that appropriate equipment and safety standards are employed, and that routine safety inspections are performed. Negative impacts to public health and safety from this proposed project are not likely.

3.8.3 Coral Propagation Technique Development

3.8.3.1 Project Description

Perhaps the most direct approach to restoring deep-water coral communities damaged by the DWH oil spill is to facilitate the growth of new corals of the same species as those damaged by the spill. Techniques for coral fragment propagation and transplantation, and to enhance larval coral recruitment, have been extensively developed for coral restoration in shallow-water environments but have yet to be conducted in deep water. Small pilot studies of coral transplantation have been carried out with *Oculina varicosa* off eastern Florida, with *Lophelia pertusa* at Viosca Knolls off the Mississippi/Alabama coast, and more recently with octocorals at Sur Ridge and Davidson Seamount in the Monterey Bay NMS in California.

This project would extend such studies to include substrate placement as structure for coral fragment transplantation and for recruitment of coral larvae. It would examine the results of these studies across the highly variable geography of the northern Gulf of Mexico, both inside and outside of areas with documented or potential injury from the DWH oil spill. Studies would also be designed to assess whether techniques can be applied at scales meaningful in the scope and context of DWH injury to MDBC. Through these studies, the project would fill critical knowledge gaps relating to coral community enhancement and would inform future restoration plans. The project would focus on species with documented impacts from the DWH oil spill and/or other important habitat-forming taxa, including mesophotic coral species such as *Bebryce* spp., *Hypnogorgia pendula*, *Muriceides* cf., *M. hirta*, *Placogorgia* spp., *Swiftia exserta*, *Thesea nivea*, *T. rubra*, *Madracis* spp., *Oculina diffusa*, *O. tenella*, and *O. varicosa*; as well as deep-sea coral species such as *Paramuricea biscaya*, other *Paramuricea* spp., *Bathypathes* sp., *Chrysogorgia* spp., *Callogorgia delta*, *Leiopathes glaberrima*, *Lophelia pertusa*, *Madrepora oculata*, and *M. carolina*. Fieldwork associated with this project would be performed across the northern Gulf of Mexico, with initial high-priority targets to include sites currently designated or under consideration for protected area designations (e.g., HAPC, NMS). The project timeline accounts for one to two years for implementation planning, five years for implementation of field- and lab-based data collection and analysis, and one year for project evaluation, close-out, and reporting. This project would implement long-range activities and has an estimated project duration of seven years. The estimated project cost is $16,951,000.

3.8.3.2 Project Activities

Comprehensive implementation planning would develop detailed work plans and assessment of resource requirements. The planning stage would establish performance criteria for each of the specific implementation activities, establish criteria for site selection, and would include a thorough assessment of existing data (e.g., integrating mapping, habitat suitability, and larval dispersal modeling, as well as habitat assessment datasets for restoration pilot test site identification and methods development). The planning stage of this coral propagation methods development project would include an evaluation of the environmental consequences of techniques in the project's fieldwork design and identification of BMPs to minimize injury during hard substrate placement and coral fragmentation/transplantation. The *in situ* or field activities that would be undertaken through this project would include surface (i.e., vessel-based) operations and subsurface operations (i.e., employing ROV, technical divers, instrumented landers, or moored buoys). Mission and mobilization plans with project sequencing and a logistics strategy would be developed with the intent to implement field work in a manner designed to minimize potential environmental consequences.

A programmatic data management scheme would be developed to ensure the integrity and organization of the multi-disciplinary datasets. The planning stage would also develop and incorporate an adaptive management plan to assess the progress towards meeting project objectives and a plan for stakeholder engagement and partnership opportunities. Annual project implementation coordination meetings with subject matter experts would be held 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.

Once the implementation planning stage was completed, a five-year field- and lab-based coral propagation methods development and pilot testing period would commence. Field and lab work would test a variety of different substrates/techniques as potential colonization substrates and transplant methods to enhance the recruitment and growth of the target species identified above. These techniques may include direct *in situ* fragmentation and transplanting, among or within sites, or use of laboratory grown coral fragments. Use of laboratory grown fragments may have the least impact on source populations and may be required for transplantation to have a net positive influence on deep coral populations. This would require development of coral husbandry techniques for most species, and care would be taken to avoid introduction of pathogens to natural populations. Specialized analyses of biological and environmental samples, such as coral microbiomes or genetics, would allow for location of restoration sites to maximize potential survival and recruitment from the same or similar populations, and to enhance the contribution of larvae from that site to other areas of the Gulf.

Although some preliminary testing of substrates in laboratory settings may be necessary, this project would primarily test substrates and techniques *in situ*, in mesophotic and deep-water coral habitats. This testing would be conducted with sufficient replication to allow robust statistical analysis of the comparison among treatments, which would require multiple structures of each type to be deployed in each of multiple sites. The *in situ* experiments would include deployments of instrumented landers at each experimental site in order to understand the environmental variables that may contribute to the success or failure of this approach and the health of the resident corals. Annual deployments would be conducted in conjunction with monitoring of earlier deployments, resident coral populations, and associated fauna. Monitoring would be at least annually until it is clear that corals are surviving on, or recruiting to, the substrates, and periodically after that. This would include use of established techniques to image the corals and communities, as well as sediment sampling for analysis of effects on the coral sediment infaunal communities. The project would identify valuable techniques and vital data for effective enhancement of coral communities across the northern Gulf of Mexico.

3.8.3.3 OPA Evaluation

The OPA evaluation of the proposed project Coral Propagation Technique Development using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.8.3.3.1 Cost-Effectiveness

Estimated costs for this alternative are based on experience and knowledge by experts in the field. The costs for the project are based on similar past projects (e.g., NOAA's Southeast Deep Coral Initiative), and are cost-effective in comparison and relative scale. Cost estimates are based on an understanding of the best available, most appropriate technologies and equipment for accomplishing the goals of the project. Cost-effectiveness of the project is expected to be enhanced by the comprehensive planning stage that would be included at the beginning of the project. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.8.3.3.1 Trustee Restoration Goals and Objectives

This alternative would contribute to the Trustees' goal of restoring mesophotic and deep benthic invertebrate and fish abundance and biomass for injured species through development of direct coral propagation techniques (Table 2-3). This alternative has a strong nexus to injuries caused by the DWH oil spill and response activities, particularly providing relevant information for the restoration, management, and protection of MDBC which were impacted by the DWH oil spill. This project is consistent with Open Ocean TIG goals and objectives and would contribute to the MDBC Restoration Type-specific goals outlined in the PDARP/PEIS.

3.8.3.3.2 Likelihood of Success

This alternative has a high likelihood of successfully testing methods and techniques for enhancement of coral recruitment and growth and assessing their application for large scale restoration. The project is technically feasible and uses best available science, proven techniques and established methods. Small pilot studies of coral transplantation have been carried out in other areas and have been shown to work with coral species that inhabit shallow water. The project has been designed at a pilot scale with robust monitoring and adaptive management to test approaches with continued evaluation throughout the project. This project would develop a comprehensive implementation plan, utilize existing methods, and be adaptively managed, to increase the likelihood of success of the pilot study. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.8.3.3.3 Avoid Collateral Injury

This project would avoid collateral injury by evaluating environmental consequences of techniques during the project planning and design activities and by identifying BMPs to minimize potential collateral injury. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.8.3.3.4 Benefits Multiple Resources

The alternative would benefit multiple marine organisms associated with MDBC. Expected benefits would include maintaining ecological integrity and increasing ecosystem resilience, resulting in improved species populations and increased habitat value for fisheries within, and associated with, these communities. The project would fill critical knowledge gaps relating to coral propagation techniques and would inform future restoration plans.

3.8.3.3.5 Public Health and Safety

This alternative is not expected to affect public health and safety. Field operations associated with this project would be performed in remote offshore areas by experienced, licensed crews applying rigorous safety plans and SOPs. The project would ensure personnel are properly trained, that appropriate equipment and safety standards are employed, and that routine safety inspections are performed. Negative impacts to public health and safety from this proposed project are not likely.

3.8.4 Active Management and Protection

3.8.4.1 Project Description

MDBC are vast and complex ecosystems that are a foundation to Gulf of Mexico food webs. Despite the depth of these resources, human activities and environmental perturbations can threaten the health and resiliency of these communities. Potential threats include oil and gas industry activity; fishing (e.g., harvest pressure, damage from bottom-tending gear, impacts from anchoring or lost gear); recreational activities, such as diving and boating; marine debris; invasive species; and climate change. Identifying active habitat management and protection actions can help to address these present threats and prevent future injury. The PDARP/PEIS also describes how restoration that prevents future injuries to natural resources from known threats can often have more certain outcomes and be more cost-effective than projects that create new resources, and how spatially based management provides a framework for addressing key threats to MDBC. Over 50 known sites containing significant deep water coral communities have been identified through a variety of efforts dating to the early 1990s when researchers began to have access to ROV and the expanding Minerals Management Service (now BOEM) 3D seismic database and developed conceptual models for the location and exploration of hard bottom associated with hydrocarbon seepage. Similarly, observations dating to the 1950s of mesophotic zone habitats along the shelf edge from the vicinity of the current Flower Garden Banks National Marine Sanctuary (FGBNMS) boundaries to the Pinnacles area south of the Florida/Alabama border documented an unexpected abundance and diversity of sub-tropical fish and corals. Many of these sites are being considered for potential protected area designations such as the proposed FGBNMS expansion and the Gulf of Mexico Fishery Management Council's (GMFMC) process to designate deep coral HAPC.

This project would enhance public awareness and perform active management and protection activities. This project would undertake education and outreach targeting MDBC resource users and the public generally; engage stakeholders and develop socioeconomic analyses to evaluate potential impacts of management or protection actions; and directly address threats to MDBC through management activities such as mooring buoy installations, documenting and removing marine debris and derelict fishing gear, and assessing and remediating risks associated with leaking and abandoned oil and gas infrastructure. This project would inform and enhance the protection and management of MDBC, targeting areas such as the FGBNMS or areas currently protected or eligible for protection under a range of existing resource management programs such as the NOAA Office of National Marine Sanctuaries' (ONMS) processes for sanctuary expansion and nomination; the GMFMC's processes for designating coral or deep coral HAPC; BOEM's processes for protection No Activity Zones, Biologically-Sensitive Underwater Features and Areas, and Deepwater Benthic Communities; and EPA's National Pollution Discharge and Elimination System permitting process. The 2012 FGBNMS Management Plan is an example of a protected area management plan developed through a science-based approach with significant stakeholder engagement that identifies management activities relevant for DWH restoration within the existing sanctuary and/or in areas to which sanctuary boundary expansion or designation has been proposed. BOEM and NOAA (through the Gulf of Mexico Fishery Management Council) implement additional protections in their respective sectors (fossil fuel development and fishing). Implementing similar actions at significant MDBC sites across the broader geography of the northern Gulf of Mexico would support DWH restoration by leveraging ongoing protected area management efforts to maximize benefits to MDBC.

Project activities would benefit species with documented impacts from the DWH oil spill and/or other important habitat-forming taxa occurring at the same or intermediate depths in the northern Gulf of Mexico, including mesophotic coral species such as *Bebryce* spp., *Hypnogorgia pendula*, *Muriceides* cf., *M. hirta*, *Placogorgia* spp., *Swiftia exserta*, *Thesea nivea*, *T. rubra*, *Madracis* spp., *Oculina diffusa*, *O. tenella*, and *O. varicosa*; as well as deep-sea coral species such as *Paramuricea biscaya*, other *Paramuricea* spp., *Bathypathes* sp., *Chrysogorgia* spp., *Callogorgia delta*, *Leiopathes glaberrima*, *Lophelia pertusa*, *Madrepora oculata*, and *M. carolina*. However, the spatial nature of the project as a whole is intended to benefit communities rather than individual target species. Education, outreach, and engagement activities could take place in any location but would likely be focused in the Gulf states while field activities would occur at important MDBC sites across the northern Gulf of Mexico, with initial high-priority targets to include sites currently designated or under consideration for protected area designations (e.g., HAPC, NMS). The project timeline accounts for one to two years for implementation planning, five years for implementation of field data collection and analysis, and one year for project evaluation, close-out, and reporting. This project would implement long-range activities and has an estimated project duration of seven years. The estimated project cost is $20,689,000.

3.8.4.2 Project Activities

Comprehensive implementation planning at the initiation of the project would develop detailed work plans and assessment of resource requirements. The planning stage would establish performance criteria for each of the specific implementation activities, would establish criteria for site selection, and would include a thorough assessment of existing data related to ongoing management and protection activities. Mission and mobilization plans, with project sequencing and a logistics strategy, would be developed with the intent to implement field work in a manner designed to minimize potential environmental consequences. Project elements would also include identification of appropriate BMPs and evaluation of the environmental consequences associated with fieldwork techniques.

A programmatic data management scheme would be developed to ensure the integrity and organization of the complex, multi-disciplinary datasets this project would produce. The planning stage would also develop and incorporate an adaptive management plan to assess progress in meeting project objectives and a plan for stakeholder engagement and partnership opportunities.

Once the initial comprehensive planning stage was complete, a five-year field activity implementation stage would commence. This stage would involve public education and outreach related to MDBC, and engagement with agencies, stakeholders, and advisory groups involved in MDBC science and restoration. This would be accomplished through developing partnerships with education venues to create and display educational exhibits and associated programs about MDBC; developing and disseminate content for K-12 education programs, social media, and traditional media sources; assessing educational and outreach outcomes with behavioral and attitudinal surveying; collaborating with researchers to interpret science and produce educational materials; evaluating priority areas eligible for protection under various existing programs and mechanisms; and informing and supporting management and protection actions through data sharing and communications with strategic partners. Additionally, the project would provide resource management and protection by directly addressing threats. This would involve preventing damage from boat anchoring through mooring buoy installation and maintenance; improving understanding of visitor uses and reducing user conflict through evaluation and development of vessel registration and/or fishing endorsement programs; assessing and remediating threats of contaminant releases or physical impacts from abandoned or leaking oil and gas infrastructure; preventing damage by removing marine debris and derelict fishing gear, where appropriate, (where site assessment indicates removal can be accomplished without resulting in more harm than benefit); supporting stable MDBC by removing invasive lionfish and other invasive species; and improving management through enhanced resource protection capacity.

This project would also fulfill the need described in the PDARP/PEIS to coordinate across the agencies involved in implementing protections and with multiple stakeholders through the existing advisory groups and public review processes that are a part of establishing protections. In addition, this project would conduct studies of the benefits and potential socioeconomic impacts from the protection and management of MDBC. Currently protected sites and sites under consideration for protected area management designations (e.g., HAPC, NMS), as well as potential significant newly discovered MDBC sites identified through the separately described projects to map and assess MDBC, would be assessed through studies to better document expected benefits and potential socioeconomic impacts of protection. This project would assess opportunities to protect sensitive MDBC by evaluating priority areas eligible for protection and management under various existing programs and mechanisms. These studies would be developed in consultation with the relevant management programs and mechanisms (e.g., ONMS, GMFMC, BOEM), and the results of these assessments would be shared with strategic partners to increase awareness of the values of, threats to, and opportunities for protection and management of sensitive MDBC.

Lastly, this project would apply a variety of techniques to assess and manage threats to MDBC from visitors or resource users. Mooring buoy installations and maintenance would prevent potential damage from anchoring. Development of vessel registration and fishing endorsement programs would reduce potential for user conflict, improve understanding of visitor use, and prevent damage from anchoring and harmful fishing practices in sites under current or potential NMS and HAPC management. Risk assessment for potential contaminant releases or physical impacts related to abandoned and/or leaking oil and gas infrastructure would allow for remediation of risks identified by that assessment using an approach similar to the EPA's and Gulf states' Brownfields Response Programs. Documentation and removal of marine debris and derelict fishing gear in the area under current or potential NMS and/or HAPC designation would prevent damage to MDBC habitats from that debris and gear. Reduction of invasive lionfish or other invasive species across the same area would support stable native MDBC community composition and trophic dynamics. Enhanced resource protection across the same area, through enhanced technologies, capacity, and collaborative partnerships with state and federal enforcement agencies (e.g., Texas Parks and Wildlife Department; Louisiana Department of Wildlife and Fisheries; and the USCG).

3.8.4.3 OPA Evaluation

The OPA evaluation of the proposed project Active Management and Protection using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.8.4.3.1 Cost-Effectiveness

Estimated costs for this alternative are based on experience and knowledge by experts in the field. The costs for the project are based on similar past projects (e.g., NOAA's Southeast Deep Coral Initiative, FGBNMS Management Plan), and are cost-effective in comparison and relative scale. Cost estimates are based on an understanding of the best available, most appropriate technologies and equipment for accomplishing the goals of the project. Cost-effectiveness of the project is expected to be enhanced by the comprehensive planning stage that would be included at the beginning of the project. The Open Ocean TIG reviewed the estimated costs for this alternative and found them to be reasonable and appropriate.

3.8.4.3.1 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goals to actively manage valuable MDBC to protect against multiple threats and provide a framework for monitoring, education, and outreach (Table 2-3). This project has a strong nexus to the injuries caused by the DWH oil spill and response activities, particularly because it would provide relevant information for the restoration, management, and protection of MDBC. This project is consistent with Open Ocean TIG goals and MDBC Restoration Type-specific goals outlined in the PDARP/PEIS.

3.8.4.3.2 Likelihood of Success

This alternative has a high likelihood of successfully managing MDBC to protect against multiple threats and provide a framework for monitoring, education, and outreach. The PDARP/PEIS describes how restoration that prevents future injuries to natural resources from known threats can often have more certain outcomes and be more cost-effective than projects that create new resources, and how spatially based management provides a framework for addressing key threats to MDBC. The Trustees have experience successfully implementing activities similar those proposed in this project. Furthermore, this project would develop a comprehensive implementation plan, would utilize established methods, and would be adaptively managed, thus contributing to a high likelihood of success. The Open Ocean TIG reviewed the proposed project approach and methods and found them to have a high likelihood of success.

3.8.4.3.3 Avoid Collateral Injury

This project would avoid collateral injury by evaluating environmental consequences of techniques during the project planning and design activities and by evaluating environmental consequences of techniques in the project's fieldwork design and identifying BMPs to minimize potential collateral injury during mooring buoy installations, marine debris and derelict fishing gear removal, removal of invasive species, and remediation of leaking and abandoned oil and gas infrastructure. Should any potential effects be identified, the Open Ocean TIG would ensure proper coordination and protective measures are put in place.

3.8.4.3.4 Benefits Multiple Resources

This alternative would benefit multiple marine organisms associated with MDBC. Expected benefits from reducing threats would enhance resource protection in existing protected areas resulting in improved populations of marine organisms living within and associated with these communities.

3.8.4.3.5 Public Health and Safety

This alternative is not expected to affect public health and safety. Field operations associated with this project would be performed in remote offshore areas by experienced, licensed crews applying rigorous safety plans and SOPs. The project would ensure personnel are properly trained, that appropriate equipment and safety standards are employed, and that routine safety inspections are performed. Negative impacts to public health and safety from this proposed project are not likely.

3.8.5 Habitat Characterization at Known High Priority Sites

3.8.5.1 Project Description

A more thorough understanding of MDBC species composition, abundance, and habitat characteristics is critical to prioritizing management interventions that would enhance recovery of injured resources and support their long-term survival. This project would provide detailed characterization of known, high-priority MDBC sites through development of bathymetric and habitat maps that could be used to inform future restoration efforts. The mapping and ground-truthing would enhance existing deep-sea coral predictive models and allow for refinement of habitat suitability models. Field implementation would be performed at a small-scale and for a short duration, yet comprehensive assessment (i.e., high resolution mapping, ground-truthing, predictive habitat modeling, habitat assessment) of sites containing known high-priority MDBC (i.e., sites currently designated as protected or under consideration for protected area designation) in the northern Gulf of Mexico. The project timeline accounts for three years of implementation of field data collection and analysis. This project would implement long-range activities and has an estimated project duration of three years. The estimated project cost is $21,500,000.

3.8.5.2 Project Activities

The objective of the habitat characterization project is to provide accurate bathymetric and habitat maps to increase knowledge of the abundance and distribution of deep water coral communities; to provide fundamental information to prioritize and support protection and management activities; and to target locations for direct restoration.

The project would begin with habitat characterization at known high-priority areas using existing resources and protocols using dedicated resources (ships, ROV, etc. engaged through cooperative agreements, interagency agreements, contracts, or and/grants). Mapping and ground-truthing could involve ship-mounted, towed and AUV-mounted side-scan sonars, synthetic aperture sonars, or multi-beam echosounders. Habitat assessment surveys would evaluate mesophotic and deep sediments, coral community condition, genetic connectivity, life history characteristics, and trophodynamic linkages. This would be accomplished through high-resolution imaging, video surveys, and biological sampling. Such characterization would facilitate, support, and evaluate performance of management, protection, and restoration activities (e.g., substrate placement, coral propagation). This would be accomplished utilizing the full suite of available technologies for mapping, ground-truthing, predictive habitat modeling, and habitat assessment and evaluation. The planning stage of this project would include an evaluation of the environmental consequences of techniques in the project's fieldwork design and identification of BMPs to minimize injury during high-resolution mapping, ground-truthing, and habitat assessment activities.

3.8.5.3 OPA Evaluation

The OPA evaluation of the proposed project Habitat Characterization at known High Priority Sites using the factors established by the OPA regulations in 15 CFR §990.54(a) is described below.

3.8.5.3.1 Cost-Effectiveness

The level of effort proposed (i.e., the time required to complete the proposed habitat characterization work) and the short timeline of this project would preclude detailed implementation planning and project phasing, resulting in missed opportunities for efficiencies of scale, an inability to comprehensively coordinate project components, and reduced cost effectiveness.

3.8.5.3.2 Trustee Restoration Goals and Objectives

Implementation of this alternative would contribute to the Trustees' goals to improve understanding of mesophotic and deep-sea communities to inform management and ensure resiliency (Table 2-3). The project does this by performing comprehensive habitat characterization at sites containing known high-priority MDBC to facilitate, support, and evaluate management, protection, and restoration activities at these sites. This project has a strong nexus to the injuries caused by the DWH oil spill and response activities, particularly restoration, management, and protection of MDBC. This project is consistent with Open Ocean TIG goals and objectives and is consistent with the programmatic Trustee restoration goals and would contribute to the MDBC Restoration Type-specific goals outlined in the PDARP/PEIS.

3.8.5.3.3 Likelihood of Success

This project forgoes comprehensive implementation planning and adaptive management in favor of expedited and shorter term implementation which may reduce the likelihood of its success. Mapping and studies of MDBC in the Gulf of Mexico have been ongoing for decades, conducted by researchers, government agencies, industry, and universities (e.g., Brooks and Giammona 1991; Rezak et al. 1985; Sulak and Dixon 2015; White et al. 2012). This project would utilize established and tested equipment and methods where possible to increase the likelihood of success.

3.8.5.3.4 Avoid Collateral Injury

This project forgoes comprehensive implementation planning in favor of expedited implementation, thus, the project may fail to avoid collateral injury by not further evaluating the environmental consequences of techniques in the project's fieldwork design. This project would also not undertake comprehensive planning to fully identify and evaluate BMPs to minimize injury during high-resolution mapping, ground-truthing, and habitat assessment activities. While the proposed project would result in overall benefits to natural resources if implemented properly, should any potential negative effects be identified during implementation, the Open Ocean TIG would ensure proper coordination and protective measures are in place.

3.8.5.3.5 Benefits Multiple Resources

The project would benefit multiple resources by providing a better understanding of MDBC which would lead to future restoration and management to reduce threats. This would benefit the marine organisms associated with these communities by maintaining ecological integrity and increasing ecosystem resilience, resulting in improved populations.

3.8.5.3.6 Public Health and Safety

This alternative is not expected to affect public health and safety. Field operations associated with this project would be performed in remote offshore areas by experienced, licensed crews applying rigorous safety plans and SOPs. The project would ensure personnel are properly trained, that appropriate equipment and safety standards are employed, and that routine safety inspections are performed. Negative impacts to public health and safety from this proposed project are not likely.

3.8.6 Mesophotic and Deep Benthic Communities Restoration Type OPA Conclusions

There are four preferred MDBC alternatives (Mapping, Ground-Truthing, and Predictive Habitat Modeling; Habitat Assessment and Evaluation; Coral Propagation Technique Development; and Active Management and Protection) that are anticipated to satisfy all the OPA evaluation factors. The Habitat Characterization at Known High Priority Sites project is not preferred at this time as it is not cost effective, and there are uncertainties with its likelihood of success.

3.9 Natural Recovery

Pursuant to the OPA regulations, the PDARP/PEIS considered a "natural recovery alternative in which no human intervention would be taken to directly restore injured natural resources and services to baseline" (15 CFR §990.53[b][2]). Under a natural recovery alternative, no additional restoration would be done by Trustees to accelerate the recovery of Fish, Marine Mammals, Sea Turtles, or MDBC Restoration Types in the Open Ocean Restoration Area using DWH NRDA funding at this time. The Trustees would allow natural recovery processes to occur, which could result in one of four outcomes for injured resources: 1) gradual recovery, 2) partial recovery, 3) no recovery, or 4) further deterioration. Although injured resources could presumably recover to, or near, baseline conditions under this scenario, recovery would take much longer compared to a scenario in which restoration actions were undertaken. Given that technically feasible restoration approaches are available to compensate for interim natural resource and service losses, the Trustees rejected this alternative from further OPA evaluation within the PDARP/PEIS. Based on this determination, tiering this RP/EA from the PDARP/PEIS, and incorporating that analysis by reference, the Open Ocean TIG did not further evaluate natural recovery as a viable alternative under OPA, and natural recovery is not considered further in this RP/EA[18].

3.10 Overall OPA Evaluation Conclusions

The Open Ocean TIG identified a reasonable range of alternatives for evaluation under the OPA (Table 1-2), which was determined by the screening criteria discussed in Chapter 2. The Open Ocean TIG applied the OPA evaluation factors to each restoration alternative to identify preferred projects. In total, 23 alternatives were evaluated under OPA (Chapter 3) and NEPA (Chapter 4) across four Restoration Types. Based on the OPA evaluations and information and analysis presented in the entirety of this document, the Trustees propose to proceed with implementation of 18 of the projects considered in this RP/EA.

Five of these projects are preliminary phase restoration projects that represent E&D activities. The OPA evaluation indicated that all five preliminary phase restoration projects would contribute to meeting the Trustees' restoration goals for their Restoration Type at reasonable and appropriate costs and with a high likelihood of success. They would provide potential benefits to multiple natural resources and would not have collateral environmental injuries or negative effects on public health and safety.

- **Fish:** Communication Networks and Mapping Tools to Reduce Bycatch – Phase 1.
- **Sea Turtles:** Gulf of Mexico Sea Turtle Atlas; Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery; Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection.
- **Marine Mammals:** Compilation of Environmental, Threats, and Animal Data for Cetacean Population Health Analyses.

For the remaining projects, 13 fully met the Trustees' restoration goals for their Restoration Type. Seven of these projects are proposed as long-range actions structured to include a full lifecycle of activities such as initial project design and assessment, tool design, and tool testing through long-term site-specific project implementation. For these projects the OPA evaluation factors were considered through a programmatic lens. These projects have a strong nexus to the injury, meet the Trustees' goals at reasonable and appropriate costs, have a high likelihood of success, and provide potential benefits to more than one natural resource or service. In addition, the projects are not expected to have negative impacts to public health and safety and would avoid collateral injury by evaluating environmental consequences of techniques during the project planning and design activities and by identifying BMPs to minimize potential collateral injury.

- **Mesophotic and Deep Benthic Communities:** Mapping, Ground-Truthing, and Predictive Habitat Modeling; Habitat Assessment and Evaluation; Coral Propagation Technique Development; Active Management and Protection.
- **Marine Mammals:** Reducing Impacts to Cetaceans during Disasters by Improving Response Activities; Reduce Impacts of Anthropogenic Noise on Cetaceans; Reduce and Mitigate Vessel Strike Mortality of Marine Mammals.

[18] NEPA requires evaluation of a "no action" alternative. This differs from the natural recovery alternative under OPA. The environmental consequences of the NEPA no action alternative are considered separately in Section 4.4.7

The remaining six projects that fully met the Trustees' restoration goals for their Restoration Type are proposed for full implementation. These projects describe in detail all actions necessary to fully implement the project. They have a strong nexus to injuries, meet the Trustees' goals at reasonable and appropriate costs, have a high likelihood of success, and provide potential benefits to more than one natural resource or service. These projects are not expected to have negative impacts to public health or safety and they would not result in collateral injury to natural resources. Proposed project activities would either be conducted through long-term existing programs with successful regulatory requirements, including established BMPs, to avoid collateral injury or they would apply BMPs identified prior to implementation to avoid collateral injury.

- **Fish:** Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries; Better By-catch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery; Restoring for Bluefin Tuna via Fishing Depth Optimization.
- **Sea Turtles:** Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery; Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices; Long-term Nesting Beach Habitat Protection for Sea Turtles.

The Open Ocean TIG determined through the OPA evaluation process that five projects did not fully meet the Trustees' restoration goals or priorities for this RP/EA at this time. In some cases, projects are not preferred because they do not meet the Trustees' current restoration priorities for this RP/EA. Other projects were not cost effective due to the proposed implementation approach or because more information is needed to refine methods for implementation. Additionally the Trustees found that some projects would have a greater likelihood of success if further planning and coordination were conducted, including establishing regional partnerships. The Trustees do not intend to proceed further at this time with these five projects.

- **Fish:** Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats.
- **Sea Turtles:** Reducing Sea Turtle Entanglement from Recreational Fishing Debris; Reducing Sea Turtle Bycatch at Recreational Fishing Sites.
- **Marine Mammals:** Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns.
- **Mesophotic and Deep Benthic Communities:** Habitat Characterization at Known High Priority Sites.

3.10.1 Consideration of Ecosystem-scale Benefits

Following OPA evaluation and consistent with the PDARP/PEIS, the Open Ocean TIG considered the extent to which individual alternatives would complement each other to meet the Trustees' goals for comprehensive, integrated ecosystem restoration (PDARP/PEIS Section 1.5.3). Resources such as fish, sea turtles, marine mammals, and deep-sea corals and benthic communities make up an interconnected Gulf food web supported by organisms in the water column and ocean floor. Sea turtles, cetaceans, and some oceanic fish are long-lived, migrate widely and use a variety of Gulf of Mexico habitat types and prey resources.

For example, cetaceans feed at all trophic levels, consuming foods ranging from invertebrates to large fish. Fish and crustaceans species serve as both predators and prey and depend on a range of Gulf of

Mexico habitat types during their growth and development. Mesophotic coral communities provide food, refuge, and reproductive opportunities for multiple species of fish and invertebrates. The seafloor biota also plays an essential role in overall productivity in the deep-sea, as organisms living in the seafloor bottom, infauna, consume detritus from the water column (Danovaro et al. 2008). In turn, larger benthic organisms higher in the food chain, such as red crabs, prey on the infauna (Danovaro et al. 2008).

When natural resources are injured, cascading ecological effects can occur, including changes in trophic structure (such as altering predator prey dynamics), community structure (such as altering the composition of organisms in an area), and ecological functions (such as altering the flow of nutrients) (Fleeger et al. 2003; Fodrie et al. 2014; Peterson et al. 2003). In turn, the ability of species to recover and the length of time required for that recovery are tied to the carrying capacity of the habitat and to the effects of stressors. The Trustees incorporated these ecosystem considerations into our analysis and development of the preferred projects by identifying synergies that may be possible across projects to maximize benefits to multiple resources. Below is a summary of the synergies and ecosystem benefits identified.

Restoration provides opportunities to mitigate stressors and obtain tangible ecosystem benefits. In addition, restoring key parts of the system that were injured would increase recovery rates for components of the ecosystem that were impacted and help to compensate for losses that would occur over the recovery period. For example, bycatch contributes to overfishing, threatens protected and endangered species, and can close fisheries, which ultimately affects livelihoods and economies. Restoration approaches to address bycatch, key stressors and targeted resource level monitoring and scientific support activities offer steps toward comprehensive restoration of multiple resources.

When evaluating individual restoration projects using the OPA evaluation factors, the Trustees recognized that the following projects to reduce bycatch would not only meet the goals of the Restoration Type targeted by that project, but would also provide important cross-resource benefits (fish, sea turtles, and marine mammals) to more fully restore for the injury.

- **Fish:** Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery; Communication Networks and Mapping Tools to Reduce Bycatch—Phase 1; Restoring for Bluefin Tuna via Fishing Depth Optimization.
- **Sea Turtles:** Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery; Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery; Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices.

The PDARP/PEIS also recognizes the importance of reducing key stressors to increase the abundance and resiliency of these interconnected resources and address the adverse effects to ecological communities and functions caused by the spill. For example, the restoration, management and protection of MDBC is important for the many associated resources, including injured fish species and plankton communities. Their restoration is also important for the deep-sea ecosystem, which has important ecological functions including nutrient recycling throughout the offshore Gulf of Mexico.

When evaluating individual restoration projects using the OPA evaluation factors, the Trustees recognized that the following projects to reduce stressors would not only meet the goals of the targeted Restoration Type, but would also provide a strong nexus to the ecosystem injury. Together these projects would have synergistic effects to reduce a broad range of key stressors impacting the resilience of multiple species and communities across the Gulf of Mexico.

- **Fish:** Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries.
- **Sea Turtles:** Long-term Nesting Beach Habitat Protection for Sea Turtles.
- **Marine Mammals:** Reducing Impacts to Cetaceans during Disasters by Improving Response Activities; Reduce Impacts of Anthropogenic Noise on Cetaceans; Reduce and Mitigate Vessel Strike Mortality of Cetaceans.
- **Mesophotic and Deep Benthic Communities:** Active Management and Protection.

The Trustees also recognize that Restoration Types influence one another and exist within a matrix of restoration and science efforts and programs across the Gulf of Mexico. The PDARP/PEIS includes a monitoring and adaptive management goal to provide for a flexible, science-based approach to ensuring that the restoration portfolio provides long-term benefits to the resources and services injured by the spill in the effective and efficient manner. Therefore, the Trustees recognized the importance of targeted resource level monitoring and support activities to address gaps in scientific understanding that limit restoration planning, implementation, evaluation, and/or understanding of resource recovery. The following projects are designed to increase our scientific understanding of restoration for these resources and to better characterize the status, trends, and spatiotemporal distributions of injured resources and habitats. Together they would improve the Trustees' ability to target restoration activities and track resource and ecosystem recovery.

- **Sea Turtles:** Gulf of Mexico Sea Turtle Atlas; Developing a Gulf-wide Comprehensive Plan for In-Water Sea Turtle Data Collection.
- **Marine Mammals:** Compilation of Environmental, Threats, and Animal data for Cetacean Population Health Analyses.
- **Mesophotic and Deep Benthic Communities:** Mapping, Ground-Truthing, and Predictive Habitat Modeling; Habitat Assessment and Evaluation; Coral Propagation Technique Development.

Independently and together, the portfolio of preferred alternatives as evaluated under OPA meet the restoration goals and take steps toward comprehensive, integrated restoration as proposed in the PDARP/PEIS.

Chapter 4: Environmental Assessment

4.1 Overview of NEPA Approach

This chapter describes the anticipated environmental impacts of the proposed action (implementation of the preferred alternatives) and the alternatives not preferred for implementation at this time. The NEPA analysis presented in this chapter is consistent with the PDARP/PEIS and tiers where applicable. Resources analyzed and impact definitions (minor, moderate, major) align with the PDARP/PEIS (Appendix C to this RP/EA). The PDARP/PEIS is incorporated by reference.

Incorporation by reference of relevant information from existing plans, studies or other material is used in this analysis to streamline the NEPA process and to present a concise document that briefly provides sufficient evidence and analysis for determining whether to prepare an environmental impact statement or finding of no significant impact, and to aid the Open Ocean TIG's compliance with NEPA (40 CFR § 1506.3, 40 CFR § 1508.9). As stated in the CEQ Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act [40 CFR §§ 1500-1508 (CEQ regulations)], agencies should "focus on significant environmental issues" and for other than significant issues there should be "only enough discussion to show why more study is not warranted" (40 CFR §§ 1502.1 and 1502.2). All source documents relied upon for the NEPA analyses are available to the public and links are provided in the discussion of the environmental consequences where applicable.

To determine whether an action has the potential to result in significant impacts, the context and intensity of the action must be considered. Context refers to area of impacts (local, state-wide, etc.) and duration (e.g., whether they are short- or long-term impacts). Intensity refers to the severity of impact and could include the timing of the action (e.g., more intense impacts would occur during critical periods like high visitation or wildlife breeding/rearing, etc.). Intensity is also described in terms of whether the impact would be beneficial or adverse. The analysis of beneficial impacts focuses on the duration (short- or long-term), without attempting to specify the intensity of the benefit.

"Adverse" is used in this chapter only to describe the federal Trustees' evaluation under NEPA. That term is defined and applied differently in consultations conducted pursuant to the ESA and other protected resource statutes. Accordingly, in the protected resources sections in each Restoration Type chapter, there may be adverse impacts identified under NEPA; however, this does not necessarily mean that an action would be likely to "adversely affect" the same species because that term is defined and applied under protected resources statutes. The results of any completed protected resource consultations are included in the Administrative Record and will be discussed in the Final RP/EA. The definition of these characterizations is consistent with that used in the PDARP/PEIS and the table from the PDARP/PEIS is presented in Appendix C.

Projects are proposed as one of three categories of activities: 1) Initial planning phase, 2) Long-range activities, and 3) Projects proposed for full implementation. The approach for NEPA analysis appropriate for each of these three types of activities is provided in this subsection.

4.1.1 Preliminary Phase Restoration Activities

As discussed in Chapter 6 of the PDARP/PEIS, a TIG may propose funding preliminary phases of restoration (e.g., initial E&D in one plan for a conceptual project, or for studies needed to maximize restoration planning efforts). This would allow the TIG to develop needed information leading to sufficient project development to conduct a more detailed analysis in a subsequent restoration plan, or for use in the restoration planning process. In this RP/EA, a number of preliminary phase restoration alternatives are proposed, primarily for efforts that require additional planning and data collation or development of data-based tools that may inform subsequent restoration efforts. Data collected would provide fundamental information to prioritize and support protection and management activities and to target locations for direct restoration. OPA evaluation for these preliminary phase restoration projects is included in this RP/EA (Chapter 3). After review, the Open Ocean TIG determined that these projects fall within the range of impacts described in Section 6.4.14 of the PDARP/PEIS, providing sufficient NEPA analysis for these alternatives. This analysis is summarized for each of these projects in Section 4.2. As more information is developed through detailed planning information or data-based tool development activities, and following completion of these preliminary phase restoration projects, the TIG may propose a related restoration project in a later plan(s) dependent upon the outcomes of these initial efforts. Preliminary phase restoration activities proposed in this plan include:

- **Fish:** Communication Networks and Mapping Tools to Reduce Bycatch – Phase 1.
- **Sea Turtles:** Gulf of Mexico Sea Turtle Atlas; Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery; Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection; Reducing Sea Turtle Bycatch at Recreational Fishing Sites.
- **Marine Mammals:** Compilation of Environmental, Threats, and Animal Data for Cetacean Population Health Analyses.

4.1.2 Long-Range Activities

This RP/EA also includes a number of projects that have been developed as long-range actions structured to include a full lifecycle of activities such as initial project design and assessment, tool design, and tool testing, through long-term site-specific project implementation. For these projects OPA (Chapter 3) and NEPA (Section 4.4) evaluation are addressed in this RP/EA through a programmatic lens. As such, this NEPA analysis evaluates a broad range of types of activities anticipated to follow from the initial work, but for which specific details (e.g., over a range of activities, defined locations, species specificity) will be refined over time. As part of implementation planning, a process will be developed so that at defined points over the course of long-range implementation (e.g., identification of site-specific actions), the TIG will review such actions and affirm consistency with the environmental compliance provided in this RP/EA. This review will be shared with the public via posting to its DWH TIG website and through updates at TIG annual meetings. Should a project's future action fall outside of the analysis considered at this time, supplemental environmental compliance and public review would be completed consistent with the DWH Trustee SOP. Long-range activities proposed in this plan include:

- **Marine Mammals:** Reducing Impacts to Cetaceans during Disasters by Improving Response Activities; Reduce Impacts of Anthropogenic Noise on Cetaceans; Reduce and Mitigate Vessel Strike Mortality of Marine Mammals
- **Mesophotic and Deep Benthic Communities**: All project alternatives.

4.1.3 Projects Proposed for Full Implementation

This RP/EA also proposes site- and activity-specific projects for full implementation. These projects are fully evaluated under OPA in Chapter 3 and NEPA in Section 4.4. These projects describe in detail all actions necessary to fully implement the project and are likewise fully evaluated under NEPA in this RP/EA. Following implementation, should a project evolve in a manner that justifies expansion or modification the Open Ocean TIG will consider such proposals and determine an appropriate path forward (e.g., project analysis indicates no change to analyses under OPA, NEPA, or other environmental statutes; supplemental analysis to the original project; or development of a new, independent restoration project in a later restoration plan). Full implementation projects proposed in this plan are:

- **Fish:** Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries; Better By-catch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery; Restoring for Bluefin Tuna via Fishing Depth Optimization; Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats.
- **Sea Turtles:** Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery; Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices; Long-term Nesting Beach Habitat Protection for Sea Turtles; Reducing Sea Turtle Entanglement from Recreational Fishing Debris.
- **Marine Mammals:** Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns.

4.2 Projects Proposing Preliminary Phase Restoration Activities

Six projects from three Restoration Types propose actions involving only planning, data collation, data-based tool development, and education and outreach activities (Table 4-1). The projects include activities such as characterizing the environment to determine the best restoration for future implementation. These activities fall within the PDARP/PEIS definition of preliminary phases of restoration planning provided in Section 6.4.14 of the PDARP/PEIS. Consistency with the PDARP/PEIS evaluation is summarized below.

Table 4-1: Projects proposing preliminary phase restoration activities.

Restoration Type	Preliminary Phase Restoration Project
Fish	Communication Networks and Mapping Tools to Reduce Bycatch – Phase 1
Sea Turtles	Gulf of Mexico Sea Turtle Atlas
	Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery
	Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection
	Reducing Sea Turtle Bycatch at Recreational Fishing Sites
Marine Mammals	Compilation of Environmental, Threats, and Animal Data for Cetacean Population Health Analyses

4.2.1 Fish Initial Planning Phase Project

4.2.1.1 Communication Networks and Mapping Tools to Reduce Bycatch – Phase 1

This project would include planning activities for the development of a near-real time, spatially explicit map of bycatch hotspots coupled with a communication tool that informs fishermen of the bycatch potential in those areas. The purpose of this project would be to determine feasibility of this communication tool for future restoration and implementation. The project would be limited to planning and data management activities and none of the proposed actions would negatively impact resources or have environmental consequences. These activities are consistent with the PDARP/PEIS evaluation of preliminary phases of restoration (planning, feasibility studies, design engineering, and permitting activities) provided in Section 6.4.14 of the PDARP/PEIS. Therefore, no further NEPA analysis is required at this time.

4.2.2 Sea Turtles Initial Planning Phase Projects

4.2.2.1 Gulf of Mexico Sea Turtle Atlas

This project would include activities such as formation of a steering committee, identification and prioritization of data needs, development of data sharing agreements, processing and standardizing data contributions, and deployment of technical infrastructure. The purpose of this project is to design an Atlas to bring together data sources and develop the system to inform future restoration and implementation. The project would be limited to desktop activities and would not impact resources or have environmental consequences. These activities are consistent with the PDARP/PEIS evaluation of preliminary phases of restoration (planning, feasibility studies, design engineering, and permitting activities) provided in Section 6.4.14 of the PDARP/PEIS. Therefore, no further NEPA analysis is required at this time.

4.2.2.2 Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery

This project would include activities such as analysis of existing data on bycatch of sea turtles in reef fish BLL fishery, evaluation of environmental variables, identification of gear or fishing modifications that may reduce bycatch, and development of a framework for future restoration efforts. The purpose of this project would be to identify methods and determine their feasibility as potential restoration measures for implementation through future restoration plans to reduce sea turtle bycatch in the reef fish BLL fishery to restore sea turtle populations. The project would be limited to desktop activities and would not impact resources or have environmental consequences. These activities are consistent with the PDARP/PEIS evaluation of preliminary phases of restoration (planning, feasibility studies, design engineering, and permitting activities) provided in Section 6.4.14 of the PDARP/PEIS. Therefore, no further NEPA analysis is required at this time.

4.2.2.3 Developing a Gulf-wide Comprehensive Plan for In-water Sea Turtle Data Collection

This project would include activities such as development of a steering committee and working group; identification and prioritization of data gaps; formation of a final strategic plan to implement in-water data collection; and facilitation of stakeholder meetings. The purpose of this project would be to identify methods and develop a Gulf-wide comprehensive data collection plan to guide subsequent in-water survey restoration projects. The project would be limited to desktop activities and would not impact resources or have environmental consequences. These activities are consistent with the PDARP/PEIS evaluation of preliminary phases of restoration (planning, feasibility studies, design engineering, and permitting activities) provided in Section 6.4.14 of the PDARP/PEIS. Therefore, no further NEPA analysis is required at this time.

4.2.2.4 Reducing Sea Turtle Bycatch at Recreational Fishing Sites

Development of a program to reduce sea turtle bycatch at recreational fishing sites would include activities such as data collection and analysis, identification of priority areas, development of bycatch reduction measures, testing of measures, program design, and education and outreach. The intent of the project is to complete initial planning and identify measures to reduce sea turtle bycatch at recreational fishing sites and inform future restoration efforts. The project would be limited to desktop and education/outreach activities and would not impact resources or have environmental consequences. These activities are consistent with the PDARP/PEIS evaluation of preliminary phases of restoration (planning, feasibility studies, design engineering, and permitting activities) provided in Section 6.4.14 of the PDARP/PEIS. Therefore, no further NEPA analysis is required at this time.

4.2.3 Marine Mammals Initial Planning Phase Project

4.2.3.1 Compilation of Environmental, Threats, and Animal data for Cetacean Population Health Analyses

This project includes activities to compile environmental, threats, and animal health data for cetacean population health analyses. These datasets would be provided in a user-friendly, web-based application that would be utilized by the Trustees, restoration planners, responders, and conservation managers to assess the health of cetacean stocks. The intent of the project is to develop a platform. The effort would be limited to desktop activities and would not impact resources or have environmental consequences. These activities are consistent with the PDARP/PEIS evaluation of preliminary phases of restoration (planning, feasibility studies, design engineering, and permitting activities) provided in Section 6.4.14 of the PDARP/PEIS. Therefore, no further NEPA analysis is required at this time.

4.3 Affected Environment

The purpose of this section is to describe the environment of the area(s) to be affected by the proposed alternatives under consideration, with emphasis commensurate with the importance of the impact on those resources (40 CFR §1502.15).

The northern Gulf of Mexico comprises a vast regional ecosystem—an interactive, interdependent network of organisms (from microbes to plants to animals) and their chemical, biological, and physical environment. Ranging from the coastline itself, to its bays and estuaries, expansive continental shelf, and vast open ocean and deep-sea, the northern Gulf of Mexico ecosystem contains some of the nation's most diverse and productive natural resources, as described in detail in Chapter 3 Ecosystem Setting and Chapter 4 Injury to Natural Resources of the PDARP/PEIS, which is incorporated by reference here.

Focusing on the resources of the Open Ocean Restoration Area, it is equally vast, and includes fish and water column invertebrates, sea turtles, marine mammals, and MDBC, as well as the associated physical, biological and socioeconomic-related resources. The following section describes the existing conditions for each resource potentially affected by the restoration actions proposed in this plan. To avoid duplication of programmatic information this RP/EA discusses only those resources that could potentially be affected by an alternative. Resource categories addressed in the PDARP/PEIS which are not relevant to the alternatives in this plan include: air quality, infrastructure, aesthetics and visual resources, and public health and safety. Accordingly, the affected environment overview does not discuss these resources. The environmental consequences evaluation for the project alternatives is provided Section 4.4.

4.3.1 Physical Resources

In this section, the geology and substrates of the affected environment are discussed as well as the hydrology and water quality affected resources specific to the project alternatives. The noise environment is discussed generally and in reference to effects on marine animals and monitoring systems.

4.3.1.1 Geology and Substrates

The Gulf of Mexico encompasses approximately 615,000 square miles (1.6 million square kilometers) of coastal and open ocean habitat, extending across five U.S. states (Texas, Louisiana, Mississippi, Alabama, and Florida) south to Mexico and east to Cuba. Moving seaward from the coastline, the northern Gulf of Mexico can be described by broad geomorphological zones, including the coastal transition areas, the continental shelf, the continental slope, and the abyssal plain. The bays, estuaries, wetlands, and barrier islands make up the coastal transition zone. The continental shelf extends from the barrier islands to the shelf break and is characterized by a wide, shallow slope to a depth of about ~650 feet (200 meters). The width of the continental shelf is variable, ranging from extremely narrow (approximately 6 miles [~10 kilometers]) near the mouth of the Mississippi River to more than 124 miles (200 kilometers) off west Florida (Shepard 1973). Significant hard bottom features in the region include dozens of topographic features along the edge of the continental shelf and extending down the continental slope that form the basis for structurally complex benthic communities at mesophotic and deeper depths (Figure 4-1)(DWH NRDA Trustees 2016a).

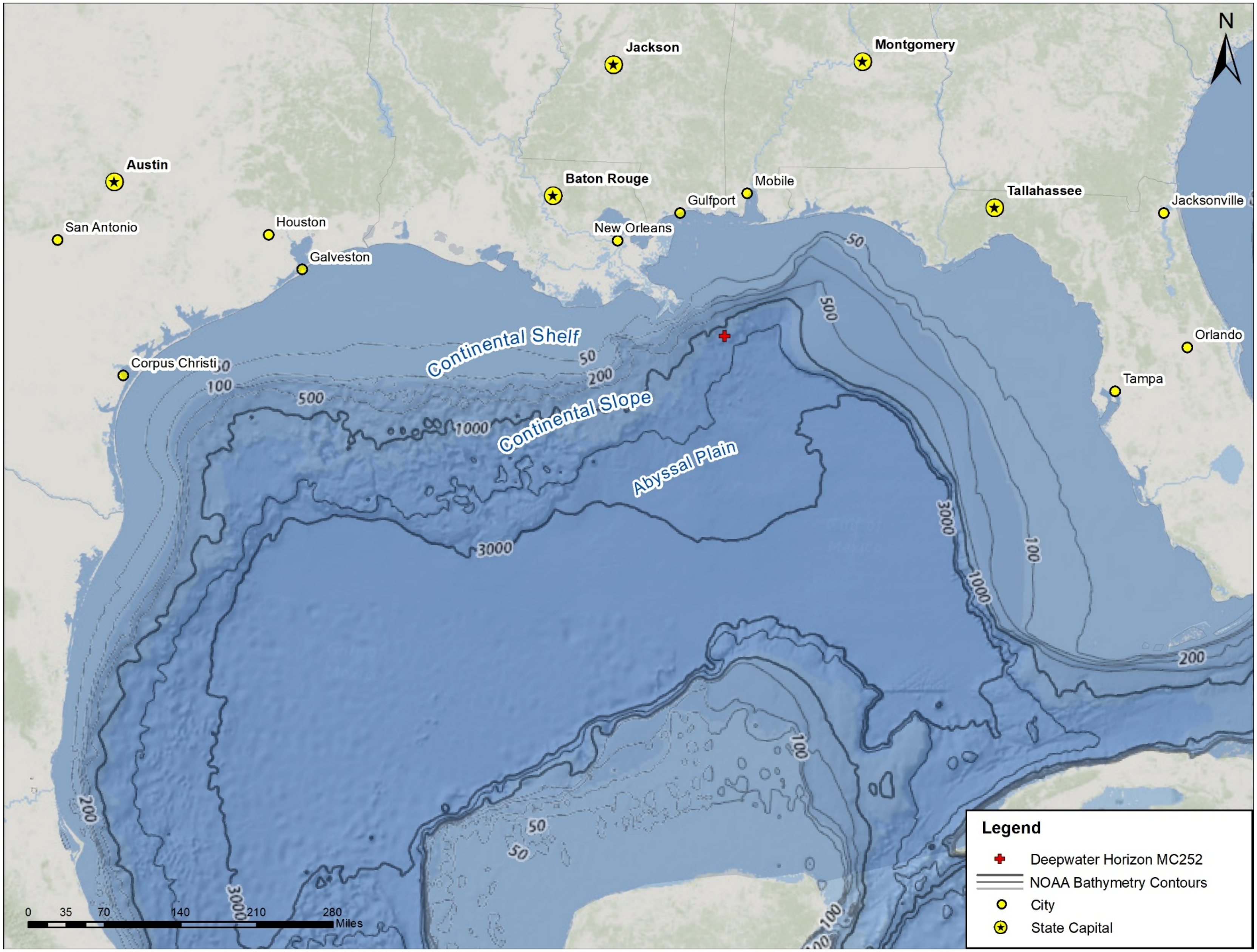
The substrates within the range of the projects analyzed in this RP/EA are quite diverse and vary depending on location. The nearshore benthic substrates generally consist of sand, silt, clay, hard bottom substrates, and vegetation (Lavoie et al. 2013). The eastern portion of the Gulf of Mexico continental shelf is primarily sand to a depth of 328 feet (100 meters). The western and central shelf consists of a mixture of sand, silt, and clay, and sediments offshore Mississippi and Louisiana are silt and clay of terrigenous origin from the Mississippi River (Balsam and Beeson 2003). The predominant sediment grain size in nearshore areas is typically sand that becomes increasingly finer with increasing distance from the shore (Lavoie et al. 2013).

Some 12,000 square miles (~31,080 square kilometers [5 percent]) of US territorial waters in the Gulf of Mexico are estimated to have hard bottom substrate (Jenkins 2011). This geologically complex area contains the reefs and banks of the Texas–Louisiana shelf (such as the Flower Garden Banks and other banks of the northwestern Gulf of Mexico); the Pinnacles area of the Mississippi-Alabama shelf; and mesophotic (164 – 984 feet [50 – 300 meters]) and deep coral ecosystems (greater than 984 feet [greater than 300 meters]) that comprise the deeper parts of the shelf-edge features and other features on the continental slope. Generally, offshore Texas, Louisiana, Mississippi, Alabama, and Florida, the seafloor near the edge of the continental shelf is characterized by a complex of reefs and banks at greater than a 164 feet (50 meter) depth, and as deep as 492 feet (150 meters). A small number of them, such as the Flower Garden Banks, are shallow enough for stony coral reefs to have become established. West of the Mississippi River delta, numerous other features contain a mix of coral reefs, coral communities, and mesophotic coral habitats. East of the Mississippi river, off the coasts of Mississippi, Alabama, and Florida, numerous areas including Pinnacles, Madison-Swanson, the Florida Middle Grounds, Steamboat Lumps, The Edges, and Pulley Ridge harbor contain mesophotic coral habitats. Deep coral ecosystems are present off the shelf edge on the continental slope and some of these hard bottom features contain both mesophotic and deep coral communities (ONMS 2016). For the purpose of this RP/EA, MDBC are considered to comprise both a geology and substrate resource, and a biological resource (see Section 4.3.2.1.1).

4.3.1.2 Hydrology and Water Quality

The northern Gulf of Mexico receives more than 60 percent of the U.S. drainage, including outlets from 33 major river systems and 207 estuaries (USEPA 2014). Three major estuarine drainage areas and three fluvial drainage areas (Texas, Mississippi, and West Florida) have a large influence on water quality in the Gulf of Mexico. Freshwater and sediment from river deltas into the coastal waters affect water quality (Gore 1992) due to the discharge of excess nutrients (e.g., nitrogen, phosphorus), sediments and contaminants from industrial wastewater discharge, urban runoff, and agriculture to downstream receiving waters. With increasing distance from shore, oceanic circulation patterns play a large role in dispersing and diluting anthropogenic contaminants and determining water quality. Due primarily to the influence of the Gulf of Mexico's extensive estuary system and input from the Mississippi River, areas of the Gulf of Mexico closer to shore show regional variation (USEPA 2012).

Figure 4-1: Bathymetry and offshore features of the Gulf of Mexico.



Salinity in nearshore areas along the northern Gulf of Mexico coast is largely influenced by river discharge. The combined discharge of the Mississippi and Atchafalaya Rivers alone accounts for more than half the freshwater flow into the Gulf of Mexico and is a major influence on salinity levels in coastal waters on the Louisiana/Texas continental shelf. The annual freshwater discharge of the Mississippi/Atchafalaya River system represents approximately 10 percent of the water volume of the entire Louisiana/Texas shelf to a depth of 295 feet (90 meters) (GMFMC 1998), with a discharge of 600,000 cubic feet per second, or 1.5 billion cubic meters per day, at New Orleans (NPS 2015).

Turbidity is high in nearshore areas within the north-western Gulf of Mexico due to terrigenous sediments. Turbidity off the coast of Florida is much lower due to the carbonate sediments derived from biological production present in that area (Rezak et al. 1990). In areas with fine bottom sediments, currents can resuspend particles to form a turbid sediment layer in the water column that can extend to 66 feet (20 meters) over fine sediment muddy bottoms.

The fresh water and sediment mix with the salt water of the northern Gulf of Mexico, creating extensive areas of biologically rich estuarine and offshore habitats. In bottom water (the lowermost layer of ocean water), low oxygen availability (a condition known as hypoxia) is a major water quality problem in portions of the northern Gulf of Mexico and its estuaries, caused in large part by nutrient loading from river inflows. The input of nutrient-rich fresh water to the coastal area fuels phytoplankton blooms in the water column. Following the eventual transportation of dead and decaying plant material to the ocean floor, this organic-rich biomass undergoes decomposition by bacteria and results in the depletion of oxygen (eutrophication) at depth (DWH NRDA Trustees 2016a). The largest oxygen depleted zone in the Gulf of Mexico is found off the coast of Texas and Louisiana near the Mississippi river drainage basin (Rabalais et al. 2002).

Recent research has shown natural hydrocarbon seeps in the Gulf of Mexico to release between ~159,000 and ~596,000 barrels of hydrocarbons into the water column annually (MacDonald et al. 2015), compared with 3.19 million barrels released over the course of the 87 day DWH oil spill alone, with another ~44,000 barrels of dispersant applied in response to that event (DWH NRDA Trustees 2016a). Studies have also documented low-level chronic effects of releases (pollutants ranging from solid wastes, to chemical contaminants, to sewage) from platforms (Kennicutt 1995), ships (Copeland 2008), and land-based sources (NOAA 1998). Produced water discharges, for example, are estimated at roughly one billion barrels per year. While concentrations of hydrocarbons contained in this discharge is low (e.g., limited under EPA's Region 6 NPDES general permit for offshore oil and gas activities to 29 milligrams/liter monthly average or 42 milligrams/liter daily maximum), the total volume is quite large (Veil et al. 2004; Veil 2008). Discharges to water of the U.S. Gulf of Mexico are regulated by the U.S. EPA under the Clean Water Act, the U.S. Army Corp of Engineers (USACE) under the Rivers and Harbors Act of 1899, and by BOEM and Bureau of Safety and Environmental Enforcement (BSEE) under the Outer Continental Shelf Lands Act (OCSLA) (ONMS 2016).

Marine debris from a variety of sources affects water quality and produces a wide variety of environmental, economic, safety, health, and cultural impacts (NOAA 2016a). Stormwater inputs from land surfaces can carry large amount of debris into coastal waters and ultimately offshore. Marine debris can also include recreational debris from beaches, piers, harbors, riverbanks, marinas, and docks as well as from fisheries gear including trawl nets (see Section 4.3.3.5.2 Shrimp Fishery), bottom longlines (see Section 4.3.3.5.2 Reef Fish Fishery), crab traps (see Section 4.3.3.5.2 Blue Crab Fishery) and mono-filament lines (see Section 4.3.2.4.1 Sea Turtles). Derelict fishing gear and other marine debris can damage the structure of marine habitats and can introduce plastic particles into marine habitats, reducing water quality. Marine debris can provide a mechanism for the transport of invasive species (DWH NRDA Trustees 2016a). Marine debris issues affecting water quality can result in beach closures (Oigman-Pszczol and Creed 2007) and can disable vessels via direct interactions with the debris or propeller/intake interactions (NOAA 2011; U.S. Commission on Ocean Policy 2004). Entanglement alone impacts over 115 marine species including mammals, turtles, birds, fish, and crabs (NOAA 2014). Marine debris prevention programs, such as the NOAA Marine Debris Program, established in 2005, exists to help reduce and prevent marine debris from land-based sources. These types of programs focus on prevention through outreach and education and providing recycling locations at piers for monofilament fishing gear, as well as debris removal activities (NOAA 2018c).

4.3.1.3 Noise

Noise in the offshore Gulf of Mexico environment, both above and below the water, can come from a variety of natural and anthropogenic sources. Some ocean sounds are the result of natural sources such as storms, waves, and marine animals that produce and use sound to communicate and discern their environment. There are a wide variety of anthropogenic sources that contribute to the soundscape in the Gulf of Mexico. As human presence in the offshore environment has grown, so have anthropogenic sound levels (NRC 2003). These sources include oil and gas industry operations (e.g., seismic surveys, the operation of fixed structures such as offshore platforms and drilling rigs, and helicopter and support-vessel traffic), shipping, cruise ships, fishing vessels, charter boats and other tour boats, aircraft, research vessels, mineral exploration and extraction, construction and/or dredging, and exercises for military preparedness and national defense (e.g., activities such as the use of sonar and explosives). Noise generated from these activities can be transmitted through both air and water and may be persistent or temporary in nature. The noise intensity levels and frequencies are highly variable, both between and among the various sources (ONMS 2016). Estimates suggest noise levels in the ocean were at least 10 times higher in the early 2000's than they were a few decades prior and commercial shipping is considered to be one of the primary contributors to noise in the world's oceans (NRC 2003). The intensity of noise from vessels is typically related to ship size and speed. Large ships tend to be noisier than small ones, and ships underway with a full load typically produce more noise than vessels without a load. In addition, a vessel's relative noise tends to increase with speed (BOEM 2017a).

Underwater noise can be divided into two main types: 1) impulsive (pulsed), which is divided into single or multiple pulses, and 2) non-impulsive (NMFS 2018b; Science Communication Unit 2013). Impulsive sound is defined within in American National Standards Institute Standard S12.9-2005/Part 4 as "sound characterized by brief excursions of sound pressure (acoustic impulses) that significantly exceed the ambient environmental sound pressure." Therefore, impulsive sound is characterized by extremely rapid rise rates in amplitude over time (rise time), minimal duration, and a rapid decay in amplitude. The duration of a single impulsive sound is usually less than one second. Examples of impulsive noise include explosions, pile driving, and seismic surveys. Non-impulsive sounds have a longer duration, typically with slower rise and decay times. The sounds of an outboard boat engine or wind turbines are examples of continuous, non-pulsed sound (BOEM 2017a).

The discussion of anthropogenic noise sources included in Chapter 3 of the Bureau of Ocean Energy Management's Final Programmatic Environmental Impact Statement for the Outer Continental Shelf Oil and Gas Leasing Program: 2017-2022 (BOEM 2016) is incorporated here by reference. Vessel traffic in the Gulf of Mexico largely attributes to the increased amount of anthropogenic noise introduced into the ocean. The primary sources of ship noise are propeller cavitation, propeller singing, and propulsion. Small vessels produce noise frequencies of 37 to 6,300 hertz (Hz). Larger vessels have noise frequencies ranging from 6.8 to 428 Hz (BOEM 2016). Noise associated with oil and gas exploration is most often produced by seismic air guns and drilling operations. Air gun arrays have frequencies less than 120 Hz whereas noise from drilling operations contain strong tonal components at low frequencies (less than 500 Hz) (BOEM 2016).

4.3.1.3.1 Noise Effects on Marine Animals

The acoustic properties of a sound source (frequency, intensity, and transmission patterns) and the sensitivity of the hearing system in the marine organism determines if marine organisms detect the sound. A study by National Research Council (NRC) showed that some sounds may adversely impact marine life in certain situations while having no perceived effect in other settings (NRC 2003). Potential impacts of sound on marine organisms can range from no or very little effect to various levels of behavioral reactions, physiological stress, threshold shifts, auditory masking and direct trauma. Responses to sound generally fall into three categories: behavioral, acoustic, and physiological (Nowacek et al. 2007). In addition, research shows that the same level of sound may have different impacts on marine life depending on the specific circumstances of a situation. Some sounds can interrupt important biological behaviors (e.g., courtship, nursing, feeding, and migration) and mask communication between animals (BOEM 2017a; NRC 2003; Richardson et al. 1995). In more extreme instances, exposures to high levels or extended periods of sound can impose physiological effects, including hearing loss and mortality. Furthermore, the same sound source can propagate differently depending on the physical environment. How a sound from a specific source propagates through a particular environment depends on a variety of factors, including physical environment factors (e.g., salinity, temperature, bathymetry, and seafloor type), sound characteristics associated with different sources (e.g., source level, directionality, source type, and duration for impulsive or continuous signals), frequency (i.e., higher frequencies dissipate faster, lower frequencies may travel farther depending on water depth), and intensity (i.e., decibel level) (BOEM 2017a).

4.3.1.3.2 Passive Acoustic Monitoring

Passive acoustic data has been collected at numerous sites in the Gulf of Mexico over the last decade and collaborative efforts with data holders may provide noise characterizations of the acoustic conditions in these waters (Estabrooke et al. 2016; Sidorovskaia and Li 2016; Wiggins et al. 2016).

The BOEM Environmental Studies Program (BOEM 2014), which includes a description of the ongoing PAM Program for the northern Gulf of Mexico, is incorporated here by reference. The objective of the program is to establish a long-term PAM program using moored acoustic recorders at permanent stations throughout the northern Gulf of Mexico. The program will provide a relative baseline with which to assess any authorized exploration activities as well as to provide more information on cetacean distributions based on vocalizations detected by the PAM system. Also incorporated here by reference is the 2017 NOAA Gulf of Mexico Marine Assessment Program for Protected Species Summer Research Cruise report (NOAA 2018d). This study aims to provide important information to inform both BOEM and BSEE regulatory needs regarding protected species, as well as other agencies and stakeholders involved in effective management and conservation. Aerial surveys, ship-board surveys of marine mammals, and spatial and temporal model development are all key tasks included within this program. During the 2017 summer research survey, the team re-deployed several long-term HARPs in addition to deploying short-term LARPs that will continuously record sounds up to 1 kHz for one year. This information will help develop species density models.

4.3.2 Biological Resources

Biological resources that may be affected by the projects are discussed in the following sections: Section 4.3.2.1 Habitats; Section 4.3.2.2 Marine and Estuarine Fauna; and Section 4.3.2.3 Wildlife Species, specifically birds, with details on the affected species protected under federal law (Section 4.3.2.4 Protected Species).

4.3.2.1 Habitats

4.3.2.1.1 Marine Benthic Communities

Northern Gulf of Mexico marine benthic communities are home to a wide array of sedentary infauna (e.g., worms and crustaceans) and epifauna (e.g., sea pens), and sessile organisms, including algae, sponges, hard and soft corals (including shallow-water, mesophotic, and deep-sea corals), hydroids, anemones, and bryozoans, as well as motile invertebrates such as decapod crustaceans, gastropods, and echinoderms. Much more mobile bony and cartilaginous fish, cephalopods, sea turtles, and marine mammals also structure, inhabit, and/or have strong associations or trophic connectivity to bottom habitats. A myriad of small animals and microbes live in these diverse habitats on the sea bottom and are also important components of the benthic food web.

Soft bottom habitats support a diverse assemblage of organisms living within or on the sediment, including crustaceans, gastropods, bivalves, and worms, as well as many larger animals such as fish, crabs, and sea cucumbers, which live and feed on the sea floor (Mineral Management Service 2006). Lower densities of conspicuous fishes and invertebrates occur on soft bottom communities when compared to areas with hard bottom substrates. Soft bottom communities are characterized by burrows and mounds from active infaunal populations.

Hard bottom habitats include natural reef or rock substrates as well as artificial reefs, and infrastructure such as oil and gas platforms. These habitats can occur both nearshore and offshore and support a wide variety of marine life, with species differences reflecting depth and other environmental factors (DWH NRDA Trustees 2016a). Descriptions of the biological environment of the Gulf of Mexico where MDBC occur are provided in Section 4.3.1 of the FGBNMS Expansion Draft Environmental Impact Statement. Those descriptions are incorporated here by reference (ONMS 2016).

Mesophotic Corals

Sections 3.5.3 and 4.5 of the PDARP/PEIS, provide an overview of the biology of mesophotic corals, and are incorporated here by reference. Mesophotic coral communities are characterized by the presence of light-dependent and heterotrophic corals and associated species found at water depths where light penetration is low. The dominant communities providing structural habitat in the mesophotic depth zone are made up of coral, sponge, and algal species. The fact that the dominant stony corals and certain octocorals contain zooxanthellae and require light distinguishes these communities from true deepwater coral communities, though their depth ranges may overlap.

Mesophotic coral communities in the north central Gulf of Mexico are characterized by octocorals (gorgonians) and black corals (Etnoyer et al. 2016; Gittings et al. 1992) and provide habitat for demersal fish (including a number of commercially and recreationally important fisheries species) and small invertebrates (Weaver et al. 2002). Mesophotic coral habitats are typically found at depths ranging from 100 feet (30 meters) and extending to over 650 feet (200 meters) in tropical and subtropical regions (DWH NRDA Trustees 2016a). While most mesophotic corals are non-reef-building, they can include reef-building corals such as plate-like zooxanthellate stony corals (*Agaricia* spp. and *Leptoceris cucullata*), white stony branching corals (*Madracis* spp. and *Oculina* spp.), branching hydrocoral (*Stylaster* spp.), and the clustering solitary cup coral (*Rhizopsammia* sp.). These stony corals form habitat for reef fishes and build new, though limited, calcareous reef. Additionally, hundreds of fish species as well as macroalgae, sharks, skates, rays, sea turtles, marine mammals, and many different types of benthic invertebrates inhabit northern Gulf of Mexico waters and associate with mesophotic coral habitats.

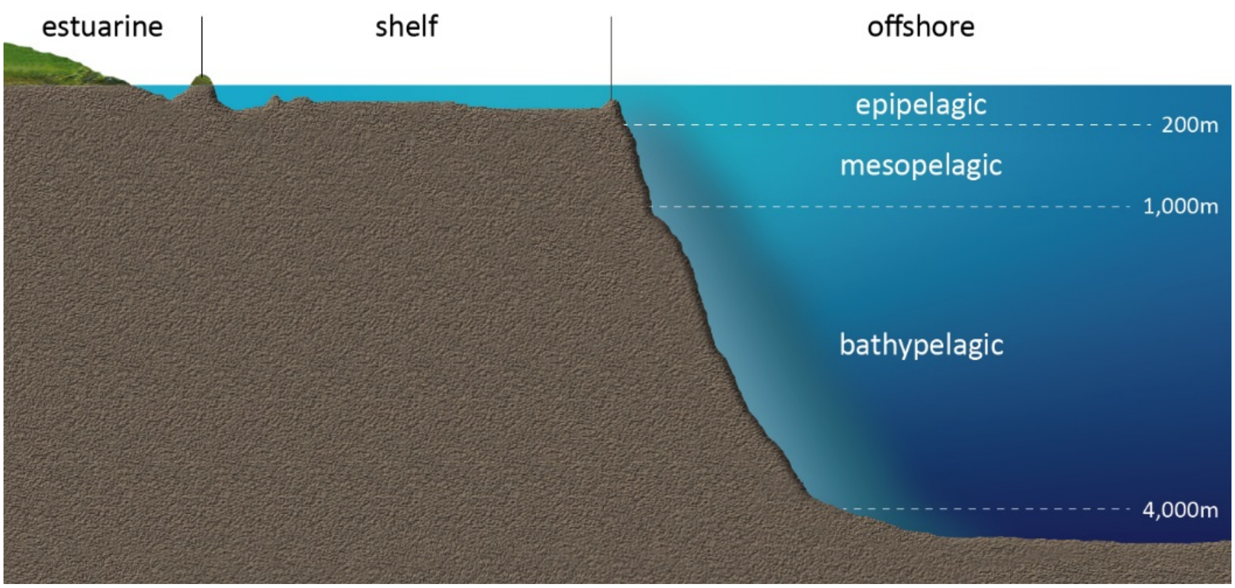
Deep-Sea Corals

Sections 3.5.3 and 4.5 of the PDARP/PEIS, provides an overview of the biology of deep-sea corals and are incorporated here by reference. Deep-sea coral communities of the Gulf of Mexico typically inhabit natural carbonate substrates and rocky outcroppings that cover a very small percentage of the ocean floor at depths greater than about 650 feet (200 meters) (Boland et al. 2017; Hourigan et al. 2007). These communities consist of foundation species, those species that form large complex habitats at these sites, and their associated fauna ranging in size from large mobile fishes to microscopic organisms. The most prominent foundation species in these communities are the deep-sea corals including relatives of the tropical reef-building corals, but also a variety of other cnidarian taxa such as black corals, gorgonians (including bamboo corals), soft corals, and stylasterid corals (ONMS 2016). Other taxa, including anemones and sponges, are also significant contributors to the framework of these deep benthic communities. Deep-sea corals may exist as a single colony on a small boulder on the sea floor but are typically in groups of up to hundreds of individual colonies on larger rocky outcroppings and may be co-located with high-density chemosynthetic communities (characterized by tubeworms, mussels, clams, bacterial mats, and other associated organisms). Deep-sea corals are slow growing and can live for over 1,000 years. They play an ecologically significant role because they create a three-dimensional structure in the deep ocean and provide protective cover for a variety of organisms such as brittle stars, crabs, and fish. Coral branches support sponges, anemones, clams, starfish, and sea urchins. Large mobile predators such as fish and crabs also live between the coral branches (DWH NRDA Trustees 2016a).

4.3.2.1.2 Water Column Communities

Horizontally, the water column can be separated into estuarine, shelf, and offshore waters (also related to geomorphological zones described in Section 4.3.1.1). Offshore waters can be further refined into three layers, according to depth (Figure 4-2). The epipelagic zone extends from the ocean surface to a depth of about 650 feet (200 meters) where sunlight can penetrate. The epipelagic zone supports photosynthesizing organisms such as phytoplankton (small, single-celled organisms that live in the water) (Miller 2004; Nybakken 2000) and currents and tides are important driving factors for movement of organisms, organic matter, and nutrients. For example, fish eggs and larvae are transported from the open ocean to protected estuaries and bays where young fish can hide from predators and grow (Day et al. 2012; O'Connell et al. 2005). In the mesopelagic zone, which extends from about 650 to 3,300 feet (200 to 1,000 meters) below the ocean surface, there is some light but not enough for photosynthesis, often termed the "twilight zone". Organisms that live in the mesopelagic zone include octopus, squid, and many fish species. At still greater depths (3,300 to 13,120 feet; 1,000 to 4,000 meters) is the bathypelagic zone, also known as the "midnight" zone because no light penetrates to these depths. In this zone, temperatures drop and organisms are adapted to life without light and with high water pressure (DWH NRDA Trustees 2016a). The Gulf of Mexico water column is home to a rich community of small planktonic plants and animals, fish and invertebrates, marine mammals, and sea turtles (further described in Section 4.3.2.2 Marine and Estuarine Fauna and Section 4.3.2.4 Protected Species).

Figure 4-2: Water column areas and zones in the Gulf of Mexico.



Sargassum

Sargassum is a genus of brown macroalga that forms an important habitat on the surface of the Gulf of Mexico. The life history of *Sargassum* is not well understood. Two pelagic species of *Sargassum* occur in the Gulf of Mexico, *Sargassum natans* and *Sargassum fluitans*, which support a diverse community of marine organisms. Pelagic *Sargassum* shows a seasonal pattern of distribution and movement in the Gulf, with the northwestern Gulf being a major nursery area. This alga supports a high diversity of marine invertebrates and vertebrates including several commercially and ecologically important pelagic fish, birds, and sea turtles. Over 54 species of fish are known to use *Sargassum* habitat for some portion of their life stages for shelter, feeding, spawning, and nurseries for juveniles. Commercially important species such as barracuda, mackerel, tuna, and swordfish use *Sargassum* habitat for shelter and as foraging grounds, preying on small and juvenile fish (Coston-Clements et al. 1991). Juvenile sea turtles, including loggerhead, Kemp's ridley, hawksbill, and green turtles use *Sargassum* for feeding and sheltering (Witherington et al. 2012). In addition, a wide variety of birds forage on invertebrates or small vertebrates found within *Sargassum*, including when it washes up on beaches (DWH NRDA Trustees 2016a).

4.3.2.2 Marine and Estuarine Fauna

Marine and estuarine fauna, which includes fish and invertebrates, are diverse across the Gulf of Mexico inhabiting diverse habitats as described above. These faunal assemblages vary based on salinity, temperature, depth, and substrate (see Section 4.3.1 Physical Resources). These species can generally be grouped by their habitat use: pelagic (inhabiting the upper layers of open ocean), demersal (inhabiting close to the seafloor), and benthic (inhabiting at the seafloor). Below, the general the groups of species that inhabit both demersal and pelagic areas are discussed. The Programmatic and Phase III Early Restoration Plan and Early Restoration Programmatic Environmental Impact Statement discussed species life stages, distributions, and importance and is incorporated here by reference (DWH Trustees 2014).

4.3.2.2.1 Demersal Nekton

Demersal nekton are those organisms that are in direct contact with the substrate or hover above it from the shelf to the slope transition down to the abyssal plain. Demersal organisms in the northern Gulf of Mexico can be generally characterized as soft bottom or hard bottom, according to their association with substrate types (DWH Trustees 2014).

Soft bottom habitat is relatively featureless and has lower species diversity than the more structurally complex hard bottom habitat, though some organisms that associate with soft bottom habitats construct burrows or excavate depressions in sediments, increasing the original complexity of the habitats. A variety of invertebrates including polychaete worms, various crustaceans, and molluscs can be very abundant in these soft bottom habitats. Shrimp (i.e. pink, brown, and white) are an important demersal species which utilize this habitat, grazing on a variety of smaller organisms inhabiting this zone. Demersal fish associated with soft bottom habitat generally prefer certain types of sediments and water depths over others (GMFMC 2004 and references therein). See Section 4.3.2.4.3 of this RP/EA for further details on shrimp species and Appendix D for a summary of life stages of soft bottom species with essential fish habitat (EFH) in the restoration area.

Hard bottom habitat includes natural reef and rock but can also refer to other substrata such as coral, clay, oyster reefs, or even artificial structures. Colonial encrusting organisms such as corals and molluscan species build reef structures which then support a wide variety of other organisms that use the biological derived structures for shelter from predation. These structures support extensive food webs with a diverse assemblage of polychaete worms, echinoderms crustaceans, and molluscs which, in turn, support higher trophic levels (DWH Trustees 2014).

Hard bottom associated fish include most snapper and grouper as well as seabasses, grunts, angelfishes, damselfishes, parrotfishes, and wrasses (Dennis and Bright 1988). Although reef fish are associated with hard bottom habitat as adults, some species, such as porgies, can be found over soft sediments as well. Like soft sediment species, many hard bottom demersal fish are estuarine dependent and spend their juvenile stages in coastal habitats. In water depths greater than 98 feet (30 meters), where reduced light penetration excludes most plants and herbivores, a distinctive mesophotic hard bottom assemblage occurs (Koenig et al. 2000; Weaver et al. 2002, 2006). Mesophotic coral communities are colonized by sponges, hydrozoans, soft corals, and tunicates. Fish assemblages on mesophotic coral communities are composed of snappers, groupers, seabasses, wrasses, bigeyes, butterflyfishes, angelfishes, jacks, and other reef-dwelling species, and are found on the continental shelf edge (CSA, Inc. and Texas A&M University 2001; Dennis and Bright 1988;

Koenig et al. 2000; Weaver et al. 2002). The deep-sea demersal fish fauna in the Gulf of Mexico includes approximately 300 species. See Section 4.3.2.1 on Habitats and Section 4.3.2.4 on Protected Species for more details. Life stages of hard bottom species with EFH in the restoration area are summarized in Appendix D.

Fishes that inhabit hard bottom in the Gulf of Mexico (e.g., red snapper) may also associate with artificial habitat, including oil and gas structures, artificial reefs, shipwrecks, and other debris (Gallaway et al. 2009; Szedlmayer and Lee 2004). Artificial structures create an environment conducive to the attraction and settlement of shallow-water tropical reef fishes in the upper water column and mesophotic species in depths greater than 98 feet (greater than 30meters) (Stanley and Wilson 2000).

4.3.2.2.2 Pelagic Nekton

The primary water column animal assemblages found in coastal and shelf waters of the Gulf of Mexico are termed pelagic nekton. Several pelagic groups, important for nutrient and energy flow through the water column ecosystem, inhabit this very productive zone.

The upper water column or epipelagic zone (to a depth of about 650 feet [200 meters]) in the Gulf of Mexico contains zooplankton, micronekton, and neuston, collectively referred to as pelagic microfauna. Microfauna play an integral role in the Gulf food chain through both the production of food sources and the transfer of energy through trophic levels. Below this zone is the mesopelagic zone (650 to 3300 feet [200 to 1000 meters]) which has some light penetration but not enough to support photosynthesis. Organisms that live in this part of the water column include octopus, squid, several species of shrimp, and many fish species (see Section 4.3.2.1.2 Water Column Communities for further information).

Major coastal pelagic fishes occurring in the Gulf of Mexico are sharks, rays, ladyfish, anchovies, herrings, mackerels, little tunny, jacks, mullets, bluefish, and cobia. Individual species (e.g., king mackerel [*Scomberomorus cavalla*], Spanish mackerel [*Scomberomorus maculatus*], and cobia [*Rachycentron canadum*]) managed jointly by the GMFMC and South Atlantic Fishery Management Council (SAFMC) are termed coastal migratory pelagic species. Pelagic species in the Gulf also include highly migratory species managed by NOAA Fisheries such as tunas, swordfish, billfish, and sharks (NOAA 2018e). Billfish typically do not school, but migrate extensively near the surface where they feed on pelagic fishes. Five species of billfish associated with the Gulf of Mexico are managed under Fishery Management Plans (FMPs). Because swordfish and tunas are highly migratory species, the fishery is managed by NOAA Fisheries Service in coordination with the International Commission for the Conservation of Atlantic Tunas (DWH Trustees 2014). Life stages of these highly migratory species with EFH in the restoration area are summarized in Appendix D. Also, see Section 4.3.2.4.3 on Magnuson-Stevens Act-Essential Fish Habitat and Section 4.3.3.5 Fisheries in this RP/EA for more details.

Fish inhabiting oceanic waters can be further divided into epipelagic, mesopelagic, and bathypelagic, on the basis of their depth preference. Epipelagic fishes inhabit the upper 700 feet (213 meters) of the water column in oceanic waters, typically beyond the continental shelf edge (Bond 1996). In the Gulf of Mexico, this group includes several shark species, swordfish, billfishes, flyingfish, halfbeaks, jacks, dolphinfish, and tunas. A number of the epipelagic species, such as dolphin fish, sailfish, white marlin, blue marlin, and tunas, are in decline and have important spawning habitat in the Gulf of Mexico. All of these epipelagic species are migratory, but specific patterns are not well understood.

Epipelagic fishes inhabit the upper 656 feet (200 meters) of the water column and include several sharks, billfishes, tunas, dolphins, flyingfishes, halfbeaks, opahs, oarfishes, jacks, remoras, pomfrets, butterfishes, molas, and triggerfishes. Several highly migratory species such as dolphinfish (*Coryphaena hippurus* and *C. equisetis*), sailfish (*Istiophorus platypterus*), white marlin (*Kajikia albida*), blue marlin (*Makaira nigricans*), and tunas (*Thunnus* spp.) are important to commercial and/or recreational fisheries. Most of these species associate with offshore structures in a transient fashion, usually in response to the availability of prey. Floating *Sargassum*, jellyfishes, siphonophores, and logs and other debris attract juvenile and adult epipelagic fishes. Most fish associated with *Sargassum* are temporary residents, such as juveniles of species that reside in shelf or coastal waters as adults (e.g., jacks, triggerfishes, filefishes) (GMFMC 2004). However, several larger species of recreational or commercial importance, including dolphinfish (*Coryphaena hippurus*), yellowfin tuna (*Thunnus albacares*), blackfin tuna (*Thunnus atlanticus*), skipjack tuna (*Katsuwonus pelamis*), Atlantic bonito (*Sarda sarda*), little tunny (*Euthynnus alletteratus*), and wahoo (*Acanthocybium solandri*), feed on the small fishes and invertebrates attracted to *Sargassum* (Bortone et al. 1977; Dooley 1972; Wells and Rooker 2004a, 2004b).

Below the epipelagic zone, the water column may be layered into the mesopelagic (650 to 3,300 feet [200 to 1,000 meters]) and bathypelagic (greater than 3,300 feet [greater than 1,000 meters]) zones, known as the midwater area. Fishes adapted to low or no-light conditions inhabit these waters.

4.3.2.3 Wildlife Species (Birds)

With respect to this RP/EA, in this section wildlife species refers to birds. Terrestrial species that are part of the affected environment for the sea turtle nesting habitat alternative are further described in Section 4.3.3.3.5. The ACNWR website[19] Comprehensive Conservation Plan (USFWS 2008) contain detailed information on the affected environment of the proposed area.

The Programmatic and Phase III Early Restoration Plan and Early Restoration Programmatic Environmental Impact Statement discussed open ocean bird resources and is incorporated here by reference (DWH Trustees 2014 and citations within). The Gulf of Mexico supports a diverse avifauna, with both resident and migratory species. Three distinct ecological groups of birds, within 17 families, occur within the restoration area: seabirds, waterfowl, and shorebirds. Bird species within a family share common physical and behavioral characteristics. Because of these commonalities, birds will be discussed by family rather than individual species, as the potential for effects would be similar for species within a family.

4.3.2.3.1 Seabirds

Pelagic bird species (seabirds) live most of their lives in open marine waters, roosting and feeding at the water surface the entire year. In the breeding season, mature adults return briefly to nesting areas on islands or along coastlines. Nesting of pelagic species in the Gulf of Mexico region is very limited and includes only a few locations containing tern colonies. Seabirds regularly observed within the Gulf of Mexico include petrels, shearwaters, storm-petrels, tropicbirds, frigatebirds, boobies, gannets, phalaropes, gulls, terns, skuas, and jaegers (McKinney et al. 2009; Peake and Elwonger 1996; Ribic et al. 1997).

[19] ACNWR website can be found at: https://www.fws.gov/refuge/Archie_Carr/

Modes of prey acquisition for pelagic seabirds include picking from the sea surface, shallow diving below the sea surface, and diving to depths of several meters (Shealer 2001). Seabird species from the Procellariidae (petrels and shearwaters), Sulidae (gannets and boobies), and Laridae (gulls and terns) families regularly dive below the sea surface (DWH Trustees 2014).

Surveys within the northern Gulf of Mexico (Hess and Ribic 2000) reported that terns (*Sterna* spp.), storm petrels (Hydrobatidae), shearwaters (*Puffinus* spp.), and jaegers (*Stercorarius* spp.) were the most frequently sighted seabirds in open ocean areas. Additionally, the distribution and relative densities of seabird species within the open ocean areas of the Gulf of Mexico vary temporally (i.e., seasonally) and spatially, based on hydrographic features such as Loop Current eddies, the presence of *Sargassum* lines, upwellings, convergence zones, thermal fronts, salinity gradients, and areas of high planktonic productivity (Hess and Ribic 2000; Ribic et al. 1997).

4.3.2.3.2 Waterfowl

Waterfowl such as sea ducks (i.e., diving ducks) and dabbling ducks (order Anseriformes) feed and rest within coastal (nearshore and inshore) waters outside of their breeding seasons. Members of the order Gaviiformes (loons) may be present in coastal waters also. Waterfowl that may occur within coastal and inshore waters of the restoration area include species within the subfamilies Aythyinae (diving ducks) and Merginae (sea ducks) (Sibley 2000). Diving ducks include the Canvasback (*Aythya valisineria*), Ring-necked Duck (*Aythya collaris*), scaups *(Aythya affinis* and *A. marila*), Bufflehead (*Bucephala albeola*), and Common Goldeneye (*Bucephala clangula*). Hooded Mergansers (*Lophodytes cucullatus*) are the primary sea duck species that may occur within the restoration area. Similar to diving seabirds, sea ducks may be vulnerable as they dive beneath the water surface for feeding (DWH Trustees 2014).

4.3.2.3.3 Shorebirds

Shorebirds utilize coastal environments for nesting, feeding, resting, and migration stopover. The Gulf Coast is of significance to beach-nesting birds and includes species that breed on beaches, flats, dunes, bars, barrier islands, and similar nearshore habitats. The northern Gulf Coast, from the Mississippi River Delta of Louisiana to the Florida Panhandle, represents 18 percent of the southeastern U.S. coastline and supports a disproportionately high number of beach-nesting bird species. Shorebirds primarily found along the coastline of the restoration area include species within four families: Charadriidae (plovers); Haematopodidae (oystercatchers); Recurvirostridae (avocets and stilts); and Scolopacidae (sandpipers). Fifty-three species of shorebirds regularly occur in the U.S. (Brown et al. 2001), with 43 species occurring during migration or wintering periods in the restoration area. Six shorebird species breed in the Gulf of Mexico (Helmers 1992): American oystercatcher (*Haematopus palliates*), snowy plover (*Charadrius alexandrines*), Wilson’s plover (*Charadrius wilsonia*), Willet (*Catoptrophorus semipalmatus*), killdeer (*Charadrius vociferous*), and black-necked stilt (*Himantopus mexicanus*). The Lower Mississippi/western Gulf Coast region is rich with a variety of shorebird habitats, and the Gulf Coast has some of the most important shorebird habitat in North America, particularly the Laguna Madre ecosystem along the south Texas coast (Brown et al. 2001; Withers 2002). Resident shorebirds primarily rely on the shorelines adjacent to the restoration area for their life functions, while some migrants overwinter along shorelines adjacent to the restoration area. Some shorebird species cross and stopover in the restoration area during their annual migration (DWH Trustees 2014).

4.3.2.4 Protected Species

In this section, the species and their associated habitats that are protected under federal law are discussed. This discussion includes: ESA-listed species and designated critical habitats, which are under the jurisdiction of either the USFWS or the NMFS; marine mammals protected under the MMPA; and EFH and HAPC protected under the Magnuson-Stevens Act.

4.3.2.4.1 Endangered Species Act

Congress passed the ESA in 1973, recognizing that the natural heritage of the U.S. was of "esthetic, ecological, educational, recreational, and scientific value to our nation and its people." The primary purpose of the ESA is to protect and recover imperiled species and the ecosystems upon which they depend. The listing of a species as endangered makes it illegal for any person under U.S. jurisdiction to "take" that species—meaning harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to do any of these things. It is also illegal to import, export, or transport and sell endangered species in interstate or foreign commerce. Similar prohibitions may extend to species listed as threatened under the ESA.

NMFS and the USFWS share responsibility for implementing the ESA. NMFS is responsible for endangered and threatened marine and anadromous species. The USFWS is responsible for most terrestrial and freshwater species, but also has responsibility over several marine mammal species such as manatees. The Services share jurisdiction over several other species such as sea turtles and Gulf sturgeon.

Section 4 of the ESA requires, with some allowable exceptions, development and implementation of recovery plans for species that are listed as threatened or endangered. These plans contain measurable recovery criteria, describe site specific management actions for recovery, and estimate time and cost to carry out the recommended recovery measures. These plans will continue to be implemented to guide recovery activities, and many of these activities in this RP/EA would complement these efforts[20].

Under Section 7(a)(1) of the ESA, federal agencies are directed to implement programs for the conservation of threatened and endangered species. Agencies are also encouraged to develop conservation actions and programs that will benefit ESA-listed species and their habitats. Under Section 7(a)(2) federal agencies must consult with the Services when any project or action they take might affect an ESA-listed species or designated critical habitat.

The threatened and endangered species and their critical habitats that may be affected in the restoration area are listed in Table 4-2.

[20] Recovery plans can be found at: https://www.fisheries.noaa.gov/national/endangered-species-conservation/recovery-species-under-endangered-species-act

Table 4-2: Federal threatened and endangered species and designated critical habitats in the restoration area that may be affected.

Common Name	Scientific Name	Status
Fish		
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened
Gulf sturgeon critical habitat	--	Designated
Smalltooth sawfish	*Pristis pectinata*	Endangered
Smalltooth sawfish critical habitat	--	Designated
Nassau grouper	*Epinephelus striatus*	Threatened
Giant manta ray	*Manta birostris*	Threatened
Oceanic whitetip shark	*Carcharinus lonigmanus*	Threatened
Sea Turtles		
Green sea turtle (North Atlantic and South Atlantic Distinct Population Segments [DPS])	*Chelonia mydas*	Threatened
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle (Northwest Atlantic DPS)	*Caretta caretta*	Threatened
Loggerhead sea turtle critical habitat	--	Designated
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Marine Mammals		
Sperm whale	*Physeter macrocephalus*	Endangered
West Indian Manatee	*Trichechus manatus latirostris*	Threatened
Gulf of Mexico Bryde's whale	*Balaenoptera edeni*	Endangered

Fish

Fish resources covered in this chapter include threatened and endangered species managed by NMFS and USFWS under the ESA. The proposed restoration area includes critical habitat for two fish species managed under the ESA; the endangered smalltooth sawfish (*Pristis pectinata*), managed by NMFS, and the threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*), co-managed by NMFS and USFWS. The majority of smalltooth sawfish (68 *FR* 15674) distribution in the restoration area is limited to the waters of southwest Florida and Florida Bay, primarily within the jurisdictional boundaries of Everglades National Park (NMFS 2009a; Simpfendorfer and Wiley 2005; Waters et al. 2014; Wiley and Simpfendorfer 2010). Gulf sturgeon (68 *FR* 13370) reside primarily in estuaries and rivers and enter the restoration area only seasonally in northern Gulf of Mexico.

Nassau grouper (*Epinephelus striatus*) (81 *FR* 42268) is listed as threatened and, although occurring in the restoration area, typically is replaced by red grouper (*Epinephelus morio*) north of Key West; it is considered transient or rare in the northern and northwestern Gulf of Mexico. The giant manta ray (*Manta birostris*) (83 *FR* 2916) is listed as threatened and is thought to have nursery grounds in the FGBNMS (Stewart et al. 2018). Adults can be found throughout the deep tropical and subtropical waters of the Gulf of Mexico. The oceanic whitetip shark (*Carcharinus lonigmanus*) (83 *FR* 4153) is listed as threatened and are usually found in the upper layer of the ocean to a depth of 490 feet (150 meters) and prefers off-shore, deep-ocean areas including the waters of the Gulf of Mexico.

Species that are candidates for becoming listed as threatened or endangered species include the dusky shark (*Carcharhinus obscurus*) (78 *FR* 29100) and great hammerhead shark (*Sphyrna mokarran*) (78 *FR* 24701). Species of concern, as defined under the ESA, in the restoration area include the Alabama shad (*Alosa alabamae*), dusky shark (*Carcharinus obscurus*), sand tiger shark (*Carcharias taurus*), speckled hind (*Epinephelus drummondhayi*), and Warsaw grouper (*Epinephelus nigritus*) (NMFS 2009b).

Sea Turtles

There are five species of endangered or threatened sea turtles found in the Gulf of Mexico (Table 4-2). These are the loggerhead (*Caretta caretta*), green (*Chelonia mydas*), Kemp's ridley (*Lepidochelys kempi*), hawksbill (*Eretmochelys imbricata*), and leatherback (*Dermochelys coriacea*). The leatherback, Kemp's ridley, and hawksbill are listed as endangered; the Atlantic DPS (including the Gulf of Mexico) of loggerhead and green turtles are listed as threatened. The USFWS and NMFS share jurisdiction for sea turtles under the ESA with the USFWS having jurisdiction in the terrestrial environment and NMFS having jurisdiction in the marine environment.

Critical habitat has been designated by NMFS and USFWS for the loggerhead turtle and includes nesting beaches in Florida, Alabama, and Mississippi, nearshore reproductive habitat seaward from these beaches and a large area of *Sargassum* habitat in the Gulf of Mexico is also designated as critical habitat. Loggerhead turtles in the Gulf of Mexico are part of the Northwest Atlantic Ocean DPS (NMFS 2014). NMFS and the USFWS designated critical habitat for this DPS in 2014 (Figure 4-3). The USFWS designation (79 *FR* 39756) includes nesting beaches in Jackson County, Mississippi; Baldwin County, Alabama; and Bay, Gulf, and Franklin Counties in the Florida Panhandle as well as several counties in southwest Florida and the Florida Keys (and other areas along the Atlantic coast). The NMFS designation (79 *FR* 39856) includes nearshore reproductive habitat within 1 mile (1.6 kilometers) seaward of the mean high water line at these same nesting beaches. NMFS also designated a large area of shelf and oceanic waters, termed *Sargassum* habitat in the Gulf of Mexico (and Atlantic Ocean) as critical habitat. NMFS also designated three other categories of critical habitat: of these, two (migratory habitat and overwintering habitat) are along the Atlantic coast, and the third (breeding habitat) is found in the Florida Keys and along the Florida east coast (NMFS 2014). No other ESA-listed sea turtles have currently designated critical habitat in the Gulf of Mexico.

Sea turtles have an expansive range due to their migratory nature and occupancy of different habitats at different life stages and during reproduction (Table 4-3). Five species of sea turtles occur year-round in the coastal, nearshore, and offshore waters of the Gulf of Mexico in at least one of their life history stages. See Section 4.3.3.3.5 for details on nesting habitat at the ACNWR.

Each species has an oceanic, small juvenile stage thought to be distributed almost exclusively in offshore habitats, generally in deep waters of the pelagic zone. This life stage is most often found in close association with *Sargassum* drift algae habitats. Witherington et al. (2012) conducted vessel-based transect surveys from five Florida ports from Pensacola to Key West extending up to 75 miles (120 kilometers) offshore to evaluate the abundance, species composition, and behavior of oceanic-stage juvenile sea turtles in the eastern Gulf of Mexico. They found that 89 percent of all sea turtle observations occurred within 3 feet (1 meter) of floating *Sargassum* and that sea turtle density estimates in *Sargassum* habitats were nearly 100 times higher than in open-water areas where *Sargassum* was not present. Ninety captures of oceanic-stage juvenile sea turtles revealed a species composition dominated by green (49 percent) and Kemp's ridley sea turtles (42 percent) with lower abundances of hawksbill (7 percent) and loggerhead sea turtles (2 percent).

Following the oceanic stage, sea turtles (with the exception of leatherbacks) transition to shallower continental shelf waters including bays, sounds, and estuaries , where there is appropriate developmental habitat for larger juvenile, subadult, and adult life history stages. For leatherback turtles, later developmental habitat includes coastal feeding areas in temperate waters and offshore feeding areas in tropical waters depending on the season (Frazier 2001).

Table 4-3: Summary of sea turtle life stages and habitats in the Gulf of Mexico.

Life Stage	Habitat	Description
Nesting females, eggs, hatchlings	Sandy beaches in Florida, Alabama, and Texas. Also sandy beaches in Mexico.	Embryos develop while buried in sand after being deposited by the females. The hatchlings will emerge and enter the ocean.
Small juveniles	Open ocean including surface habitats throughout the Gulf of Mexico.	Spend more than 80 percent of their time at or near the sea surface, limited diving ability, tend to associate with floating *Sargassum*, drift and swim to remain in surface currents.
Large juveniles and adults	Continental shelf, nearshore and inshore habitats, and oceanic waters.	Use the entire water column, from surface to bottom; active swimmers; dive frequently and typically deeper than 62 feet (20 meters); spend on average 10 percent of time at the surface; consistently use the same breeding and foraging areas; actively migrate to breed (adults). Some individuals migrate between neritic and deeper oceanic waters and reproductive migrations may also cross oceanic waters.

Additional information is provided in the Strategic Framework for Sea Turtle Restoration Activities: Module 2, which describes biological and ecological information about sea turtles, and is incorporated here by reference (DWH NRDA Trustees 2017a).

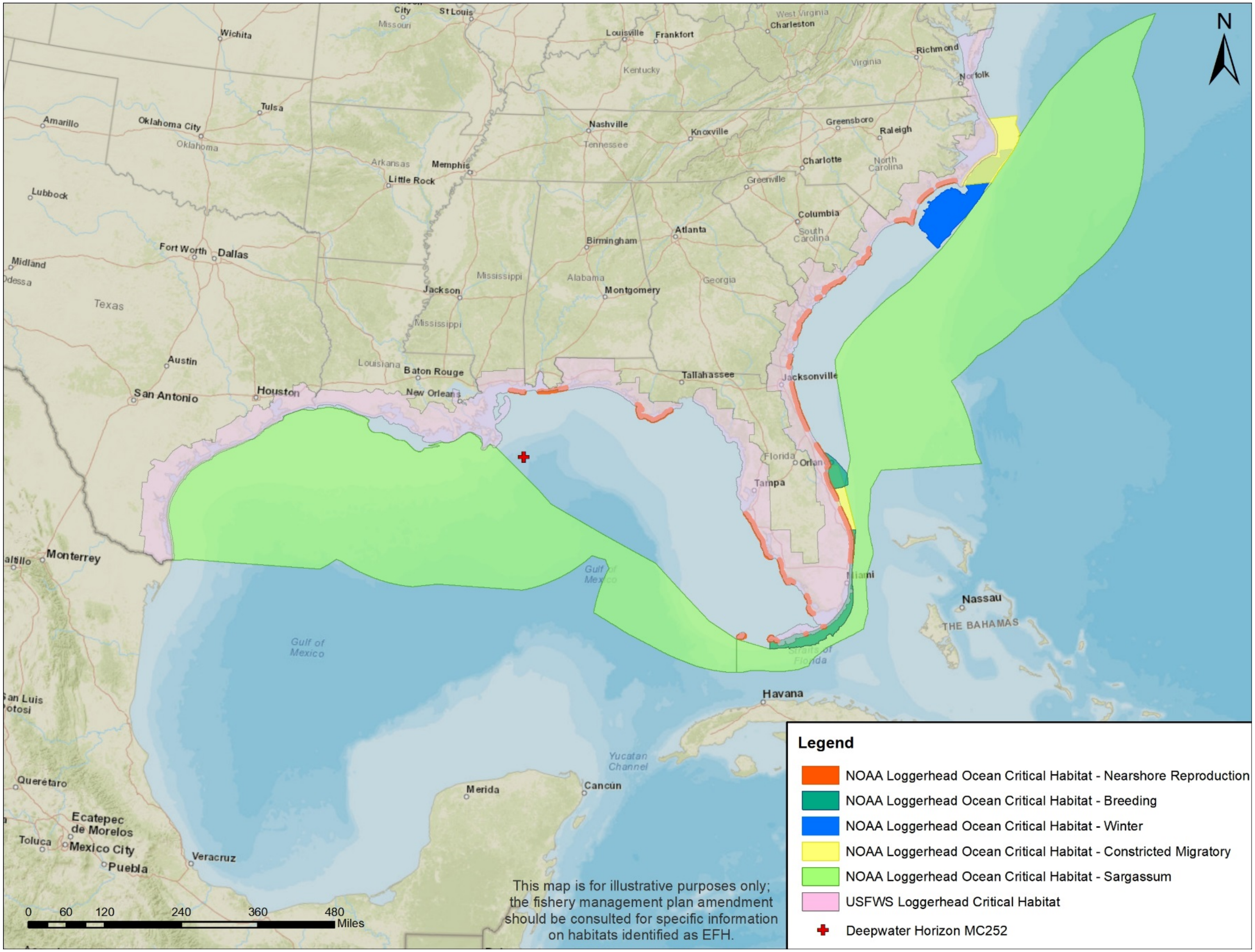
Marine Mammals

The sperm whale (*Physeter macrocephalus*) (northern Gulf of Mexico stock) (35 *FR* 8491) is listed as endangered and resident populations occur within the Gulf of Mexico. The Florida subspecies of the West Indian manatee (*Trichechus manatus latirostris*) has been reclassified as threatened (81 *FR* 1597) and is mostly found in warm coastal waters of peninsular Florida but also in the northern Gulf of Mexico (Hayes et al. 2017). The final rule to list the Gulf of Mexico Bryde's whale (*Balaenoptera edeni*) as endangered under the ESA was issued on April 15, 2019 (84 FR 15446). The rule becomes effective on May 15, 2019 and consultations will be updated to reflect this recent change in status in the final RP/EA. All marine mammals are protected under the MMPA (see Section 4.3.2.4.2).

Birds

There are three species of marine and coastal birds listed as threatened under the ESA and present within the restoration area: piping plover (*Charadrius melodus*) (50 *FR* 50726); Roseate tern (*Sterna dougallii*) (52 *FR* 42064); and red knot (*Calidris canutus rufa*) (79 *FR* 73706). Roseate terns forage offshore and feed by plunge-diving, often submerging completely when diving for fish. Piping plover and red knot are shorebirds and will not be affected by the proposed activities.

Figure 4-3: Critical habitat for loggerhead sea turtles.



4.3.2.4.2 Marine Mammal Protection Act

All marine mammals are protected under the MMPA of 1972. The MMPA established a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part. Threats to marine mammals include fisheries interactions, anthropogenic noise, vessel interactions, contaminants and pollutants, disease, marine debris, research, predation and natural mortality, competition for resources, loss of prey base, climate change, ecosystem change, and activities associated with oil and gas exploration and extraction.

A summary of information on the marine mammal species likely to occur in the northern Gulf of Mexico is presented in Appendix E, including distribution and abundance, hearing frequency, habitat, behavior, and status (ESA/MMPA stock). Information for each species are briefly summarized below.

West Indian Manatee. The West Indian manatee (*Trichechus manatus*), the only sirenian found in the northern Gulf of Mexico and listed under the ESA, is divided into two subspecies: *T. m. manatus* (Antillean manatee) and *T. m. latirostris* (Florida manatee). Only the Florida manatee subspecies is likely to be found in the northern Gulf of Mexico. The Florida manatee subspecies is found throughout the southeastern U.S., with individuals sighted as far north as Massachusetts and as far east as Texas (Fertl et al. 2005; Rathbun et al. 1982; Schwartz 1995). Most of the Gulf of Mexico West Indian manatee population is located in peninsular Florida (USFWS 2001), where critical habitat has been designated in Manatee, Sarasota, Charlotte, Lee, Collier, and Monroe Counties.

Gulf of Mexico Bryde's Whale. The Gulf of Mexico Bryde's whale (*Balaenoptera edeni*), the only year-round resident baleen whale in the northern Gulf of Mexico, is considered strategic under the MMPA. The final rule to list the Gulf of Mexico Bryde's whale as endangered under the ESA was issued on April 15, 2019 (84 FR 15446). The rule becomes effective on May 15, 2019. The Gulf of Mexico Bryde's whale is most frequently sighted along the 328 feet (100 meters) isobath (Davis and Fargion, 1996; Davis et al. 2000; LaBrecque et al. 2015). Most sightings have been made in the DeSoto Canyon region and off western Florida, although there have been occasional sightings in the west-central portion of the northeastern Gulf. A Bryde's Whale Biologically Important Area is found in western Florida shelf edge.

Sperm Whale. Resident populations of sperm whales (*Physeter macrocephalus*) occur within the Gulf of Mexico and are classified as a strategic stock[21] under the MMPA by NMFS (Waring et al. 2016). Sperm whales are widely distributed within the Gulf of Mexico. Based on satellite tracking studies conducted by Jochens et al. (2008), the sperm whale home range (defined as an area over which an animal or group of animals regularly travels in search of food or mates and that may overlap with those of neighboring animals or groups of the same species) is broad, comprising nearly the entire Gulf of Mexico in waters deeper than 1,640 feet (500 meters). By contrast, the Gulf of Mexico sperm whale composite core area (defined as a section of the home range that is utilized more thoroughly and frequently as primary locales for activities such as feeding) generally includes Mississippi Canyon, the Mississippi River Delta, and (to a lesser extent) the Rio Grande

[21] A strategic stock is defined by the MMPA as a marine mammal stock that meets the following criteria: (1) the level of direct human-caused mortality exceeds the potential biological removal level; (2) based on the best available scientific information, it is in decline and is likely to be listed as a threatened species under the ESA within the foreseeable future; or (3) listed as a threatened or endangered species under the ESA or is designated as depleted under the MMPA.

Slope (Jochens et al. 2008). These data support the fact that sperm whales aggregate in the Mississippi Canyon area but regularly move across the northern Gulf of Mexico continental slope.

Dwarf and Pygmy Sperm Whales. At sea, it is difficult to differentiate dwarf sperm whales (*Kogia sima*) from pygmy sperm whales (*Kogia breviceps*), and sightings are often grouped together as *Kogia* spp. Both species have a worldwide distribution in temperate to tropical waters. In the Gulf of Mexico, both species occur primarily along the continental shelf edge and in deeper waters off the continental shelf (Mullin et al. 1991; Mullin 2007; Waring et al. 2016).

Beaked Whales. Three species of beaked whales are known to occur in the Gulf of Mexico: Blainville's beaked whale (*Mesoplodon densirostris*), Gervais' beaked whale (*Mesoplodon europaeus*), and Cuvier's beaked whale (*Ziphius cavirostris*). Stranding records (Würsig et al. 2000) as well as passive acoustic monitoring in the Gulf of Mexico (Hildebrand et al. 2015) suggest that Gervais' beaked whale and Cuvier's beaked whale are the most common. Blainville's beaked whales are rare, with only four documented strandings in the northern Gulf of Mexico (Würsig et al. 2000). Due to the difficulties of at-sea identification, beaked whales in the Gulf of Mexico are identified either as Cuvier's beaked whales or are grouped into an undifferentiated species complex (*Mesoplodon* spp.). In the northern Gulf of Mexico, they are broadly distributed in water depths greater than 3,281 feet (1,000 meters) over lower slope and abyssal landscapes (Davis et al. 2000).

Delphinids. Fourteen species of delphinids are known to occur in the Gulf of Mexico: Atlantic spotted dolphin (*Stenella frontalis*), Clymene dolphin (*Stenella clymene*), pantropical spotted dolphin (*Stenella attenuata*), spinner dolphin (*Stenella longirostris*), striped dolphin (*Stenella coeruleoalba*), bottlenose dolphin (*Tursiops truncatus*), false killer whale (*Pseudorca crassidens*), killer whale (*Orcinus orca*), pygmy killer whale (*Feresa attenuata*), melon-headed whale (*Peponocephala electra*), short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), Fraser's dolphin (*Lagenodelphis hosei*), and rough-toothed dolphin (*Steno bredanensis*). The most common non-endangered cetaceans in the deep water environment of the northern Gulf of Mexico are the pantropical spotted dolphin, spinner dolphin, and rough toothed dolphin (Waring et al. 2016).

The bottlenose dolphin (*Tursiops truncatus*) is a common inhabitant of the northern Gulf of Mexico, particularly within continental shelf waters. There are two ecotypes of bottlenose dolphins, a coastal form and an offshore form, which are genetically isolated from each other (Hayes et al. 2018). Inshore populations in the northern Gulf of Mexico are separated into 31 geographically distinct population units, or stocks, for management purposes by NMFS (Hayes et al. 2018) and are thought to spend most of their time within the respective bays, sounds, or estuaries. All 31 geographically distinct stocks are considered "strategic" under the MMPA. The strategic stock designation in this case was based primarily on the occurrence of an UME of unprecedented size and duration (from February 2010 through July 2014) that affected these stock areas. Carmichael et al. (2012) hypothesized that the unusual number of bottlenose dolphin strandings in the northern Gulf of Mexico during this time may have been associated with environmental perturbations, including sustained cold weather and the DWH oil spill in 2010 as well as large volumes of cold freshwater discharge in the early months of 2011.

4.3.2.4.3 Magnuson-Stevens Fishery Conservation and Management Act - Essential Fish Habitat

Many federally managed fish species spend all or part of their life cycle in the Gulf of Mexico, resulting in most of the Gulf designated as EFH. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" [16 U.S.C. § 1801(10)]. "Fish" includes "finfish, molluscs, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds," whereas "spawning, breeding, feeding or growth to maturity" covers the complete life cycle of those species of interest. Appendix D identifies and describes the various life stages of managed fish that project alternatives may affect. Open ocean areas are designated as EFH under the Magnuson-Stevens Act for several species (e.g. red drum, hard bottom (reef) fish species, highly migratory pelagic and coastal species, and shrimp). Soft bottom habitats are designated EFH for shrimp and red drum (*Sciaenops ocellatus*) by the GMFMC (2004). Hard bottom habitats represent EFH for members of the reef fish management unit (snappers, groupers, tilefishes, jacks, triggerfishes, and wrasses) overseen by the GMFMC. The Programmatic and Phase III Early Restoration Plan and Early Restoration Programmatic Environmental Impact Statement summarized essential fish habitat in relationship to the northern Gulf of Mexico and is incorporated here by reference (DWH Trustees 2014 and citations within). A composite map resulting from combining EFH for the fisheries management plans in the Gulf of Mexico can be found here:
http://archive.gulfcouncil.org/Beta//GMFMCWeb/downloads/FINAL3_EFH_Amendment.pdf

Hard Bottom Species

Hard bottom species, or reef fish, are a group of commercially and recreationally important fish including species of snappers, groupers, tilefishes, jacks, triggerfish, and hogfish. Hard bottom species are widely distributed in the Gulf and occupy both pelagic and demersal zones during their life cycle (GMFMC 2018b). In general, both eggs and larval stages are planktonic and feed on zooplankton and phytoplankton. Juvenile and adult reef fish are typically demersal and are usually associated with bottom topographies on the continental shelf (less than 330 feet [100 meters]) which have high relief, such as coral reefs, artificial reefs, rocky hard bottom substrates, ledges and caves, sloping soft bottom areas, and limestone outcroppings (DWH Trustees 2014). Appendix D provides information on both hard and soft bottom fish species identified within the restoration area. The EFH map for hard bottom species (reef fish) can be found here:
https://sero.nmfs.noaa.gov/maps_gis_data/habitat_conservation/efh_gom/images/reef_fish_efh_gom.pdf

Coastal Migratory Pelagic Species

Coastal Migratory Pelagic species (e.g., king mackerel [*Scomberomorus cavalla*], Spanish mackerel [*Scomberomorus maculatus*], cobia [*Rachycentron canadum*]) are managed jointly by the GMFMC and SAFMC are termed coastal migratory pelagic species. The EFH map for coastal migratory pelagic fish can be found here:
https://sero.nmfs.noaa.gov/maps_gis_data/habitat_conservation/efh_gom/images/coastal_migratory_pelagic_efh_gom.pdf.

Highly Migratory Species

Some epipelagic fishes, including sharks, tunas, swordfish, and other billfishes, are managed by NMFS' Highly Migratory Species Division of the Office of Sustainable Fisheries and have EFH designated areas within the restoration area. NMFS finalized Amendment 10 to the 2006 Consolidated Highly Migratory Species (HMS) Fishery Management Plan: Essential Fish Habitat in 2017 which updated HMS EFH areas. Amendment 10 and a link to the EFH mapper for HMS may be found here:
https://www.fisheries.noaa.gov/action/amendment-10-2006-consolidated-hms-fishery-management-plan-essential-fish-habitat

Red Drum

Red drum (*Sciaenops ocellatus*) is a demersal species that occur throughout the Gulf in a variety of habitats, ranging from depths of about 230 feet (70 meters) offshore to very shallow estuarine waters (GMFMC 2004). They commonly inhabit virtually all of the Gulf's estuaries where they occur over a variety of substrates including seagrasses, sand, mud, and oyster reefs. Red drum tolerate salinities ranging from freshwater to highly saline water. Spawning occurs near the mouths of bays and inlets, and on the Gulf side of barrier islands. Eggs hatch mainly in the Gulf, and larvae are transported into estuaries where they mature before moving back to the Gulf. Estuarine wetlands, which include tidal wetlands, salt marshes, and tidal creeks, are especially important to larval, juvenile, and sub-adult red drum. Harvest of red drum in the exclusive economic zone (EEZ) is currently set to zero by the red drum FMP (GMFMC 2018a). Recreational harvest of red drum is allowed in state waters as regulated by each state. The EFH map for red drum can be found here:
https://sero.nmfs.noaa.gov/maps_gis_data/habitat_conservation/efh_gom/images/red_drum_efh_gom.pdf.

Shrimp

There are three species of shrimp under EFH; the EFH map can be found here:
https://sero.nmfs.noaa.gov/maps_gis_data/habitat_conservation/efh_gom/images/shrimp_efh_gom.pdf.

Brown Shrimp

Brown shrimp (*Farfantepenaeus aztecus*) are found along the Atlantic Coast from Massachusetts to Florida and within the Gulf of Mexico from Florida through the Yucatan Peninsula. This species spawns at depths greater than 25 feet (8 meters). Brown shrimp in the Gulf of Mexico spawn in spring and summer at water temperatures between 62.6 and 84.2 degrees Fahrenheit (°F). Adult brown shrimp are thought to die after spawning once (St. Amant et al. 1966). Post-larval brown shrimp move into shallow, low salinity areas with marsh grass in estuaries after water temperatures reach 51.8°F. Juvenile brown shrimp inhabit nursery areas and gradually move to deeper and higher salinity areas as they grow. Adult brown shrimp move seasonally with changes to water temperatures. Brown shrimp are omnivorous and food sources include detritus, small invertebrates, and fish depending on the life stage of the shrimp. Carnivorous fishes and crustaceans feed on brown shrimp. Competition between brown shrimp and two other commercially important shrimp species, pink and white shrimp, is considered minor because the species have different preferred substrate and salinity preferences and temporal differences in habitat use. Each species also exhibits differences in diurnal activity (DWH Trustees 2014 and citations within).

Pink Shrimp

Pink shrimp (*Farfantepenaeus duorarum*) are found from the lower Chesapeake Bay to Florida along the Atlantic Coast and in the Gulf of Mexico from Florida to approximately Isla Mujeres, Mexico. The species is most abundant in estuaries, bays, and broad, shallow continental shelf waters. The highest densities of pink shrimp are found within the Gulf of Mexico along the Florida and Yucatan, Mexico, coasts. Pink shrimp move from shallow coastal nursery grounds to deeper waters as juveniles or early adults. Spawning then occurs in oceanic waters at depths of 13 to 157 feet (4 to 48 meters), and sometimes deeper water. Peaks in spawning occur in late spring, summer, and early fall. Spawning moves from shallower waters to deeper waters as water temperature decreases. Post-larval life stages move into coastal nursery areas and concentrate in areas with shelter for shrimp. They spend between two and six months in these nursery areas, developing into juvenile and adult shrimp, before moving into offshore waters at depths between 30 and 144 feet (9 and 44 meters). Pink shrimp are found in areas with substrates consisting of shell-sand, sand, coral-mud, or mud. Subadult life stages prefer shell-sand and loose peat. Adult pink shrimp prefer calcareous sediments and also use hard sand substrate (DWH Trustees 2014 and citations within).

Pink shrimp are omnivores and feed on primarily benthic prey. Juveniles and young adults forage along the bottom in seagrass beds. Primary food sources change with life stage. Post-larvae feed on microplankton cultures and nauplii. Juvenile pink shrimp feed on dinoflagellates, foraminiferans, nematodes, polychaetes, ostracods, copepods, mysids, isopods, amphipods, caridean shrimp and eggs, and molluscs. Adult shrimp prey upon foraminiferans, gastropods, squid, annelids, crustaceans, small fish, and plants. Pink shrimp are prey for birds and fish (including snook, spotted sea trout, and mangrove snapper or grey snapper, and reef fish species). Pink shrimp habitat overlaps with brown and white shrimp. However, there are temporal differences and different environmental conditions preferred for the peak use of habitat areas for each species (DWH Trustees 2014 and citations within).

White Shrimp

White shrimp (*Litopenaeus setiferus*) are distributed along the Atlantic Coast from New York to Florida. They are also found in the Gulf of Mexico from Apalachee Bay, Florida, to Ciudad Campeche, Mexico. This species is typically found in water less than 100 feet (30 meters) deep. White shrimp spawn from March to November, though most commonly they spawn between April and October. Rising temperatures at the bottom of the water column trigger the beginning of the spawning season, and decreasing water temperatures in the fall occur at the same time as the end of spawning. Spawning occurs at salinities of 27 parts per thousand (ppt) or greater and at depths of 26 to 102 feet (8 to 31 meters). White shrimp are larvae for approximately 10 days. During this life stage they are planktonic. Post-larvae move from oceanic areas into estuaries. Larval shrimp feed on zooplankton and phytoplankton. Juvenile shrimp are also found in estuaries, and tend to move further upstream within the estuaries than juvenile pink or brown shrimp. Juvenile white shrimp also prefer muddier substrates within loose peat and sandy mud. Adult white shrimp prefer shallow muddy-bottom substrate. Both adult and juvenile white shrimp are benthic omnivores. Adults consume detritus, plant material, microorganisms, macroinvertebrates, and fish parts. This species serves as prey for many fish species and other marine and estuarine organisms (DWH Trustees 2014 and citations within).

Coral

Corals display a diverse range of life history traits. They can exist in a large concentration (stony coral reefs and aggregations of gorgonians or black corals) or as solitary coral, which is how they are most commonly found throughout the Gulf. They occupy a variety of substrate types and can be found in nearshore environments as well as continental slopes and canyons, including the intermediate shelf zones (GMFMC 2004). EFH for coral consists of the total distribution of coral species and life stages throughout the Gulf of Mexico, with the exception of octocorals, which were removed from the fishery management unit in 2011 because the harvest of these corals occurs primarily off the coast of Florida, in state waters, and Florida manages the quota for harvestable octocorals for the aquarium trade (GMFMC 2018c). This includes reefs that have been designated HAPC (see next section) due to their ecological sensitivity, such as the East and West Flower Garden Banks, Florida Middle Grounds, southwest tip of the Florida reef tract, and predominant patchy hard bottom offshore of Florida from approximately Crystal River south to the Keys, and scattered along the pinnacles and banks from Texas to Mississippi, at the shelf edge. While these have a special designation, currently, wherever coral exists in the Gulf of Mexico is considered EFH for corals (GMFMC 2016). The EFH map for coral can be found here:
https://sero.nmfs.noaa.gov/maps_gis_data/habitat_conservation/efh_gom/images/coral_efh_gom.pdf.

Habitat Areas of Particular Concern

HAPC are defined as subsets of EFH that exhibit one or more of the following traits: rare, stressed by development, provide important ecological functions for federally managed species, or are especially vulnerable to anthropogenic (or human impact) degradation. They can cover a specific location (a bank or ledge, spawning location) or cover habitat that is found at many locations (e.g., coral, nearshore nursery areas, or pupping grounds). HAPC are designated through action by the regional fishery management councils (in this case the GMFMC) and do not necessarily convey additional restrictions or protections on an area. However, the FMP under which they were designated may include regulations that protect habitat from fishing impacts. The HAPC and FMPs were developed together with the intent of providing additional protection to the HAPC. Bluefin tuna HAPC was established in Amendment 1 to the 2006 Consolidated Highly Migratory Species Fishery Management Plan: Essential Fish Habitat and modified by Amendment 10 in 2017 (Figure 4-4). EFH-HAPC include general habitat types (e.g., corals) and geographically defined areas of ecological importance (e.g., Flower Garden Banks).

The GMFMC has designated eight coral HAPC since 1984 (Florida Middle Grounds, East and West Flower Garden Banks, North and South Tortugas, Pulley Ridge, Stetson Bank, and McGrail Bank) (Figure 4-4). Not all HAPC are associated with fishing regulations, but the types of fishing activities that can occur in those areas designated as coral HAPC are limited, and anchoring by fishing vessels is prohibited. GMFMC also took final action to designate an additional 23 coral HAPC in November 2018, though the NMFS rulemaking to implement this designation is not yet complete. Figure 4-4 will be updated at the time this plan is finalized to reflect any change to the status of this rulemaking process. Twenty-four additional sites remain under consideration by the GMFMC for potential designation as coral HAPC (GMFMC 2018c).

4.3.3 Human Uses and Socioeconomics

This section provides the socioeconomic conditions in the region pertinent to the restoration area including socioeconomics and environmental justice, land and marine management activities, tourism and recreational uses, fisheries, and marine transportation.

4.3.3.1 Socioeconomics and Environmental Justice

The population of the Gulf coastal counties and parishes was nearly 17 million in 2010 according to the U.S. Census. Four Gulf of Mexico counties have more than 500,000 residents: Lee, Pinellas and Hillsborough counties, Florida; and Harris County, Texas. The communities along the Gulf of Mexico are diverse, ranging from large urban areas like Houston and New Orleans, which have well-integrated economies, to smaller rural areas that are more dependent on a few industries. The Gulf of Mexico has an economic impact on local and regional economies of coastal communities from Florida to Texas. In 2013, total tourism industry spending was approximately $165.1 billion, which supported $43.4 billion in wages and salaries. Nearly $24.2 billion in tax revenue was generated by this industry (BOEM 2017b).

Offshore mineral extraction was the largest sector in terms of gross domestic product and wages, accounting for 62.9 percent of the total economic activity and 47.5 percent of the total wages associated with the Gulf of Mexico. In contrast, the tourism and recreation sector accounted for greater than 67 percent of all jobs associated with the Gulf of Mexico, but it generated only 24.7 percent of the total wages and 17 percent of the local gross domestic product tied to activities in the Gulf of Mexico. Marine transportation was also a large employment sector with 12.7 percent of the gross domestic product. The marine construction sector, ship and boat building sector, and the living resources sector (e.g., commercial fishing) generated the smallest portion of Gulf of Mexico-related employment in 2016 (NOAA 2016b).

4.3.3.2 Cultural Resources

At the end of the eighteenth century and beginning of the nineteenth century, the Gulf of Mexico was an arena of commerce, political unrest, war and piracy, with each one intertwined with the other. A variety of Spanish, English and French vessels from merchants, slavers, smugglers, privateers or pirates, ended up on the bottom of the Gulf of Mexico as a result of conflict, weather, or shipworm damage. In the twentieth century, during World War II, 56 German U-boats operated in the Gulf of Mexico using shipping lanes and navigational beacons to locate and torpedo unsuspecting prey (Brooks et al. 2016). More recently, the wreckage associated with the DWH oil spill marks the graves of eleven workers who died aboard the drilling rig in 2010, as it sank to the sea floor 45 miles from the Louisiana coast in water depths of nearly one mile. Historical records show that there are over 3,200 shipwrecks in the Gulf of Mexico. Just over 700 shipwrecks or likely shipwrecks have been located, mostly from sonar imaging. About 35 of these have been positively identified as actual historic wrecks that would be eligible for designation on the National Register of Historic Places. Resources such as these could be in the vicinity of long-range MDBC actions. Additional information about these shipwrecks is summarized in the FGBNMS Draft Environmental Impact Statement Appendix C (ONMS 2016) and is incorporated by reference here.

4.3.3.3 Land and Marine Management

Land and marine areas may be set aside for a variety of active and passive recreational purposes. Land may be managed for wildlife and habitat protection and conservation, and/or scenic, cultural, and historical values (e.g. National Wildlife Refuges). For marine management, the 1982 United Nations Convention on the Law of the Sea established the sovereign rights of coastal states beyond their land territory and internal waters, described as a territorial sea. The U.S. is not a party to the United Nations Convention on the Law of the Sea, but recognizes the treaty as customary international law. For regulatory purposes, state waters extend from the baseline to 3 nautical miles in Louisiana, Mississippi, and Alabama. In Texas and on the Gulf Coast of Florida, state waters extend to 9 nautical miles. Federal waters continue from the state seaward boundary to 200 nautical miles from the baseline (the limits of the EEZ).

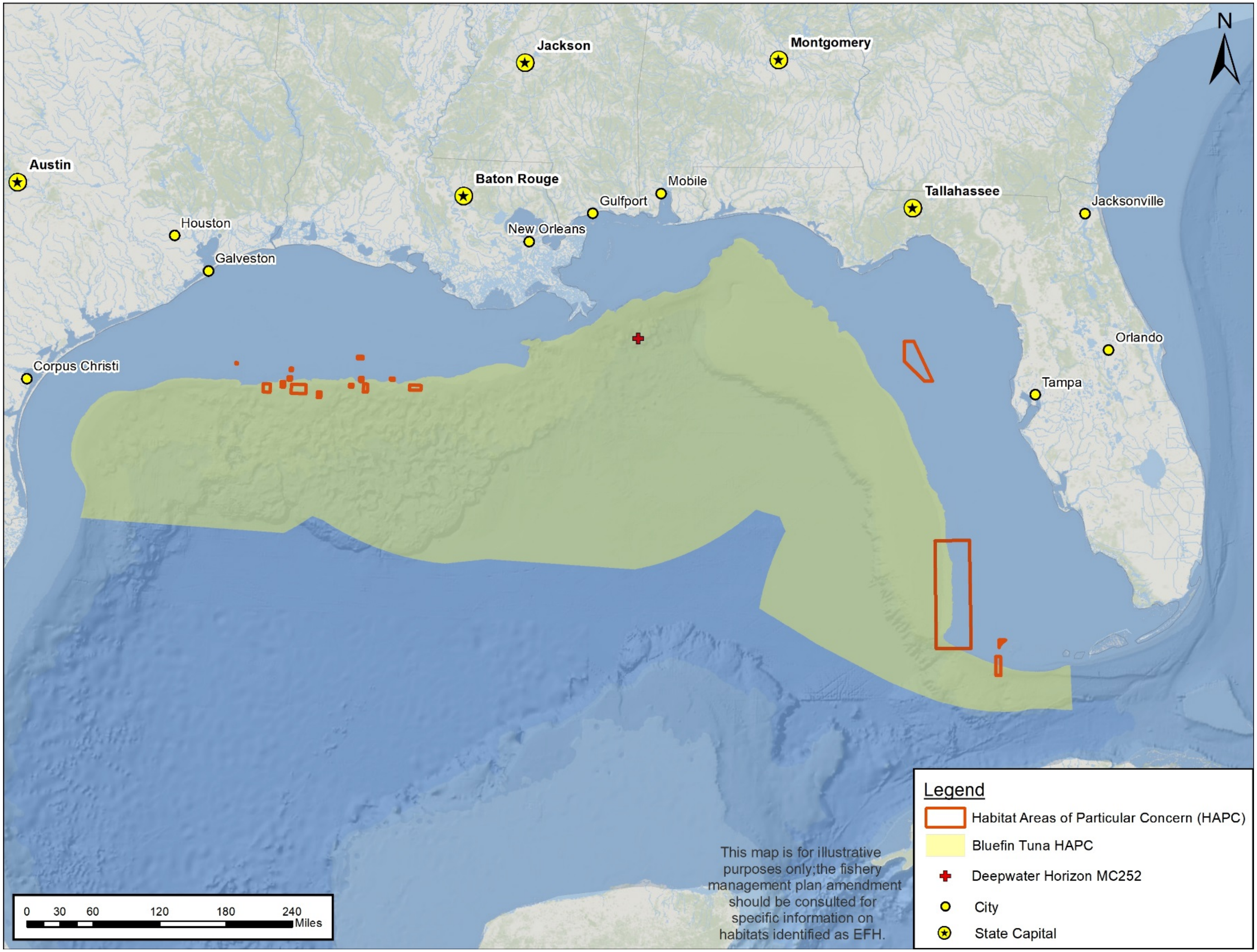
Management of specific species are described in the Section 4.3.3.5 for fisheries species and in Section 4.3.2.4 for protected species. Management of fisheries habitat is described above in Section 4.3.2.4.3.

4.3.3.3.1 Marine Protected Areas

Marine areas are managed by different federal, state, or private agencies for a range of different purposes including managing marine mineral resources, protecting natural resources, and managing for recreational purposes. Marine Protected Areas (MPAs) are established and managed to protect ecosystems, preserve cultural resources such as shipwrecks and archaeological sites, or sustain fisheries production. According to Executive Order 13158, an MPA is defined as "any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." Most MPAs have a primary focus on conservation of natural heritage, while a few have a primary focus on sustainable production or cultural heritage (NMPAC 2010). Natural heritage MPAs are managed to conserve, restore, and understand the area's natural biodiversity, populations, communities, habitats, and ecosystem. A sustainable MPA supports the continued extraction of renewable, living resources but protects the area's habitat for feeding, spawning, mating, or nursery grounds. Cultural heritage MPAs are managed to protect, understand, and maintain the legacy of physical evidence and attributes of a group or society for future generations (NMPAC 2011).

The NMS were developed under the National Marine Sanctuaries Act as areas designated to protect regions of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities. NMS are areas or systems of marine protected areas developed to conserve, protect, and enhance their biodiversity, ecological integrity, and cultural legacy. The Flower Gardens Banks is the sole NMS in the northern Gulf of Mexico (Figure 4-5). Day-to-day management of national marine sanctuaries has been delegated by the Secretary of Commerce to NOAA's Ocean Service Office of NMS (NOAA 2013b). The FGBNMS is currently considering several alternatives for potential expansion of the sanctuary boundaries, as described by ONMS (2016).

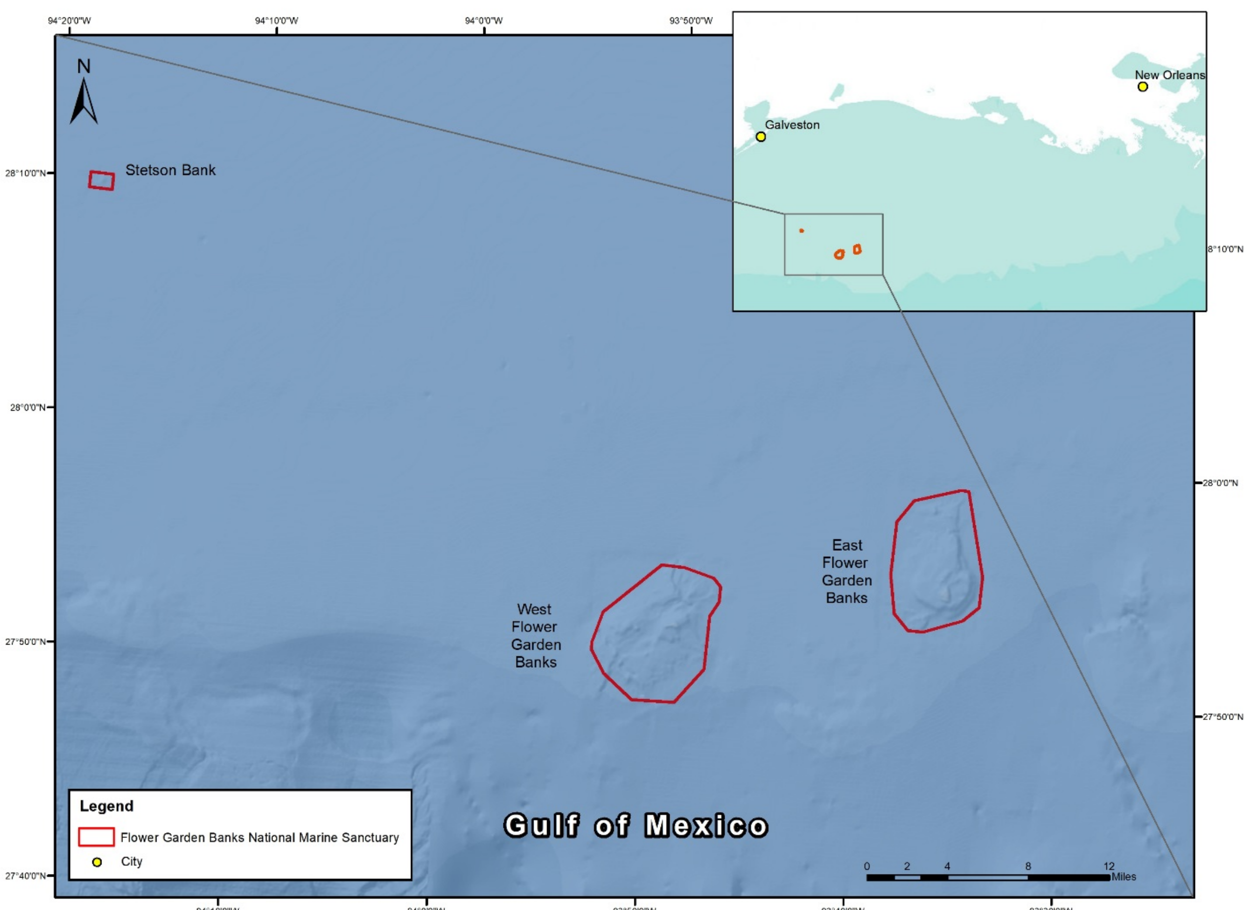
Figure 4-4: Habitat areas of particular concern in the Gulf of Mexico.



4.3.3.3.2 Oil and Gas Management

Federal management of oil and gas resources on the continental shelf of the U.S. is governed by the Outer Continental Shelf Oil and Gas Leasing Program. This program addresses federal regulation of leasing, exploration, development, and production of oil and gas on the outer continental shelf. The outer continental shelf is defined to include all submerged lands lying seaward of state coastal waters and subject to U.S. jurisdiction and control. BOEM is responsible for implementing the requirements of the OCSLA for the oil and gas-leasing program. BOEM is responsible for managing environmentally and economically responsible development of the nation's offshore energy and mineral resources. Principal functions include offshore leasing, resource evaluation, review and administration of oil and gas exploration and development plans, renewable energy development, marine mineral development, environmental assessment, and environmental studies. The BSEE, a separate bureau within DOI, is responsible for safety and environmental oversight of offshore oil and gas operations, including permitting and inspections of offshore oil and gas operations. Principal functions include the development and enforcement of safety and environmental regulations, permitting offshore exploration, development and production, inspections, offshore regulatory programs, oil spill response, and newly formed training and environmental compliance programs.

Figure 4-5: Flower Garden Banks National Marine Sanctuary.



Both BOEM and BSEE provide and consolidate guidance for the avoidance and protection of biologically sensitive features and areas (i.e., topographic features, pinnacles, live bottoms [low-relief features], other potentially sensitive biological features, and deep water benthic communities) from direct impact from oil and gas industry activity, through lease stipulations and case-by-case reviews of permit applications that attach mitigations/conditions of approval to permits. The stipulations and permit conditions designate “No Activity Zones” and separation distances from the sensitive areas.

4.3.3.3.3 Sea Turtle Stranding and Salvage Network

The STSSN was formally established in 1980. The eighteen state network extends from Maine through Texas and includes the U.S. Caribbean. STSSN participants include federal, state, academic, and private partners. NOAA NMFS and USFWS share federal jurisdiction for the conservation and recovery of sea turtles, with NMFS serving the primary federal coordinating role for the STSSN. A State Coordinator is designated for each state and data are archived in a centralized national database. All STSSN participants are federally authorized or permitted under the ESA, and in some cases, also under state authority.

Maintaining the sea turtle stranding network is a recovery action included in ESA Recovery Plans for the five sea turtle species found in the Gulf of Mexico. The STSSN responds to stranding events and documents each event by collecting standard information from each turtle. This information includes measurements, anomalies (e.g., vessel injuries, hooking or entanglement), photographs, and, potentially biological samples. Carcasses suitable for more detailed examination may be collected for later necropsy. Live turtles that are sick or injured are transferred to permitted sea turtle rehabilitation facilities. STSSN data are used to inform mortality investigations and to identify mortality sources.

4.3.3.3.4 Marine Mammal Stranding Networks

NOAA Fisheries authorizes the Southeast Region Stranding Network and their volunteers, under the authority of Sections 109(h) and 112(c) of the MMPA, to respond to marine mammal strandings. Permit No. 18786-02 was issued to the Marine Mammal Health and Stranding Response Program under the MMPA/ESA for emergency response and scientific research activities. The Stranding Network coordinates responses to stranding events, monitors stranding rates, monitors human-caused mortalities, maintains a stranding database, and conducts investigations to determine the cause of stranding events. Other existing authorizations and permits are included here by reference and include MMPA Section 109h which allows the taking of marine mammals by federal, state or local government officials or employees if the taking in the course of his or her duties as an official or employee and is for the protection or welfare of the mammal, the protection of public health or welfare, or the non-lethal removal of nuisance animals; the Programmatic Environmental Impact Statement on the Marine Mammals Health and Stranding Response Program (NMFS 2009c) which addresses the Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release as well as large whale entanglement response, health surveillance, and mortality investigations; and the ESA Biological Opinion on the issuance of Permit No. 18786 (PCTS # FPR-2015-9113).

Additional guidance for oil spill response and marine mammal strandings are provided in Geraci and Lounsbury’s Field Guide for Strandings (Geraci and Lounsbury 1993), the Pinniped and Cetacean Oil Spill Response Guidelines (Ziccardi et al. 2015), and the National Contingency Plan for Response to Unusual Marine Mammal Mortality Events (Wilkinson 1996).

4.3.3.3.5 Archie Carr National Wildlife Refuge

Located on the Atlantic Coast, the 258 acre Archie Carr National Wildlife Refuge (ACNWR) is managed by the USFWS and is part of the Everglades Headwaters National Wildlife Refuge Complex. The Refuge Complex headquarters are located in Vero Beach, Florida. The refuge was established in 1991 to conserve threatened and endangered species, with sea turtles as a primary focus. The refuge functions through integrated partnerships with federal, state, and local governments, as well as, private entities. The refuge facilitates wildlife observation programs and school trips, and provides opportunities for photography, kayaking, and recreational fishing.

A highly diverse array of wildlife, marine, and estuarine species are present on the refuge. Over 245 species of bird, mammal, reptile, amphibian, insect, and fish species can be found within the ACNWR. Chapter 2 - Refuge Overview of the Archie Carr Comprehensive Conservation Plan (USFWS 2008), provides a detailed discussion of the present species.

Approximately 25 percent of all global loggerhead sea turtle nests and 10 percent of the North Atlantic population of green sea turtles nest on the ACNWR. Additionally, leatherback sea turtles have been observed to nest at the refuge in significant numbers. In 2017, the Refuge was ranked the world's most important/highest density beach for loggerheads (over 12,000 nests), and combining all three species had a nesting density of over 1,400 nests per mile (1.6 kilometers) and over 29,000 nests.

A general discussion of each sea turtle species is found in Section 4.3.2.4 Protected Species. The Archie Carr Comprehensive Conservation Plan, which discusses the physical, biological, and socioeconomic environment as well as the administration and management of the NWR, provides detailed information and is incorporated here by reference (USFWS 2008).

4.3.3.4 Tourism and Recreational Use

Many tourism and recreational opportunities are centered on or around the northern Gulf of Mexico, and are therefore dependent on a clean, healthy Gulf ecosystem. The mild climate and coastal waters provide numerous venues for recreation. Recreational activities in nearshore areas include personal watercraft usage, boat tours, beach visitation, swimming, snorkeling and scuba diving (Hernandez-Hernandez and Adams 2004). These activities provide economic benefits and sources of employment for local communities. The tourism industry has a large economic impact on the region. In 2013, greater than 1.7 million workers were employed in the travel and tourism industry in the Gulf Coast states. During the same time, total industry spending was approximately $165.1 billion, which supported $43.4 billion in wages and salaries. Nearly $24.2 billion in tax revenue was generated by this industry (BOEM 2017b).

4.3.3.4.1 Boating

The northern Gulf has some 615,000 square miles (1.6 million square kilometers) of open water presents abundant opportunities for boating activities, near-shore and offshore. There are over 300 marinas in the region and numerous public boat ramps for each coastal county along the Gulf Coast. Numerous public and private boat docks and marinas; boat launches; and equipment rental and tour boat companies provide access to the Gulf of Mexico for tourists. In 2012, the recreational fishing effort averaged at approximately 8.3 million trips. Anglers were primarily residents of the coastal area with most trips occurring on private and rental vessels (BOEM 2016). See Section 4.3.3.5.1 for details on recreational fishing.

4.3.3.4.2 Diving

The National Survey on Recreation and the Environment estimated the number of participants that went scuba diving off Texas and Louisiana in 1999-2000 and found that approximately 70,000 people age 16 or older went scuba diving off Texas and about 11,000 off Louisiana (Leeworthy and Wiley 2001). Forecast estimates provided by Leeworthy et al. (2005) projected that the participation rate in diving was expected to increase between 2000 and 2010 for the U.S., but specific rate increases for Texas and Louisiana could not be parsed from the data.

A limited number of MDBC are accessible to recreational scuba divers – the three banks within the current sanctuary boundaries (East and West Flower Garden Banks and Stetson Bank), and Bright, Geyer, and Sonnier Banks. It was estimated that in 2016 the number of dive trip days were between 2,500 and 3,000 for FGBNMS. In 1996, Texas scuba divers accessed offshore waters through dive charter or for-hire recreational dive operations for a total of 360 trips accounting for 4,335 dive trip days with approximately 21 percent of the boat trips and 54 percent of the dive trip days spent at FGBNMS (ONMS 2016).

4.3.3.5 Fisheries

The GMFMC is one of eight regional fishery management councils established by the Fishery Conservation and Management Act of 1976. The GMFMC prepares fishery management plans that are designed to manage fishery resources within the 200-mile limit of the EEZ in the Gulf of Mexico (Figure 4-6). Federal waters begin 3 to 9 nautical miles offshore and extend to the outer edge of the EEZ.

NMFS manages and regulates commercial and recreational fishing in federal waters. It sets closures for sensitive areas and marine sanctuaries; quotas; trip limits; and minimum size limits for highly migratory species, coastal migratory fish, reef fish, shellfish, and other fish. For recreational fishing, the NMFS regulates fishing activities, including setting of seasons and closures; permitting activities; and setting of daily limits, bag limits, and minimum size requirements.

4.3.3.5.1 Recreational Fisheries

Saltwater recreational fisheries in the Gulf of Mexico are among the most valuable in the U.S. In 2014, total fishing trip and durable equipment expenditures were $11.5 billion, and major expenditures included boat expenses ($5.8 billion), fishing tackle ($2.2 billion), vehicle expenses ($1.0 billion), second home expenses ($138 million), and other equipment ($941 million) (NMFS 2016a). In 2014, western Florida ranked first ($7.5 billion), Texas ranked fifth ($1.8 billion), and Louisiana ranked sixth ($1.6 billion) nationally in sales impacts from total expenditures related to recreational fishing (NOAA 2017b).

Some 2.7 million residents of the Gulf states participated in marine recreational fishing. Almost 21 million trips were taken by residents and visitors and over 144 million fish were caught in 2016 (NOAA 2017b). Of the total number of recreational trips in 2016, the majority of recreational fishing trips were from west Florida (64 percent), while other Gulf Coast states accounted for 11 percent in Louisiana, 12 percent in Alabama, 7 percent in Mississippi, and 6 percent in Texas. Key recreational species targeted in the Gulf of Mexico include spotted seatrout, gray snapper, red drum, sand seatrout, and red snapper. The largest harvests by weight were for spotted seatrout, red snapper, red drum, king mackerel, Spanish mackerel, and striped mullet (NOAA 2017b).

Recreational fishing is a year-round activity in the Gulf of Mexico and can be classified as a nearshore or offshore effort depending on the size of the vessel and its fishing location (distance from shore); the majority of the activity takes place in nearshore waters. Offshore fishing consists of anglers fishing from larger vessels (i.e., private, rental, charter, or party) in offshore waters (3 miles [greater than 4.8 kilometers]). The choice of fish species targeted by recreational anglers depends on the season, fishing location, and seasonal movement of particular species. For example, there are seasonal closures for grouper that occur in some winter months (January–June for gag and February-March for shallow-water grouper species outside of 20 fathoms). Organized saltwater fishing tournaments are popular amateur and professional events held throughout the Gulf of Mexico from Texas to Florida. Recreational fishing tournaments are held year-round, but most take place in summer during weekends. Depending on the fishing tournament and its rules, participants have the option to target inshore (e.g., red drum, spotted seatrout, snook) or offshore (e.g., dolphinfish, wahoo, kingfish, marlin, sailfish, swordfish, sharks, and tuna) categories, or to enter both categories (NOAA 2017b).

Recreational red snapper harvest is managed by the Gulf states under exempted fishing permits through 2019. The recreational sector in the Gulf of Mexico includes both private angling and a federal for-hire component. The federal for-hire component includes charter vessels and head boats with a federal charter/head boat permit for reef fish, allowing these vessels to fish in federal waters. For-hire vessels without a federal permit are restricted to fishing for red snapper in state waters only. Recreational fishing for red snapper is managed with a 16-inch total length minimum size limit and a two-fish bag limit (NOAA 2018g). The current allocation for red snapper is about 49 percent to recreational sectors and 51 percent to commercial sectors (NOAA 2017b). Within the recreational sector, 57.7 percent are allocated to the private angling sector and 42.3 percent are allocated to the federal for-hire sector.

4.3.3.5.2 Commercial Fisheries

Commercial fisheries represent a multi-billion dollar industry to the northern Gulf Coast region and have traditionally included finfish, shrimp, oysters, and crabs. state, federal, and international agencies regulate fishery resources within their jurisdiction. For species that are not managed by federal regulations, states have the authority to extend state rules into federal waters for residents of that state or vessels landing a catch in that state.

FMPs are developed in order to manage fish resources. Some plans are developed independently by fisheries management organizations, such as the GMFMC, the SAFMC, state resource agencies, and the Atlantic Highly Migratory Species Division of NOAA Fisheries consistent with recommendations from the International Commission for the Conservation of Atlantic Tunas and the Atlantic Tunas Convention Act. Other plans are developed and managed jointly among management bodies such as the Coastal Migratory Pelagics FMP which is jointly managed by the GMFMC and the SAFMC. FMPs of importance to this RP/EA include:

- Menhaden Fishery Management Plan (Gulf States Marine Fisheries Commission [GSMFC]).
- Consolidated Atlantic Highly Migratory Species Fishery Management Plan.
- Reef Fish Management Plan (GMFMC).
- Shrimp Fishery Management Plan (GMFMC).

The FMPs provide detailed information on the biology, distribution, habitat associations, life history characteristics, migratory patterns, spawning characteristics, and nursery areas, and include detailed EFH maps for species they cover.

Commercial fisheries are an important component of the economy of the Gulf of Mexico. In 2014, the seafood industry in the five Gulf Coast states supported nearly 191,000 jobs and the Gulf of Mexico's seafood industry generated $24.3 billion in sales. Florida generated the highest employment (93,000 jobs), sales ($18.3 billion), income ($3.4 billion), and value added impacts ($6.1 billion). Louisiana and Texas had the highest landings revenue in 2014, with $451 million and $278 million, respectively (NMFS 2016a). The main commercial fishing gears used along the Gulf Coast are bottom trawls, purse seines, pots/traps, hook-and-line, and longlines (bottom and pelagic), as shown in Table 4-4.

Table 4-4: Primary commercial fishing methods, target species, seasons, and general areas fished in the Gulf of Mexico.

Fishing Method	Target Species	Primary Fishing Season	Primary Fishing Area
Bottom Trawling (including skimmer nets)	Brown shrimp, pink shrimp, white shrimp, seabob, royal red shrimp, and groundfish	Year-round depending on species and seasonal closures	Soft bottom, shelf waters from nearshore to the upper slope off all Gulf Coast states depending on closed areas
Purse Netting	Menhaden, butterfish, scads, blue runner, and Spanish sardines	Spring and summer months	Menhaden inner shelf off Louisiana and Mississippi, scads and sardines inner shelf off Florida panhandle
Gillnetting	Coastal sharks, mullet, Spanish mackerel, and black drum	Spring and summer depending on species and seasonal closures	Coastal waters, Alabama, Mississippi, Louisiana; prohibited in Florida and Texas
Hook-and-Lining (bottom fishing and trolling)	Snappers, groupers, amberjacks, triggerfishes, sharks, king mackerel, Spanish mackerel, and cobia	Year-round; effort varies with species-specific closures	Oil platforms, artificial reefs, and natural hard bottom areas throughout the Gulf of Mexico's most activity on inner and middle shelf
Surface Longlining	Sharks, swordfish, tunas, and dolphinfish	Year-round with summer peaks	Open Gulf of Mexico seaward of 656 feet (200 meters)
Bottom Longlining	Groupers, snappers, tilefishes, and sharks	Year-round; effort varies with species specific closures	Outer shelf waters from Florida to Texas on suitable bottom type
Trapping	Spiny lobster, stone crab, and deep-sea red crab	Stone crab (October to March); spiny lobster (July to March); fish (year-round)	Florida shelf waters

Pelagic Longline Fishery

HMS including tuna, billfish, sharks, and swordfish are managed domestically by the NMFS under the Magnuson-Stevens Fishery Conservation and Management Act and the Atlantic Tunas Convention Act. The Consolidated Atlantic Highly Migratory Species FMP covers HMS in the Gulf of Mexico. International management of tuna and tuna-like species is conducted by the International Commission for the Conservation of Atlantic Tunas.

The 2017 Stock Assessment and Fishery Evaluation Report for Atlantic Highly Migratory Species which describes the PLL fishery, is incorporated here by reference (NMFS 2018a). The Atlantic Highly Migratory Species PLL fishery primarily targets yellowfin tuna, swordfish, and big-eye tuna. The U.S. PLL fleet makes up a small fraction of the fishing effort in comparison to international PLL fishers (NOAA 2018h). The PLL main line can vary in length from 5 to 40 miles (8 to 64 kilometers). There are typically 20 to 30 baited hooks per mile. PLL lines are set near the surface via floats. About 70 percent of the fishing effort for yellowfin tuna occurs at depths of 200 to 360 feet (60 to 110 meters). In general, longline sets targeting tuna are set in the morning and hauled back at night.

The PLL fishery primarily catches swordfish, yellowfin tuna, and bigeye tuna. However, the PLL fishery may also target dolphinfish, albacore tuna, and sharks to a lesser degree. Although PLL gear can be modified to target a given species, it is generally considered a multi-species fishery. PLL gear can inadvertently catch non-target species such as bluefin tuna, sharks, seabirds, sea turtles and marine mammals. In 2016 the Atlantic PLL fishery interacted with 154 loggerhead sea turtles and 339 leatherback sea turtles. Many of the species caught as bycatch are released alive, however some are released dead. Bycatch mortality of overfished species can reduce the ability of these populations to rebuild (NMFS 2018a).

In 2016 the overall Atlantic HMS ex-vessel revenue for yellowfin tuna was $9,622,286. Yellowfin tuna are typically caught using PLL gear. Approximately 64 percent of all the Atlantic HMS harvest came from PLL gear in 2016. In 2016, 5,217,600 hooks were set and 62,807 yellowfin tunas were kept in the U.S. Atlantic PLL fishery. Bluefin tuna are incidental catch in the yellowfin tuna fishery. In 2016 reports via logbooks, 411 bluefin tuna were kept and 582 bluefin tuna were discarded as bycatch in the U.S. Atlantic PLL fishery. To address past overharvest of the bluefin tuna (longline category quota), several regulations have been implemented. For instance, the Individual Bluefin Quota program establishes vessel specific bluefin allocations for longlines including landings and dead discards as well as required retention of all legal-size bluefin tuna. Under this program fishermen are required to secure enough quota to account for bluefin interactions on a quarterly basis. Requirement of weak hooks have also been used to reduce bluefin tuna catch. Weak hooks are made of a smaller wire gage. These weak hooks are intended to straighten when large bluefin tuna are hooked and allow bluefin tuna to escape while smaller fish remain hooked. Weak hooks are mandatory in the Gulf of Mexico PLL fishery. Gear restricted areas to reduce bluefin tuna interactions have also been implemented (NMFS 2018c).

For the targeted yellowfin tuna, harvested sizes range from 30-170 centimeters fork length. Juvenile yellowfin tuna form schools and are mainly limited to surface waters. Larger yellowfin tuna are found in sub-surface waters. Yellowfin tuna spawn between January and April in areas in the Gulf of Mexico off Cape Verde and in the southeastern Caribbean Sea (NMFS 2018a).

Shrimp Fishery

The shrimp trawl fishery is a dominant fishery in the northern Gulf of Mexico. The estuarine-dependent white, pink, brown, royal red, seabobs, and rock shrimp species make up the Gulf of Mexico shrimp catch. The fishery in federal waters is managed by NOAA and the GMFMC, who coordinate with state management programs. The fishery in state waters is managed by state resource agencies and coordinated by the GSMFC.

The FMP, as amended, for the Shrimp Fishery of the Gulf of Mexico, United States Waters, which describes the Gulf of Mexico shrimp fishery is incorporated here by reference (GMFMC 1981). The shrimp fishery season varies by species. The brown shrimp season starts in May, peaking in June and July, and then gradually declining to an April low. The white shrimp annual catch has two peaks. The major peak is in late summer/early fall with an October high. The minor peak is in May. Pink shrimp catch has a broad peak from October through May. Harvesters, processors, marketers, and consumers make up the four categories of shrimp fishery users. Otter trawls are heavy mesh bags that have wings on either side to funnel shrimp into the tail. A pair of trawl doors at the end of each wing are used to hold the net open. Otter trawls are the most common fishing gear used in the shrimp fishery. These conical nets can be set mid-water or dragged along the seafloor. Rocky areas are typically avoided as these areas can damage the trawl. Brown shrimp are typically caught from less than 30 fathoms, but they can be caught out to 50 fathoms. The brown shrimp fishery takes place along the entire Gulf of Mexico coast with high brown shrimp catches occurring along the Texas, Louisiana, and Mississippi coasts. White shrimp are typically caught in shallow water of less than 15 fathoms. White shrimp catch is high throughout the central, northern, and western gulf coast. The largest U.S. white shrimp catch occurs west of the Mississippi River to Freeport, Texas. Pink shrimp are typically caught at less than 25 fathoms. Peak catch for pink shrimp occurs at 11 to 15 fathoms. The U.S. catch is mainly limited to Florida.

In 2010, the shrimp trawl fishery in federal waters resulted in a bycatch of fish and invertebrates of approximately 229 million pounds, which exceeded shrimp landings by a factor of 1.76 (NMFS 2013). Shrimp trawls are a less selective gear and result in large amounts of bycatch compared to other U.S. fisheries. Finfish, marine mammals, and sea turtles can be bycatch species in the shrimp trawl fishery.

BRDs have been implemented as ways to reduce finfish bycatch within shrimp trawl fisheries and are required for large and small vessels shoreward of the 100-fathom (183-meter) depth contour in the Gulf of Mexico (73 *FR* 8219). BRDs must achieve a 30 percent reduction in weight of finfish bycatch. Current certified BRDs include the Fisheye, Jones Davis, modified Jones Davis, Cone Fish Deflector Composite Panel, and Square Mesh Panel Composite Panel.

Sea turtle species that have been observed as bycatch in the Gulf of Mexico shrimp fishery include primarily Kemp's ridley, loggerhead, leatherback, and green turtles; hawksbills are less frequently encountered. More information on sea turtles in the Gulf of Mexico can be found in Section 4.3.2.4.1 of this RP/EA. TEDs are used anterior to BRDs to decrease sea turtle bycatch. TEDs consist of grid with bars that prevent most sea turtles from passing through into the back of the net where they would become trapped and eventually drown.

Annual mortality of marine mammals in the Gulf of Mexico shrimp otter trawl fishery had not been estimated prior to 2015 (Soldevilla et al 2015). Dolphin bycatch most commonly occurs as entanglements in TED nets and lazy lines and modifications of these gear components may offer promise for reducing bycatch mortalities (Soldevilla et al 2015).

Blue Crab Fishery

The Blue Crab Fishery of the Gulf of Mexico a Regional Management Plan, which describes blue crab fishery is incorporated here by reference (Guillory et al. 2001b). The blue crab trap fishery is widely dispersed, fishing along the bottom sea floor of shallow marine and estuarine waters up to 9 nautical miles from the shoreline. The benthic habitat where the blue crab trap fishery occurs can be variable, and includes marshes, sea grass, soft mud bottoms and sand. Traps are made of wire mesh with a mesh size of 1.5 inches (25 millimeters). The volume of the crab trap can be no larger than 8 cubic feet (0.23 cubic meters). Traps are placed along the seafloor and are connected to a buoy line. The blue crab fishery is managed by Gulf states that coordinate through the GSMFC resource agencies. Regulations vary by state. Traps must also be pulled during daylight hours. Catch is limited to 10 gallons per person per day. Blue crabs harvested as incidental bycatch by shrimp trawls may not exceed 200 pounds per vessel per trip.

The blue crab fishery is one of the largest recreational and commercial fisheries in the Gulf of Mexico. Blue crabs are almost exclusively harvested by traps. The Louisiana blue crab fishery is by far the largest blue crab fishery in the Gulf of Mexico. Louisiana accounted for about 87 percent of total Gulf blue crab landings in 2009. The 2011 Gulf of Mexico annual blue crab processed value was about $34 million (Guillory et al. 2001b).

Juvenile and adult blue crabs are found throughout the Gulf of Mexico in shallow marine and estuarine waters. Spawning occurs in high salinity offshore waters. Spawning season varies by location. Juvenile growth occurs inshore and larval development occurs offshore. The juveniles are generally associated with bottom habitats that provide protection from predators including marshes, sea grass, and soft mud bottoms. Adult blue crabs can be found in a variety of bottom habitats throughout the Gulf. There are likely two different stocks, an eastern stock along the Florida coast and a western stock from central Texas to Louisiana (Guillory et al. 2001b).

There is little quantification of the amount of bycatch in active blue crab traps retrieved by the fishery. However, finfish species such as spotted seatrout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), black drum (*Pogonis cromis*), and southern flounder (*Paralichthys lethostigma*) are observed as bycatch in active blue crab traps and in some states, desirable bycatch species can be kept for personal consumption (within limits) or commercial use (if licensed). Bycatch of sea turtles and marine mammals can also occur through entrapment or entanglement.

Gear loss is an important issue within the blue crab trap fishery. Gear loss can contribute to habitat degradation, navigational hazards, and economic losses for fishermen. Furthermore, these traps continue to trap and kill fish and crabs throughout the lifetime of the trap. Based on the 2001 GSMFC Blue Crab Derelict Traps and Trap Removal Programs report, at least 23 species of fish and five species of invertebrates have been observed in blue crab traps (Davis 1942; Guillory 1993). Approximately 250,000 blue crab traps are added to the Gulf of Mexico each year. Gulf-wide cleanup programs to remove derelict crab traps, which started in 2002, have removed 75,000 lost traps between 2002 and 2015 (NOAA 2015). Additionally, programs which limit fishing effort have reduced the number of lost traps by reducing the number of active traps fishing at any given time (Perry and VanderKooy 2015). Estimates of the economic value of lost blue crabs due to derelict crab traps in Louisiana range from $11 million to $15 million over a three-year period (Butcher et. al 2018).

Menhaden Fishery

The Gulf of Mexico menhaden fishery is managed by a Regional Management Plan, which describes the menhaden fishery and is incorporated here by reference (GSMFC 2015). The menhaden fishery typically occurs nearshore. About 66 percent of menhaden are caught within 3 miles (5 kilometers) of the shoreline. The highest menhaden catch occurs at 89 degrees W latitude. The Gulf Menhaden season opens in April and closes in November. Purse seines are typically used to catch menhaden. The total length of the Menhaden purse seine is restricted to 1500 feet (457 meters). Texas is the only state that has a Gulf Menhaden quota for the reduction purse seine fishery. In 2015 the total allowable catch was set to 31.5 million pounds and applies to all waters up to 9 miles (15 kilometers) off the Texas coast. In 1995 purse seines were banned in Florida's state territorial waters. Within the menhaden fishery possession of any species other than menhaden and herring-like species is limited to 5 percent, by weight. BRDs to exclude larger non-target fish have been used within the Gulf Menhaden fishery since the 1950s.

The Gulf of Mexico menhaden fishery uses BRDs to reduce bycatch of large non-target species; however, bycatch of finfish does occur (GSMFC 2015). For example, a study by Condrey 1994 found that eight species made up 93 percent of the total finfish bycatch within the Gulf menhaden fishery. These eight species were the Atlantic croaker (*Micropogonias undulatus*), striped mullet (*Mugil cephalus*), gafftospail catfish (*Bagre marinus*), silver seatrout (*Cynoscion nothus*), Spanish mackerel (*Scomberomorus maculatus*), Atlantic bumper (*Chloroscombrus chrysurus*), hardhead catfish (*Ariopsis*), and sand seatrout (*Cynoscion arenarius*). Of these species, the Atlantic croaker was the species most frequently observed as bycatch, making up 25 percent of the bycatch in the Gulf menhaden fishery (Condrey 1994). Bycatch of sea turtles and marine mammals can also occur through entrapment or entanglement. Furthermore, bottlenose dolphins are known to feed on schooling Gulf menhaden, which can result in interactions with the fishery.

The menhaden reduction fishery is the largest fishery in the Gulf by volume. The reduction fishery is the only significant source of fishing pressure on the Gulf menhaden stock, while the bait fishery is almost negligible in comparison. Landings typically peak from May to August. Gulf menhaden are typically spotted using spotter planes. Spottings are communicated to fishing vessels. Purse boats are used to set nets. Purse seines vary in size and material but are generally around 1,200 feet (366 meters) long. Purse seines close at the bottom via a draw string. Carrier vessels transport catch to reduction plants. They can carry up to 550 metric tons (mt) of menhaden. Most of the catch in this area comes from within 3 miles (5 kilometers) offshore. From 1991 to 2012, 84 percent of menhaden landings in the Gulf were from Louisiana and 16 percent from Mississippi. Commercial menhaden landings in 2011 were 613,300 mt. Reduction and bait landings in 2011 amounted to an ex-vessel value of $89,786,000 (GSMFC 2015).

Menhaden can live up to five or six years and reach approximately 9 inches in length. Menhaden are most common in the north-central Gulf but are found from the Yucatan Peninsula in Mexico to Tampa Bay Florida. Gulf Menhaden typically exhibit schooling behavior and often occur in large schools of 10,000 to 150,000 individuals. These schools are typically found in shallow-water estuarine environments, but adults travel offshore to spawn between September and April. They do not migrate extensively east/west. Juveniles and adults are omnivorous filter feeders (GSMFC 2015).

Reef Fish Fishery

Section 2.0 of the Biological Opinion on the Reef Fish Fishery, which provides an overview of the fishery, is incorporated here by reference (NMFS 2005). The Gulf of Mexico reef fish fishery management plan was one of the first management plans developed by the GMFMC. Currently 31 species are managed by the FMP – 11 species of grouper, 11 species of snapper, three species of tilefish, four species of jacks, hogfish, and gray triggerfish. Amendments to the original FMP added species of tilefish, species of jacks, the white grunt, the red porgy and the gray triggerfish to the management plan. Many different size limits, recreational bag limits, commercial trip limits, quotas and gear restrictions exist for the different reef fish species. Approximately six percent of total finfish and shellfish landings in the Gulf of Mexico come from the reef fish fishery. The dockside revenue for all reef fish in federal waters in the Gulf of Mexico was $59,486,917 in 2015 (GMFMC 2017a).

Reef fish are caught off the coasts of all Gulf of Mexico states. Adult reef fish are typically found and fished for in environments characterized by coral reefs, limestone, hard bottoms or artificial reef substrates. The reef fish fishing season varies by species. Recreational gear typically consists of rod and reel. Reef fish are caught at varying depths depending on the species preferred habitat. Red snapper are commonly caught between 98 and 197 feet (30 and 60 meters). Red groupers, another common target species is caught between 98 and 394 feet (30 and 120 meters). The primary gear utilized by the commercial reef fish fishery consists of bottom longlines, bandits and handlines (Scott-Denton et al. 2011). About 11.5 percent of commercial reef fish landings are caught using longline gear. The number of hooks per bottom longline vessel is limited to 1,000 hooks; only 750 of those hooks can be rigged to fish at one time (GMFMC 2017b).

The use of vertical and longline gear can result in sea turtle and non-target fish bycatch. Sea turtles and bottlenose dolphins can get hooked and/or entangled in fishing line; however, in some cases they can be released alive (NMFS 2005; NMFS 2016b).

4.3.3.6 Marine Transportation

U.S. economy relies heavily on the ports in the northern Gulf of Mexico region for the import and export of both foreign and domestic goods. About 50 percent of all U.S. international trade tonnage passed through the Gulf of Mexico (Figure 4-6). This industry is dependent upon navigation services for safe and efficient operations. Shipping fairways and traffic separation schemes established by the USCG control the movement of vessels as they approach commercial ports which also each have a navigation channel that is maintained and regulated by the USACE. These fairways include buoys and beacons that serve as navigation aids and are identified on NOAA's Office of Coast Survey's navigation charts.

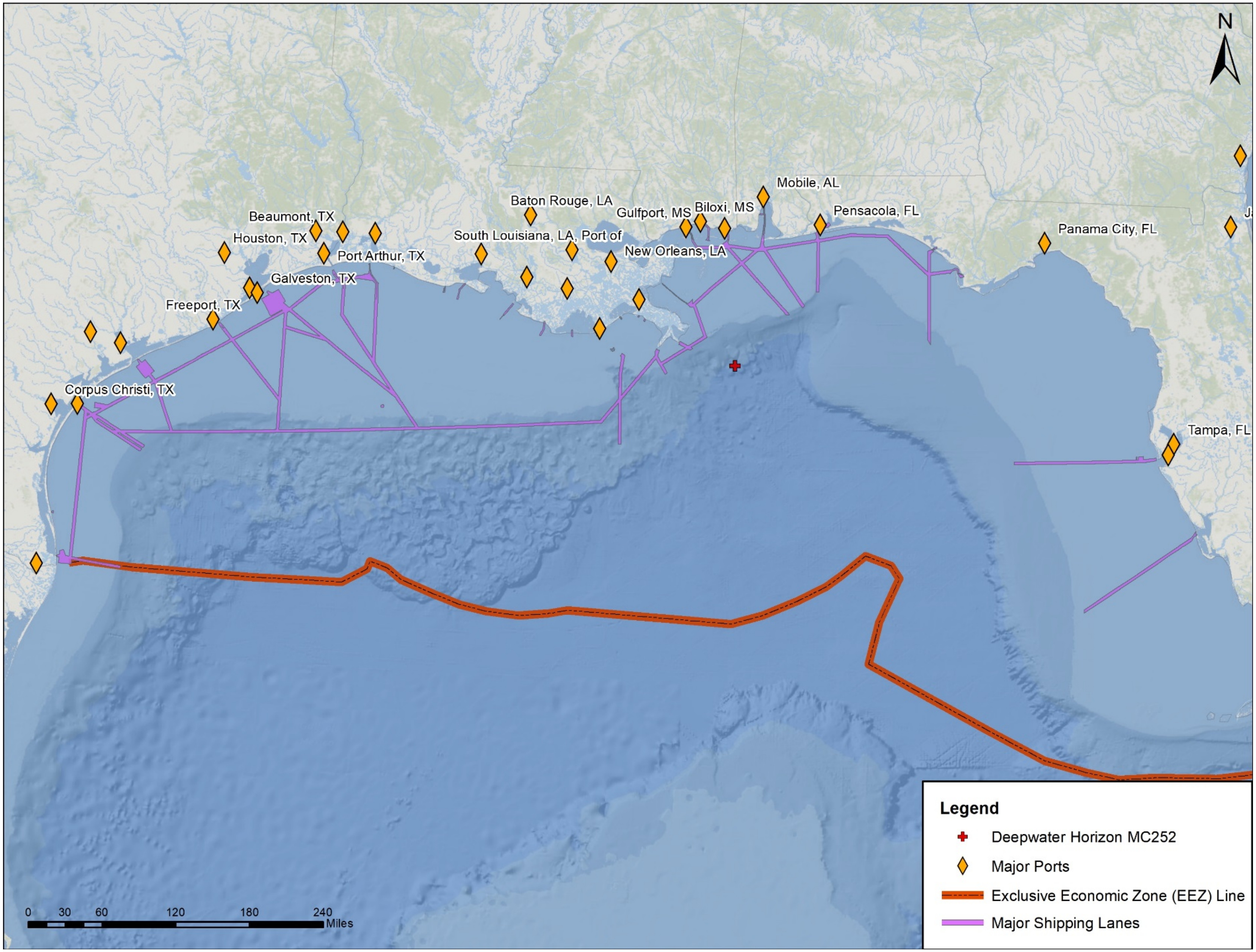
In order to mitigate the impacts of vessel traffic on protected species in the Gulf of Mexico, NOAA Fisheries has published Vessel Strike Avoidance Measures and Reporting for Mariners Guidelines that are incorporated here by reference (NMFS 2008b). There are additional guidelines for the North Atlantic Right Whale. All sightings of dead or injured protected species must be reported immediately to the Southeast U.S. Stranding Hotline. If the injury or death of the animal was caused by a collision with a vessel, responsible parties shall remain available to assist the stranding network as needed (NMFS 2008b). There have been only four reported large whale ship strikes in the Gulf of Mexico. Species that are most at risk for ship strikes include slow-moving species and deep-diving species on the surface (e.g. Gulf of Mexico Bryde's whales, sperm whales, pygmy/dwarf sperm whales, and beaked whales). Fast-moving species, such as the common bottlenose dolphin are at lower risk of possible ship strikes (BOEM 2016).

Vessels that currently operate in the Gulf of Mexico include, but are not limited to, crude oil tankers, liquefied natural gas tankers, oil spill response vessels, commercial container vessels, tugs, barges, military vessels, USCG vessels (e.g., search, rescue, homeland security), cruise ships, commercial fishing vessels, and small watercraft (BOEM 2016). Military vessels operating in the Gulf of Mexico are associated with training and testing activities and occur within Military Warning Areas and Eglin Water Test Areas. Commercial recreational craft include cruise ships, fishing charters, and dive charters. Recreational boating is also prevalent within coastal areas. Commercial business craft include support vessels, fishing vessels, and ferries. The primary types of support vessels include offshore supply vessels associated with the oil and gas industry, anchor handling vessels and towing barges. The oil and gas industry is a robust industry in the Gulf of Mexico that includes over 3,000 offshore oil and gas facilities that require supply vessels to support the on-going activities which contributes to the significant vessel traffic. In addition, research vessels are also present within the Gulf of Mexico for a wide variety of research and data collection projects (BOEM 2016).

Seven deep water commercial ports that can handle fully laden Panamax ships are located in the restoration area: Houston, Corpus Christi, Beaumont, and Galveston, Texas; New Orleans, Louisiana; Mobile, Alabama; and Tampa, Florida. Large commercial vessels and military vessels have access to nine deep water ports located along the coast of the Gulf of Mexico and between 2006 and 2011, large commercial vessel traffic increased in the Gulf of Mexico by 18.8 percent. Smaller vessels such as commercial business craft, research vessels, and small watercraft also use these ports. Additionally, the U.S. Department of Defense has a large presence in the Gulf of Mexico with multiple Navy and Airforce facilities located within the coastal zone.

Commercial and recreational fishing operations also contribute to vessel traffic in the Gulf of Mexico. Commercial fishing operations are often restricted by seasons and gear restrictions. The species sought by commercial fishing operations, seasons, and general areas fished with each gear type are described in above in Section 4.3.3.5. The five highest volume commercial fishing ports in the Gulf of Mexico during 2017 by pounds of landed fish are Empire-Venice, Louisiana; Brownsville-Port Isabel, Texas; Bayou La Batre, Alabama; Key West, Florida; and Dulac-Chauvin, Louisiana (NMFS 2019).

Figure 4-6: Major shipping lanes and major ports in the northern Gulf of Mexico.



4.4 Environmental Consequences

This section describes the environmental impacts that may result from the implementation of any of the alternatives considered in this RP/EA. The resource categories presented in this section correspond to the categories of existing conditions in Chapter 3 Ecosystem Setting and Chapter 4 Injury to Natural Resources of the PDARP/PEIS, and Section 4.3, Affected Environment of this RP/EA. This section analyzes environmental consequences by project within each Restoration Type.

4.4.1 Resources Not Analyzed in Detail in this RP/EA

To avoid redundant or unnecessary information, projects addressed in this RP/EA were reviewed to determine whether some resources either would not be affected or would have minimal, short-term impacts that are common to all alternatives. This allows for a focused impact analysis by eliminating (from detailed analysis) resources with little or no potential for adverse impacts. Based on this review of proposed restoration activities, several resource categories were identified as having no expected impacts across Restoration Types (i.e. air quality; infrastructure; aesthetics and visual resources; and public health and safety) and have been removed from further analysis. The resources, along with the rationale for the analysis of impacts to the resources in this section, are as follows.

4.4.1.1 Physical Resources

4.4.1.1.1 Air Quality

The EPA defines ambient air in 40 CFR Part 50 as “that portion of the atmosphere, external to buildings, to which the general public has access.” In compliance with the 1970 Clean Air Act and the 1977 and 1990 Clean Air Act Amendments, EPA has promulgated National Ambient Air Quality Standards (NAAQS). The NAAQS include primary standards that set limits to protect public health, including the health of “sensitive” populations such as asthmatics, children, and the elderly.

Plan alternatives are either not anticipated to affect air quality (e.g., data gathering), or are expected to be nominal. Survey vessels and equipment associated with data collection and other offshore proposed restoration projects would emit a variety of air pollutants, including nitrogen oxides (NO_x), sulfur oxides (SO_x), particulate matter, volatile organic compounds, and carbon monoxide (CO), as well as greenhouse gases (e.g., CO_2) primarily from combustion of fossil fuels for propulsion and power generation. The amount of air pollutants generated during project activities would depend primarily on the number, design, and size of the vessels; the size of engines and generators on the vessels; the distance traversed under power; and overall duration of the survey activities. Due to the limited extent of the proposed activities, the amount of air pollutants generated would be small and all vessels would follow existing federal compliance requirements. Also, emissions would be distributed over a broad area in the Gulf of Mexico generally far from shore and likely would not result in any elevated pollutant concentrations exceeding air quality standards.

4.4.1.2 Human Uses and Socioeconomics

4.4.1.2.1 Infrastructure

Potential impacts to existing infrastructure are expected to be negligible from proposed project activities. Proposed activities that include field surveys would use existing marine infrastructure facilities and would not add significantly to the existing uses of these facilities or require any modifications to support the proposed activities. There could be some nominal positive impacts to some of these port facilities from additional supplies to support the survey or other offshore activities, but these activities are limited in duration.

4.4.1.2.2 Aesthetics and Visual Resources

Proposed project activities are not expected to have impacts on aesthetics or visual resources. Most aesthetic and visual resources and recreational tourism associated with the Gulf of Mexico are located on the coast or in coastal waters. As most proposed project activities would either be shore-based desktop exercises or occur in offshore waters beyond sight of land, no impacts are expected. The few projects that are have minimal nearshore activities involve small vessels in response to marine mammal stranding or derelict crab trap removal. These small vessels are typical in coastal waters.

4.4.1.2.3 Public Health and Safety

There are no proposed project activities that are expected to affect public health and safety. Most proposed activities would be implemented in partnership with the fishing industry through volunteer and incentivized participation. Participation in these project alternatives would be managed to prevent impacts to health and safety and make participants aware of the potential for injury (e.g. use of FDDs, or volunteer events for derelict gear retrieval). Potential public health and safety issues would be addressed through disclaimers and waivers, would follow appropriate safety requirements, and/or would be coupled with training and educational events to ensure proper use of equipment. With these precautions no activities are expected that could cause public health or safety issues.

4.4.2 Resources Analyzed in this RP/EA

Resources analyzed in this chapter in greater detail, where appropriate for each project include:

- **Physical Resources**: Geology and substrates; hydrology and water quality; and noise.
- **Biological Resources**: Habitats; wildlife species (birds); marine and estuarine fauna; and protected species.
- **Socioeconomic Resources**: Socioeconomics; cultural resources; land and marine management; tourism and recreational use; fisheries; and marine transportation.

These are discussed, first at a level common to all alternatives (overview), and then additional specific resource information relevant to Restoration Types are further described.

4.4.3 Fish Project Alternatives

This analysis incorporates by reference the relevant portions of Section 6.4.5 of the PDARP/PEIS. The PDARP/PEIS provides programmatic evaluation of the environmental consequences of the Restoration Approaches for the Fish Restoration Type which are considered in this RP/EA and are incorporated by reference here. This section presents the environmental consequences of the proposed actions in context of the affected environment described in Section 4.3 of this RP/EA. Table 4-5 provides a summary of the Fish Restoration Type impacts analysis.

After preliminary investigation, some resource categories under the Fish Restoration Type alternatives were determined to be either unaffected or minimally affected by the restoration actions being proposed. Accordingly, these resources are discussed briefly below. Only those resource categories for which potential, adverse impacts are expected are discussed in detail in this RP/EA. To avoid redundant or unnecessary information, resource categories and topics that are not expected to be affected by a proposed restoration alternative are not analyzed further under a given project.

Resource categories not analyzed in detail for the Fish Restoration Type here are identified below, with brief rationale for non-inclusion:

- **Noise:** Restoration alternatives related to the Fish Restoration Type involve vessels that already operate in the Gulf of Mexico regularly. Potential changes to noise are not expected with the activities of these project alternatives. It is assumed that no new vessel trips are being conducted, therefore this resource area was not carried forward for detailed analysis.
- **Land and Marine Management:** Restoration alternatives related to the Fish Restoration Type involve pilot studies associated with current commercial and recreational fishing fleets and would not interact with any land use practices or influence change on any management plans of marine managed areas. This resource area was not carried forward for detailed analysis.
- **Marine Transportation:** Restoration alternatives related to the Fish Restoration Type do not involve shipping or military vessels. Fisheries related vessels already operate in the Gulf of Mexico regularly. It is assumed that no new vessel trips are being conducted, therefore this resource area was not carried forward for detailed analysis.
- **Cultural Resources:** Restoration alternatives related to the Fish Restoration type involve shore-based desktop work (e.g. development of new methodologies or techniques for fisheries bycatch reduction) or would occur in pelagic waters offshore far away from shore-based or sea floor cultural resources. As a result, this resource area was not carried forward for detailed analysis.

4.4.3.1 Reduction of Post-release Mortality from Barotrauma in the Gulf of Mexico Reef Fish Recreational Fisheries

The goal of the project would be to reduce post-release mortality rates of reef fish. Distribution of and education on FDDs would aim to decrease the effects of barotrauma and help reef fish return to depths where they can recover from the catch-and-release process. Project activities would include distribution of FDDs to fishermen; education and outreach; monitoring FDD use and measuring the efficacy of the devices by the fishing public; and validating the effectiveness of the FDDs. Field data collection methods would include the use of FDD devices, telemetry, underwater video, and other potential techniques. Capture-tag-recapture of reef fish would also be utilized during field surveys.

The data generated during these activities would be synthesized and analyzed to produce a report that summarizes the findings of the validation studies, best practices, and goals for obtaining more data. These actions would help to restore recreationally important reef fish.

Potential impacts from the project are largely beneficial and adverse impacts are minor. Benefits to biological resources and human uses and socioeconomics are anticipated. BMPs identified in required permits, consultations, or environmental reviews, including those described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.3.1.1 Physical Resources

Section 6.4.5.6.1 of the PDARP/PEIS, which describes the potential impacts to physical resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to reduce post-release mortality of red snapper and other reef fishes in the Gulf of Mexico recreational fishery using FDDs were described as having no impacts to the physical environment. This project is consistent with these findings. Given that the equipment for the proposed project would not be permanently deployed, adverse impacts to physical resources, such as geology and water quality, from the use of FDDs are not anticipated.

4.4.3.1.2 Biological Resources

Section 6.4.5.6.2 of the PDARP/PEIS, which describes the potential impacts to biological resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to reduce post-release mortality of red snapper and other reef fishes in the Gulf of Mexico recreational fishery using FDDs were described as having the potential to cause minor short-term adverse impacts and long-term and short-term benefits to biological resources. This project is consistent with these findings.

Short-term, minor adverse impacts to biological resources could occur from the potential interaction with weighted-release devices. For instance, there may be a greater interaction of gear with coral and sponge species, although proper training would reduce this potential for impact. Proper use of the FDDs is not anticipated to disturb habitats, marine and estuarine fauna, or protected resources. Over both the short- and long-term the use of FDDs could result in positive impacts on marine and estuarine fauna and protected resources. Benefits on reef fish populations are expected by increasing survivorship and reproductive success of individual fishes. No impacts are anticipated for wildlife species (birds) associated with this offshore project.

4.4.3.1.3 Human Uses and Socioeconomics

Section 6.4.5.6.3 of the PDARP/PEIS, which describes the potential impacts to socioeconomic resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to reduce post-release mortality of red snapper and other reef fishes in the Gulf of Mexico recreational fishery using FDDs were described as having the potential to benefit socioeconomic resources. The project is consistent with these benefits described but due to the voluntary nature of the project there are no adverse impacts anticipated to socioeconomics.

FDDs would be provided to recreational fishers free of cost, as would strategically publicized outreach programs. Participation would be voluntary; therefore, the project would not adversely and/or disproportionately affect minority or low-income populations and its implementation would likely benefit surrounding communities equally. This project could also lead to minor increases in fish biomass that would increase fishing opportunities resulting in an economic benefit to the community and to the recreational and commercial fisheries.

There is the potential that anglers would consider using the FDDs an inconvenience or detriment to their fishing experience and/or success, however FDD usage would be voluntary and if the fishermen perceive FDDs as a detriment to their fishing experience they could discontinue use. Due to the voluntary nature of this project, there would not be adverse impacts to tourism and recreational use. Recreational anglers may derive some satisfaction (benefits) associated with releasing fish and reducing barotrauma effects.

4.4.3.2 Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery

The goal of the project would be to reduce fish bycatch in the shrimp trawl fishery. This would be accomplished through activities such as innovative BRD identification, validation of BRD effectiveness, outreach workshops, and dockside trainings. The initial activity of the project would be to conduct a BRD Innovation Survey within the Gulf shrimp fishery to identify industry-based innovations in BRD technology that are currently in use. The project would then conduct proof-of-concept tests on these identified prototypes using diver evaluations and paired trials. Designs with the most favorable characteristics (i.e. bycatch reduction, shrimp retention, simplicity, and ease of use) would go on to full certification testing on commercial shrimp trawling vessels. Following scientific and comparative testing, a list of certified BRDs for use in shrimp trawl fisheries would be compiled. Certification of more effective BRDs would likely decrease bycatch mortality of a variety of species within the shrimp trawl fishery.

Potential impacts from the project are largely beneficial. Benefits to biological and human uses and socioeconomics are anticipated. BMPs identified in required permits, consultations, or environmental reviews, including those described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.3.2.1 Physical Resources

Section 6.4.5.4.1 of the PDARP/PEIS, which describes the potential impacts to physical resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship were described as having no impacts to physical resources. This project is consistent with these findings. This project does not propose a change in fishing behavior in terms of fishing effort or trawl type. BRD trial runs would take place during existing fishing efforts.

4.4.3.2.2 Biological Resources

Section 6.4.5.4.2 of the PDARP/PEIS, which describes the potential impacts to biological resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship were described as having long-term benefits to biological resources with no anticipated adverse impacts. This project is consistent with these findings.

This approach involves replacing gear with better BRDs. This project would take place on existing vessels during regular shrimp trawl runs. Adverse impacts to wildlife, marine and estuarine fauna, and protected resources associated with shrimp trawl fisheries above what already occurs would not be expected. Instead, benefits are expected due to the reduction of bycatch from better BRDs. There are no anticipated impacts to habitats associated with this offshore project. This project would not increase or change current effort in the existing shrimp trawl fishery analyzed in NMFS ESA consultations (2014b and 2017b).

4.4.3.2.3 Human Uses and Socioeconomics

Section 6.4.5.4.3 of the PDARP/PEIS, which describes the potential impacts to socioeconomic resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship were described as having the potential to cause long-term benefits and minor to moderate, short-term to long-term adverse effects to socioeconomic resources. Additional analyses of the project specific activities indicated that adverse impacts to socioeconomics are not anticipated; rather, benefits should occur.

Participation in BRD trial runs would be voluntary and incentivized. This restoration activity does not have the potential to adversely and/or disproportionately affect minority or low-income populations. Implementation of this project would benefit surrounding communities equally. Financial incentives offered to fishermen could provide socioeconomic benefits. Additionally, reducing bycatch mortality may result in increases in fish biomass that may, in turn, result in increased catch or fishing opportunities leading to economic benefits to the community as well as increased tourism. The scale of these impacts would depend on the specific techniques implemented.

In the case of fisheries, there is the potential for alternative BRDs to be less efficient at retaining shrimp than traditional BRDs; however, pilot study participation would be voluntary, and fishermen would not have to endure this potential consequence if they chose not to. Additionally, pilot study BRDs would need to retain shrimp at a comparable shrimp retention rate to be certified as a BRD for this project. This project would focus on federally or state permitted vessels which often already use at least one BRD per trawl and therefore potential reductions in shrimp retention on these vessels would be easier to offset.

4.4.3.3 Restoring Bluefin Tuna via Fishing Depth Optimization

The goal of the project would be to reduce bluefin tuna bycatch. Demonstration pilot studies would be conducted in cooperation with voluntarily participating commercial PLL vessels. Vessels would fish with industry standard gear alternating setting it between normal PLL fishing depth (generally 230-295 feet [70-90 meters]) and deeper depths (between 360-394 feet [110-120 meters]) and using paired longline sets. Onboard monitoring by observers would collect data on catch rates at normal and deeper PLL depth, fish interaction time, fishing depth, and temperature; PSAT tags would also be deployed on caught bluefin and yellowfin tuna to evaluate distribution and migration and to provide additional behavioral information on these species. Data would also be collected on possible effects to other species from a deeper PLL fishing depth. Data would be analyzed and the results would be provided to the fishery through outreach workshops held across the US Gulf coast as well as in Mexico to educate attendees on techniques to reduce bycatch. Reduction in bluefin tuna bycatch would help restore bluefin tuna populations.

Potential impacts from the project are largely beneficial and adverse impacts are minor. Benefits to biological and human uses and socioeconomics are anticipated. BMPs identified in required permits, consultations, or environmental reviews, including those described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.3.3.1 Physical Resources

Section 6.4.5.2.1 of the PDARP/PEIS, which describes the potential impacts to physical resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from the project intended to reduce mortality among highly migratory species and other oceanic fishes were described short-term, minor adverse impacts to physical resources. This project includes activities that are not specifically addressed in the PDARP/PEIS. This project proposes to alter depths at which PLL operates while utilizing the same PLL gear. The change in PLL depth does not intend to change fishing behavior in terms of fishing effort, distance traveled, or number of fishing vessels; therefore, impacts to physical environments are not expected.

4.4.3.3.2 Biological Resources

Section 6.4.5.2.2 of the PDARP/PEIS, which describes the potential impacts to biological resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to reduce mortality among highly migratory species and other oceanic fishes were described as having the potential to cause minor to long-term, moderate adverse impacts to biological resources. This project includes activities that are not specifically addressed in the PDARP/PEIS such as changing depths of deployment of fishing hear (not gear conversion). Additional analyses indicated that these activities may have minor short-term adverse impacts as well as some benefits on marine and estuarine fauna and protected species. There are no anticipated impacts to habitats and wildlife species (birds) associated with this offshore project.

Short-term, minor adverse impacts could occur to marine and estuarine fauna from altering PLL fishing depth. It is possible that altering PLL fishing depth may result in an increase in the bycatch of other non-target species (other than bluefin tuna) and/or certain protected species. This could result in short-term, minor adverse impacts on non-target species. Catch rates of non-targeted and protected species would be monitored during pilot studies to assure that adverse impacts are kept to a minimum and remain short-term. Pilot studies would aim to find an optimal PLL depth where benefits outweigh consequences. Minor adverse impacts to yellowfin and bigeye tuna may occur, due to potential increased CPUE, but are anticipated to be minimal due to regulations already in place to protect yellowfin and bigeye tuna populations.

Deeper PLL fishing depth is anticipated to reduce bluefin tuna bycatch based on unpublished data (Foster et al. 2015). Catch rates of other species, including protected species such as sea turtles and marine mammals, may also decrease. Completion of the pilot studies, adaptive management, and ongoing monitoring would assure that any potential adverse impacts are minimized. Catch rates would need to be monitored during pilot studies and could lead to benefits to marine and estuarine fauna. This project would not increase or change current effort in the existing fishery that has been analyzed in NMFS ESA consultations (2004 and 2016b).

4.4.3.3.3 Human Uses and Socioeconomics

Section 6.4.5.2.3 of the PDARP/PEIS, which describes the potential impacts to socioeconomic resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to reduce mortality among highly migratory species and other oceanic fishes were described as having the potential to cause long-term benefits as well as short-term, minor to moderate adverse impacts to socioeconomic resources. This project includes activities that are not specifically addressed in the PDARP/PEIS. Additional analyses indicated that these activities may benefit human uses and socioeconomics resources; however, there may be short-term, minor adverse impacts to fisheries.

Participation in trial runs of a deeper PLL set depth would be voluntary and incentivized. Adverse impacts to socioeconomics are not anticipated. This restoration activity does not have the potential to adversely and/or disproportionately affect minority or low-income populations. The implementation of this project would benefit surrounding communities equally. The benefit of reduced fishing pressure on bluefin tuna would provide a mechanism for population and fishery recovery and eventual quota increases. This could lead to economic benefits. The potential for increased CPUE may also lead to economic benefits. Additionally, if incentives are implemented, vessel owners may incur additional economic benefits.

Short-term, minor adverse impacts from altering the PLL fishing depth could include the possibility of increased bycatch of commercially and recreationally important fish. The catch rates of a deeper PLL fishing depth on bycatch of non-target species would be collected during this project to keep adverse impacts to a minimum. There is an expected benefit from reduced fishing pressure on bluefin tuna which would provide a mechanism for population and fishery recovery and possible eventual quota increases over the long-term. Additionally, this project may result in the decreased bycatch of other commercially and recreationally important fish.

4.4.3.4 Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats

The goal of the project would be to reduce the impacts of ghost fishing. This project would develop an outreach program for commercial and recreational fishermen across the northern Gulf of Mexico to increase fishermen’s awareness of the impacts of derelict fishing gear and techniques to reduce the loss of gear. In addition, training events would be held for participants in removal activities. Field surveys would be performed to identify locations within the Gulf of Mexico that have a high density of debris. Surveys would likely utilize visual assessments, side-scan sonar, and/or magnetometer surveys. Annual or twice-annual gear removal events would take place based on the estimated need, cost effectiveness, and positive restoration outcome. Monitoring and targeted assessment of areas following removal activities would be conducted to evaluate project success. Removal of derelict gear would reduce the risk of marine organism entanglement and reduce mortality rates associated with ghost fishing.

Potential impacts from the project are largely beneficial and adverse impacts are minor. Benefits to biological and human uses and socioeconomics are anticipated. BMPs identified in required permits, consultations, or environmental reviews, including those described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.3.4.1 Physical Resources

Section 6.4.5.1.1 of the PDARP/PEIS, which describes the potential impacts to physical resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to reduce impacts of ghost fishing through gear conversion and/or removal of derelict fishing gear were described as having the potential to cause minor, short-term adverse impacts as well as long-term benefits to physical resources. This project is consistent with these findings.

Increased turbidity and sediment disturbances during assessment surveys and actual gear removals may have short-term, minor adverse impacts on water quality and substrates. The removal of blue crab traps would reduce trap movements on benthic sediments and could have beneficial impacts to substrates. Additionally, the removal of plastic derelict gear can reduce the introduction of plastic particles into marine estuarine substrates increasing water quality. Persistent synthetic plastics provide mechanisms for the introduction of polychlorinated biphenyls (PCB).

4.4.3.4.2 Biological Resources

Section 6.4.5.1.2 of the PDARP/PEIS, which describes the potential impacts to biological resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to reduce impacts of ghost fishing through gear conversion and/or removal of derelict fishing gear were described as having the potential to cause short-term, minor adverse impacts as well as long-term benefits to biological resources. This project is consistent with these findings.

Short-term, minor adverse impacts could occur to habitats via temporary disruptions during derelict gear removal events. The removal of blue crab traps have benefits to benthic habitats through the eliminations of continued trap disturbance on those habitats. Additionally, the removal of derelict fishing gear can reduce the introduction of plastic particles and PCBs in marine habitats. Marine debris in general can also provide a mechanism for the transportation of invasive species and therefore removal of debris could reduce the introduction of invasive species into new habitats.

Short-term, minor adverse impacts could occur to marine and estuarine fauna from individual species disruption and habitat disruption during gear removals. The removal of blue crab traps and other derelict gear could provide benefits to wildlife species (birds), marine and estuarine fauna, and protected species, by reducing the risk of entrapment in derelict gear. For instance, 23 species of fish and five species of invertebrates have been observed in blue crab traps (Davis 1942; Guillory 1993). The removal of derelict gear could also improve habitats, which could benefit marine and estuarine fauna including protected species resources. The removal of buoy line may lead to reductions in marine mammal, sea turtle, and diving seabird entanglement (Gilardi et al. 2010).

4.4.3.4.3 Human Uses and Socioeconomics

Section 6.4.5.1.3 of the PDARP/PEIS, which describes the potential impacts to socioeconomic resources from restoration approaches intended to restore fish, is incorporated here by reference. Impacts from projects intended to reduce impacts of ghost fishing through gear conversion and/or removal of derelict fishing gear were described as having the potential to benefit socioeconomics with no adverse impacts to socioeconomic resources. This project is consistent with these findings.

Because participation in this approach would be voluntary, adverse economic impacts associated with participating are not anticipated. This restoration activity does not have the potential to adversely and/or disproportionately affect minority or low-income populations. Implementation of this project would benefit surrounding communities equally.

There would be incentives for participation in derelict gear removals and these could have economic benefits. Furthermore, marine debris can result in beach closures, which can have particularly serious economic ramifications in coastal areas dependent upon tourism (Oigman-Pszcol and Creed 2007). Removal of derelict gear can help avoid these beach closures and the economic ramifications associated with them. Marine debris have the potential to disable vessels via direct interactions with the debris or propeller/intake interactions, which can result in economic costs (U.S. Commission on Ocean Policy 2004). Marine debris can also interfere with navigational safety because they can be difficult to see and avoid. These types of encounters with marine debris at sea can result in costly damage to a vessel (NOAA 2011). Increases in fish biomass from the reduction of ghost fishing can also lead to economic yields for fishermen. Benefits from this project could occur due to an increase in commercially and recreationally important fish biomass from a reduction in ghost fishing. Removal of derelict traps are expected to result in an indirect beneficial impact to commercial and recreational boater safety due to reduced entanglement hazards to boat propellers.

Table 4-5: Impact summary of evaluated alternatives for Fish.

ALTERNATIVE	PHYSICAL RESOURCES				BIOLOGICAL RESOURCES				HUMAN USE AND SOCIOECONOMIC RESOURCES								
	Geology and Substrates	Hydrology and Water Quality	Air Quality	Noise	Habitats	Wildlife Species (birds)	Marine and Estuarine Fauna	Protected Species	Socioeconomics/ Environmental Justice	Cultural Resources	Infrastructure	Land and Marine Management	Tourism and Recreational Use	Fisheries	Marine Transportation	Aesthetics and Visual Resources	Public Health and Safety
Fish																	
Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries	NE	NE	NE	NE	s	NE	+/s	+/s	+	NE	NE	NE	+	+	NE	NE	NE
Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery	NE	NE	NE	NE	NE	+	+	+	+	NE	NE	NE	+	+	NE	NE	NE
Restoring for Bluefin Tuna via Fishing Depth Optimization	NE	NE	NE	NE	NE	NE	+/s	+/s	+	NE	NE	NE	+/s	+/s	NE	NE	NE
Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats	+/s	+/s	NE	NE	+/s	+	+/s	+/s	+	NE	NE	NE	+	+	NE	NE	NE

Notes: + -Beneficial effect; NE- No effect; s - short-term, minor adverse effect

4.4.4 Sea Turtle Project Alternatives

This analysis incorporates by reference portions of Section 6.4.7 of the PDARP/PEIS. The PDARP/PEIS provides programmatic evaluation of the environmental consequences of the Restoration Approaches for Sea Turtles Restoration Type that are considered in this RP/EA and are incorporated by reference here. This section presents the environmental consequences of the proposed actions in context of the project-specific affected environment described in Section 4.3. Table 4-6 provides a summary of the Sea Turtles Restoration Type impacts analysis.

After preliminary investigation, some physical and biological resources evaluated under the Sea Turtles Restoration Type alternatives were determined to be either unaffected or minimally affected by the restoration actions being proposed for this Restoration Type. Accordingly, these resources are only discussed briefly below. Only those resource categories for which potential, adverse impacts are expected are discussed in detail in this RP/EA. To avoid redundant or unnecessary information, resource categories and topics that are not expected to be affected by a proposed restoration alternative are not analyzed further under a given project.

Resource categories not analyzed in detail for the Sea Turtles Restoration Type are identified below, with brief rationale for non-inclusion:

- **Noise:** Restoration alternatives for the Sea Turtles Restoration Type associated with the fishing industry are typical and do not add more vessel noise to the current noise environment. Changes to noise would be negligible in both the long and short-term; therefore, this resource area was not carried forward for detailed analysis.
- **Marine Transportation:** Restoration alternatives for the Sea Turtles Restoration Type do not involve shipping or military vessels. Fisheries related vessels and research vessels already operate in the Gulf of Mexico regularly. It is assumed that no new vessel trips are being conducted; therefore, this resource area was not carried forward for detailed analysis.
- **Cultural Resources:** Restoration alternatives for the Sea Turtles Restoration Type associated with the fishing industry are typical and would not have any additional effects on cultural resources. Land acquisition for nesting turtles likewise would not adversely affect any cultural resources. Due to these assumptions, this resource area was not carried forward for detailed analysis.

4.4.4.1 Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery

The goal of the project would be to develop an effective sea turtle observation program for use in the Gulf of Mexico menhaden purse seine fishery. Major activities would include coordination and development of scientific observing methods with the menhaden fishery, including proof-of-concept testing, and implementation of a pilot observer program. An initial outreach phase involving fishery representatives would be used to inform potential methodologies and protocols with both human observers and video cameras, and/or other technology. The proposed measures would then undergo testing during regular fishing operations to determine feasibility. The results of the proof-of-concept testing would then be reviewed to determine viable methods for observing the fishery and to design a pilot observer program. A two-year observer pilot program in cooperation with the NOAA Observer Program and industry to collect initial monitoring data and to assess the feasibility and effectiveness of the program. The project team would review the results of the observer coverage to determine if specific fishing practices can be modified to reduce potential sea turtle bycatch or if additional observer coverage is necessary. That information would be shared with the industry, and the methods to reduce interactions would be developed to potentially inform future restoration actions.

The impacts from the project are largely beneficial and adverse impacts are minor. Benefits to biological resources may result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed. Additionally, BMPs are described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.4.1.1 Physical Resources

Section 6.4.7.1.1 of the PDARP/PEIS, which describes the impacts to physical resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures were described as having no adverse impacts to physical resources. This project is consistent with these findings. Adverse impacts to physical resources are not anticipated from this project as normal fishing practices for deploying and hauling gear would not increase as a result of this project alternative.

4.4.4.1.2 Biological Resources

Section 6.4.7.1.2 of the PDARP/PEIS, which describes the impacts to biological resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures were described as having long-term benefits and no adverse impacts to biological resources. This project is consistent with these findings.

Project activities may benefit marine and estuarine fauna and protected species such as sea turtles and marine mammals. Through increased detection of marine and estuarine fauna and protected species within the menhaden fishery, knowledge on their interaction would be gained and ultimately help to reduce any associated injuries with this interaction. Furthermore, the project would contribute to filling knowledge gaps and informing future restoration activities. Habitats and wildlife species would not be affected by this project. NMFS Observer Program regulations would be adhered to at all times.

4.4.4.1.3 Human Uses and Socioeconomics

Section 6.4.7.1.3 of the PDARP/PEIS, which describes the impacts to socioeconomic resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures were described as having long-term benefits and minor, short-term adverse impacts to socioeconomic resources. Additional analyses of project specific activities indicated there would be no impacts to socioeconomics since the project is focused on observation and data collection.

4.4.4.2 Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices

The goal of this project is to develop and test new TED prototypes that would reduce bycatch of small sea turtles in shrimp otter trawls. Initial project activities include the collection and captive rearing of loggerhead hatchlings for approximately one year to a size appropriate for TED prototype testing. A variety of candidate TEDs would be installed in trawls and towed by research vessels to test their ability to exclude small sea turtles. For each test, three divers deployed on the trawl would release each turtle into the trawl and monitor its passage. Data recorded during each exposure would include: video record, total time in the trawl, turtle activity level, and turtle disposition (escape or capture). The relative efficiency of the candidate TED design would be compared to that of a control TED tested under the same conditions. The prototypes that meet the escape rate criteria would be recommended for fishery-independent proof-of-concept and commercial target catch retention and bycatch testing. Proof-of-concept testing would compare candidate TEDs to a standard control TED aboard a twin-rigged research vessel. Prototype TEDs that meet minimum shrimp loss criteria would be recommended for dependent commercial trials aboard contracted commercial vessels. The results would be used to inform future restoration efforts to reduce bycatch of small sea turtles in the otter trawl fishery.

The impacts from the project are largely beneficial and adverse impacts are minor. Benefits to biological and human use and socioeconomic resources would result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed. Additionally, relevant BMPs are described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.4.2.1 Physical Resources

Section 6.4.7.1.1 of the PDARP/PEIS, which describes the potential impacts to physical resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation methods were described as causing temporary, minor disruption of the benthic habitat and water column. This project is consistent with these findings.

Fishing practices for shrimp trawls involve deploying and hauling of gear and generally avoids hard bottom. These prototype pilot studies are supplemental to normal fishing practices and would occur on sandy soft bottom areas. These practices may cause short-term, minor adverse impacts to the benthos and water column causing turbidity during field testing. These impacts would be short-term and localized to the nearshore area where the prototypes are being tested.

4.4.4.2.2 Biological Resources

Section 6.4.7.1.2 of the PDARP/PEIS, which describes the impacts to biological resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation methods were described as causing long-term beneficial effects and no adverse impacts to biological resources. The PDARP/PEIS only considered changes to gear and fishing practices and assumed no increase in the number of fishing trips over normal fishing practices. This project would require additional fishing trips, and therefore additional trawling activities, specifically to test TED prototypes. Implementation of this project may have short-term, minor adverse impacts to habitats and marine and estuarine species and may provide long-term benefits to marine fauna and protected species.

The data collected during these prototype trials would provide a benefit to sea turtles. The results of the TED prototype testing would increase knowledge of how juvenile sea turtles interact with TEDs and provide a path forward to improve bycatch reduction techniques. Future restoration projects may implement these improved TEDs on a voluntary basis. Beneficial effects on finfish sharks, ray, and sea turtles are expected as the increased efficiency of the TEDs would reduce the number of these species incidentally caught as a result of current fishing practices. During testing, divers would be involved to monitor the sea turtles being collected in the trawls. There are no anticipated impacts to wildlife species associated with this project. The activities in this project have already been analyzed in existing permits and consultations.

4.4.4.2.3 Human Uses and Socioeconomics

Section 6.4.7.1.3 of the PDARP/PEIS, which describes the impacts to socioeconomic resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation methods were described as having long-term benefits and minor, short-term adverse impacts on socioeconomic resources. Additional analyses of project specific activities indicated that there would no impacts to socioeconomic resources.

No impacts to socioeconomics and environmental justice, land and marine management, and tourism and recreation are expected as a result of this project because it is a pilot study of prototypes and would not be implemented by the fishery. Future restoration projects may include voluntary adoption of the most efficient TED configuration(s), the transactions would be negotiated or arranged between willing parties and, as such, are not expected to give rise to adverse socioeconomic impacts to those who choose to engage in such transactions. The project would not adversely and/or disproportionately affect minority or low-income populations and its implementation would likely benefit surrounding communities equally. Future restoration projects may implement these improved TEDs on a voluntary basis.

4.4.4.3 Long-term Nesting Beach Habitat for Protection for Sea Turtles

The goal of this project is to aid sea turtle restoration efforts through acquisition of priority nesting habitat. Through a willing seller approach, priority parcels would be acquired to ensure the highest density sea turtle nesting beaches are protected in perpetuity. Seventeen high priority tracts have been identified for acquisition by the USFWS and its conservation partners. A third-party land trust would be utilized to engage and cultivate relationships with landowners, conduct appraisals to ensure cost is not above market value, then negotiate and secure property. The Trustees would conduct due diligence tasks to evaluate parcels, including environmental assessments, property surveys and title searches, to ensure the property is not contaminated, boundaries are clear, and that tracts and titles are clear. The USFWS would work with a third-party land trust to convey the tracts from the trust to ACNWR, the State of Florida, or Brevard or Indian River County as donations for their long-term protection and management. The high-density sea turtle nesting beach habitat would be protected long-term, which would help sea turtle, particularly green and loggerhead sea turtle, populations increase.

The impacts from the project are all beneficial. Benefits to physical, biological, and human use and socioeconomic resources may result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.4.3.1 Physical Resources

Section 6.4.7.3.1 of the PDARP/PEIS, which describes the impacts to physical resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to enhance sea turtle hatchling productivity and restore and conserve natural habitat, specifically through land conservation activities, were described as providing long-term benefits to physical resources. This project is consistent with these findings.

Parcels would be acquired according to DOI regulations. The parcel(s) acquired would be protected from development, thus reducing the risk of disturbance to geology and substrates. Where protected land overlaps with groundwater recharge zones, surface water, or brackish-water resources, water sources and quality could be further protected from future degradation by helping to reduce runoff. ACNWR has a variety of water resources, which if included in the purchased land parcel, would be protected.

4.4.4.3.2 Biological Resources

Section 6.4.7.3.2 of the PDARP/PEIS, which describes the impacts to biological resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to enhance sea turtle hatchling productivity and restore and conserve natural habitat, specifically through land conservation activities, were described as providing long-term benefits to biological resources. This project is consistent with these findings.

Protection and conservation of sea turtle nesting beaches would minimize development encroachment on nesting and foraging habitat, which would be a long-term benefit to birds, sea turtles, terrestrial wildlife, and other species that use the beach habitat. Furthermore, benefits are expected for sea turtles as the high-density nesting habitat would be preserved. This project would eliminate future threats to the nesting habitat such as light disturbance and development for the life of the project. Protected seabirds and beach-dwelling mammals would also benefit as beach habitat would be protected from development. Beach habitats contribute to the quantity and quality of adjacent shallow water habitats that serve as nurseries or forage areas for some finfish species. The beach–shallow water interface also provides nutrient exchange to aquatic habitats. Protecting these habitats could result in a long-term benefit to these species and indirectly benefit the food chain that relies on the health of adjacent shallow water areas.

4.4.4.3.3 Human Uses and Socioeconomics

Section 6.4.7.3.3 of the PDARP/PEIS, which describes the impacts to socioeconomic resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to enhance sea turtle hatchling productivity and restore and conserve natural habitat, specifically through land conservation activities, were described as having minor to moderate adverse impacts and benefits to socioeconomic resources. This project is consistent with these finding.

Conserving habitat by acquiring property through fee acquisition would permanently limit the amount and type of development that would be permitted on these lands, and the management and the intensity of use on these properties would likely change. Acquisition and conservation activities could have long-term, minor impacts to socioeconomics due to changes in development activities, spending, and taxes. The transactions would be negotiated or arranged between willing parties and, as such, are not expected to give rise to adverse socioeconomic impacts to those who choose to engage in such transactions. This land-based project would not affect fisheries. Once acquired, the refuge and partners would manage these properties for the benefit of the environment and the public. Where applicable, implementing partners would comply with all laws pertaining to the protection of cultural resources if present. Benefits to tourism and recreational use are expected as recreation would be allowed within the refuge as long as it is compatible with, and does not detract from, the mission of the refuge or the purposes for which it was established (USFWS 2015). Over the long-term, this project could result in healthy coastal ecosystems and provide wildlife enthusiasts with increased wildlife viewing opportunities.

4.4.4.4 Reducing Sea Turtle Entanglement from Recreational Fishing Debris

The goal of this project is to reduce sea turtle injury and mortality from entanglement in discarded or lost recreational fishing gear. The project would begin by identifying hotspots and problem areas for sea turtle entanglement in discarded/lost recreational fishing gear across the Gulf of Mexico. Identified debris hot spots would be targeted for cleanup efforts. Cleanup efforts may be one-time or multiple events and would be implemented through grants to state or local governments, nongovernmental organizations, or other stakeholders. The reduction of future entanglement would be accomplished through education and outreach as well as facilitation of proper debris disposal including monofilament disposal containers and educational materials developed in coordination with partners. The reduction of injury and mortality would benefit sea turtles, particularly Kemp's ridley, loggerhead, green, and hawksbill turtles.

The impacts from the project are all beneficial. Benefits to physical, biological, and human use and socioeconomic resources may result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.4.4.1 Physical Resources

Section 6.4.7.4.1 of the PDARP/PEIS, which describes the impacts to physical resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures were described as having no adverse impacts or benefits to physical resources. This project is consistent with these findings.

This approach is anticipated to involve evaluating recreational fishing hotspots for debris and implementing clean-up in specific locations. Areas targeted for clean-up would include fishing piers, jetties, reefs (both natural and artificial), or any other in-water structure that accumulates recreational fishing gear debris that has the potential to entangle sea turtles.

4.4.4.4.2 Biological Resources

Section 6.4.7.4.2 of the PDARP/PEIS, which describes the impacts to biological resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures were described as providing long-term benefits and short-term, minor adverse impacts to biological resources. This project is consistent with these findings.

Minor, short-term adverse impacts may be expected as gear removal may result in disturbance to habitats. These negative impacts would be very local to the area from where the gear is being removed. Benefits are expected due to reduced entanglement as a result of reduction of the amount of marine debris in waterways. This action would result in reduced sea turtle mortalities from entanglement and ingestion. In addition to sea turtles, these benefits would extend to marine mammals, bird species, and any other species that can become entangled in discarded or lost fishing gear.

4.4.4.4.3 Human Uses and Socioeconomics

Section 6.4.7.4.3 of the PDARP/PEIS, which describes the impacts to socioeconomic resources from restoration approaches intended to restore sea turtles, is incorporated here by reference. Impacts from projects intended to reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures were described as potentially providing long-term benefits or short-term and long-term minor adverse impacts to socio-economic resources, depending on the specific restoration project implemented. Additional analyses of project specific activities (recreational fishing debris removal) indicated that this project would provide benefits for socioeconomics and no adverse impacts.

There are no anticipated impacts to land and marine management associated with this marine debris removal project. The project would not adversely and/or disproportionately affect minority or low-income populations and its implementation may likely benefit surrounding communities equally.

Table 4-6: Impact summary of evaluated alternatives for Sea Turtles.

ALTERNATIVE	PHYSICAL RESOURCES				BIOLOGICAL RESOURCES				HUMAN USE AND SOCIOECONOMIC RESOURCES								
	Geology and Substrates	Hydrology and Water Quality	Air Quality	Noise	Habitats	Wildlife Species (birds)	Marine and Estuarine Fauna	Protected Species	Socioeconomics/ Environmental Justice	Cultural Resources	Infrastructure	Land and Marine Management	Tourism and Recreational Use	Fisheries	Marine Transportation	Aesthetics and Visual Resources	Public Health and Safety
Sea Turtles																	
Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery	NE	NE	NE	NE	NE	NE	+	+	NE	NE	NE	NE	NE	NE	NE	NE	NE
Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices	s	s	NE	NE	s	NE	+/ s	+	NE	NE	NE	NE	NE	NE	NE	NE	NE
Long-term Nesting Beach Habitat Protection for Sea Turtles	+	+	NE	NE	+	+	+	+	l	NE	NE	+	+	NE	NE	NE	NE
Reducing Sea Turtle Entanglement from Recreational Fishing Debris	NE	NE	NE	NE	+/ s	+	+	+	+	NE	NE	NE	+	+	NE	NE	NE

Notes: + -Beneficial effect; NE -No effect; s - short-term, minor adverse effect; l – long-term, minor adverse effect

4.4.5 Marine Mammal Project Alternatives

This analysis incorporates by reference the relevant portions of Section 6.4.9 of the PDARP/PEIS. The PDARP/PEIS provides programmatic evaluation of the environmental consequences of the Restoration Approaches for the Marine Mammals Restoration Type that are considered in this RP/EA and are incorporated by reference here. This section presents the environmental consequences of the proposed actions in context of the project-specific affected environment described in Section 4.3. Table 4-7 provides a summary of the Marine Mammals Restoration Type impacts analysis.

After preliminary investigation, some resource categories under the Marine Mammals Restoration Type alternatives were determined to be either unaffected or minimally affected by the restoration actions being proposed for this Restoration Type. Accordingly, these resources are discussed briefly below. Only those resource categories for which potential, adverse impacts are expected are discussed in detail in this RP/EA. To avoid redundant or unnecessary information, resource categories and topics that are not expected to be affected by a proposed restoration alternative are not analyzed further under that a given project.

Resource categories not analyzed in detail for the Marine Mammals Restoration Type here are identified below, with brief rationale for non-inclusion:

- **Wildlife Species:** Restoration alternatives related to the Marine Mammals Restoration Type mostly involve planning and data collation but when field activities are proposed, they are focused offshore and therefore would not impact other wildlife species (birds). As a result, this resource was not carried forward for detailed analysis.
- **Cultural Resources:** Restoration alternatives related to the Marine Mammals Restoration Type mostly involve planning and data collation activities with minimal field activities focused offshore; therefore they would not impact cultural resources. As a result, this resource area was not carried forward for detailed analysis.
- **Land and Marine Management:** Restoration alternatives related to the Marine Mammals Restoration Type mostly involve planning and data collation activities with minimal field activities focused offshore; therefore they would not impact land and marine management. As a result, this resource area was not carried forward for detailed analysis.
- **Tourism and Recreational Use:** Restoration alternatives related to Marine Mammals Restoration Type mostly involve planning and data collation activities with minimal field activities focused offshore; therefore they would not impact tourism and recreational use. Any field efforts associated with the project would not be an increase above existing levels of activity. As a result, this resource area was not carried forward for detailed analysis.
- **Fisheries:** Restoration alternatives related to the Marine Mammals Restoration Type mostly involve planning and data collation activities with minimal field activities focused offshore; therefore they would not impact fisheries. As a result, this resource area was not carried forward for detailed analysis.

4.4.5.1 Reducing Impacts to Cetaceans during Disasters by Improving Response Activities

This project would improve and enhance response and assessment activities for any Gulf of Mexico cetacean species threatened by anthropogenic and natural disasters in the Gulf of Mexico thorough gap analysis and risk assessment, improved planning and protocol development, and development of new tools and techniques to minimize or reduce injury and mortality. An area-specific disaster response gap analysis, risk assessment, and protocol development would be performed to identify areas in the current stranding response network that would benefit from additional support, including staffing, training, equipment, communications, and expertise. The second project activity would increase the capacity of the marine mammal stranding network to prevent and respond to mass strandings. This would include addressing capacity needs by purchasing equipment necessary to respond to mass strandings and deploying equipment caches for an effective response. A third activity would enhance the ability to respond, investigate, and assess the health of cetaceans during disasters in the Gulf of Mexico through scientific studies and the development or application of tools, techniques, and standard protocols addressing detection, response, assessment, mitigation, and monitoring. This would include a feasibility study of an early warning system for mass strandings using a near real time PAM notification system. The implementation of disaster response and preparedness measures would improve the survival and health outcomes of marine mammal populations injured by the DWH spill.

The impacts from the project are beneficial and adverse impacts are minor. Benefits to the biological environment and human uses and socioeconomics may result if this project were implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.5.1.1 Physical Resources

Section 6.4.9.3.1 of the PDARP/PEIS, which describes the impacts to physical resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended to increase marine mammal survival through better understanding of causes of illness and death as well as early detection and intervention for anthropogenic and natural threats were described as causing short-term, minor adverse impacts to physical resources. This project is consistent with these findings.

This project may have short-term, minor adverse effects on geology, substrates, and water quality during stranding responses due to use of temporary pools for rehabilitation of stranded mammals, contamination (e.g., from wastes or pathogens), and carcass burial on site. This project would have no effect on the local soundscape as no construction or noise-generating activities are anticipated as a consequence of improved disaster response activities. This is consistent with the finding in the environmental impact statement (EIS) on the Marine Mammals Health and Stranding Response Program (NMFS 2009c).

4.4.5.1.2 Biological Resources

Section 6.4.9.3.2 of the PDARP/PEIS, which describes the impacts to biological resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended to increase marine mammal survival through better understanding of causes of illness and death, as well as early detection and intervention for anthropogenic and natural threats, were described as causing long-term benefits and short-term, minor adverse impacts to biological resources. This project is consistent with these findings.

This project may have short-term, minor adverse impacts to habitats, marine and estuarine fauna, and protected species incidental with response activities. For example, habitat disturbance may increase for activities such as rescue attempts in coastal areas and associated increases in boat travel in nearshore areas. Rescue attempts and associated increases in travel and activity may result in accidental injury to other animals during the response. However, improved response would likely increase the success of rescue, rehabilitation, and release of live marine mammals. Marine mammal stranding data, as well as other data collected by enhanced stranding networks, would better guide NMFS and other natural resource managers in managing and protecting marine mammals and their habitat. Therefore, this restoration approach would also provide benefits to protected species. This is consistent with the finding in the EIS on the Marine Mammals Health and Stranding Response Program (NMFS 2009c) and associated ESA consultation with NMFS.

4.4.5.1.3 Human Uses and Socioeconomics

Section 6.4.9.3.3 of the PDARP/PEIS, which describes the impacts to socioeconomic resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended to increase marine mammal survival through better understanding of causes of illness and death as well as early detection and intervention for anthropogenic and natural threats were described as causing long-term, minor adverse impacts and benefits to socioeconomic resources. Additional analyses of the project specific activities indicated that adverse impacts to socioeconomics are not anticipated; rather, benefits should occur.

The project would not adversely and/or disproportionately affect minority or low-income populations and its implementation would likely benefit surrounding communities equally by potentially creating job opportunities with the marine mammal stranding network. This is consistent with the finding in the EIS on the Marine Mammals Health and Stranding Response Program (NMFS 2009c).

4.4.5.2 Reduce Impacts of Anthropogenic Noise on Cetaceans

This project aims to reduce the anthropogenic noise exposure to cetaceans in priority areas of the Gulf of Mexico through risk assessments, data collection, and the development of area-specific restoration implementation plans for noise reduction. The first project activity would focus on moving existing noise reduction technologies and prototypes towards implementation in the Gulf. The project would utilize existing report recommendations, literature, and technical work groups to identify measures that are ready for implementation or trial field studies. The second project activity would identify priority areas for implementing restoration actions that prevent or reduce noise impacts to cetaceans by establishing a working group to conduct a risk assessment based on best-available information for noise and cetacean populations in the Gulf of Mexico. The third activity would maintain the five existing Gulf of Mexico PAM arrays. Additional short-term arrays would also be deployed utilizing anchors and may be moved on a one to two-year basis. The fourth project activity would develop and implement a specific restoration implementation plan for preventing and/or reducing noise in each key area based on the information and knowledge gained from the project.

The impacts from the project are largely beneficial and adverse impacts are minor. Benefits to physical and biological environments and human use and socioeconomic resources would result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.5.2.1 Physical Resources

Section 6.4.9.4.1 of the PDARP/PEIS, which describes the impacts to physical resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended measure noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals were described as having short and long-term benefits to physical resources. Additional analysis of the project activities indicated that there may be localized, short-term, minor adverse impacts on geology, substrates, and noise.

Short-term, minor adverse impacts could occur due to deployment and monitoring of PAM equipment, including installation of anchors on the sea floor and mooring lines to support the equipment. This is consistent with evaluations by the National Data Buoy Center (NOAA NDBC 2018) programmatic EA. The project team would implement BMPs to minimize the likelihood and severity of disturbance. This project would have no effect on hydrology and water quality as there are no discharge activities planned. Reductions in anthropogenic noise (e.g., noise from commercial ships and recreational watercraft) would be a benefit anticipated as a result of the eventual implementation of strategic plans that can be used to reduce ambient or acute noise.

4.4.5.2.2 Biological Resources

Section 6.4.9.4.2 of the PDARP/PEIS, which describes the impacts to biological resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended measure noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals were described as causing long-term benefits and short-term, minor adverse impacts to biological resources. This project is consistent with these findings.

Benthic habitats could be disrupted during deployment of the PAM equipment, which includes installation of anchors on the sea floor. Impacts would be localized and short-term. Increased vessel activity for deploying and monitoring effects of noise may result in increases in direct interactions with marine mammals, however this is expected to be minimal given the limited number of trips (one to two per year) and potential for combining such efforts with other cruises. This evaluation is consistent with evaluations by the National Data Buoy Center (NOAA NDBC 2018) programmatic EA for benthic habitats and marine mammal affects. The project team would implement measures to reduce the likelihood and severity of disturbance. Benefits to marine mammals would include reduction of anthropogenic ocean noise, which could help marine mammals maintain a viable population. There are no anticipated impacts to marine and estuarine fauna as there is no interaction with in-water activities.

4.4.5.2.3 Human Uses and Socioeconomics

Section 6.4.9.4.3 of the PDARP/PEIS, which describes the impacts to socioeconomic resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended measure noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals were described as causing potential long-term, minor to moderate indirect adverse impacts to socioeconomic resources. This project is consistent with these findings.

Depending on outcomes of the industry engagement and the strategies developed to reduce noise impacts on marine mammals, marine transportation industries may change behaviors, which could result in short-term minor impacts to costs. However, noise reducing strategies can benefit shipping industries, since typical noise reduction technologies focus on creating efficient operation for large ships. Updated, efficient ships could decrease utilization costs for shipping companies. This project is only gathering data and disseminating information to the industry. Implementation of new technologies and equipment would not be required, but would be provided as an option to the industry.

4.4.5.3 Reduce and Mitigate Vessel Strike Mortality of Cetaceans

This project aims to decrease the relative risk of vessel collisions with offshore cetacean species injured by the DWH oil spill, especially large whales, in the offshore waters of the Gulf of Mexico. To appropriately focus vessel strike risk reduction activities, this project would first conduct planning analyses to establish vessel activity in the Gulf, consolidate data for characterizing offshore cetacean distribution, and then combine vessel and cetacean data to identify areas of relative concern for collision risk. This activity would result in a catalog of spatio-temporal areas of concern where there is elevated risk of whale-vessel collisions in the Gulf of Mexico. The second activity would identify high-risk areas and restoration activities that would sustainably and most effectively reduce the risk of vessel collision for large whales and, to the extent possible, other offshore cetacean populations through collaborative partnerships. This would include using a shipping liaison to work directly with industry to identify, test, and implement potential measures. The third activity would be the implementation of the selected risk reduction measures according to the recommendations and priorities developed in partnership with industry.

The impacts from the project are largely beneficial. Benefits to the physical, biological, and human uses and socioeconomics would result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.5.3.1 Physical Resources

Section 6.4.9.7.1 of the PDARP/PEIS, which describes the impacts to physical resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended to reduce injury and mortality of marine mammals from vessel collisions were described as causing few adverse impacts nor beneficial effects to physical resources. Additional analyses of project specific activities indicated that this project would have neither adverse nor beneficial impacts.

This project would have no effects on geology and substrates as there are no bottom-disturbing activities planned. This project would have no effects on hydrology and water quality as there are no discharge-related activities planned. Implementation of measures such vessel speed reductions could impact noise emissions, the degree to which would be dependent upon the scale of the measures and would be evaluated if proposed at a later time.

4.4.5.3.2 Biological Resources

Section 6.4.9.7.2 of the PDARP/PEIS, which describes the impacts to biological resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended to reduce injury and mortality of marine mammals from vessel collisions were described as causing minor, indirect adverse impacts to biological resources. Additional analyses of project specific activities indicated that this project would have no impacts.

No effects are expected for habitats because there are no construction or equipment deployment activities planned. It is also anticipated that there would be no effect on marine and estuarine fauna as few interact with large vessels. There may be long-term benefits to protected species, particularly Gulf of Mexico Bryde’s whales, with a reduction of marine mammal injury and mortality from vessel collisions. The population of Gulf of Mexico Bryde’s whales in the northern Gulf of Mexico is very small, with markedly low genetic diversity. As such, any reduction in injury or mortality from vessel collisions is important for this population. Reductions in vessel collisions may also have benefits for sperm whales, as well as small cetaceans such as bottlenose dolphins. Adopting measures to reduce the incidences of ship strikes is expected to be an effective means to reduce the number and severity of ship strikes on marine mammals and promote their population growth and recovery.

4.4.5.3.3 Human Uses and Socioeconomics

Section 6.4.9.7.3 of the PDARP/PEIS, which describes the impacts to socioeconomic resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended to reduce injury and mortality of marine mammals from vessel collisions were described as causing long-term, minor to moderate adverse impacts to socioeconomics. This project is consistent with these findings.

Long-term, minor to moderate adverse impacts could occur to marine transportation resources if strategies are developed to identify voluntary measures that could include reduced speeds or rerouting. Impacts may include increased costs to commercial operators that volunteer to observe these measures. A shipping industry liaison position would work collaboratively on strategies and education to minimize these adverse impacts.

4.4.5.4 Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns

To assess the health, habitat use, and movement patterns of Gulf of Mexico small shelf cetaceans, this project would develop, use, and refine alternative methodology to conduct health/veterinary assessments in deeper water. The project activities would include health assessments and satellite tagging on bottlenose dolphin and Atlantic spotted dolphin stocks’. Sampling would occur on 10-15 dolphins over a two week sampling period twice per year, in years one, three, and five. As a result of this project, health assessments on approximately 60 to 90 dolphins, including telemetry data, where possible, would be obtained. These data would be analyzed and summarized into a report to provide assessment on the impacts of current and emerging stressors on small cetaceans and refine restoration strategies for these stocks/species. Secondarily, the project would develop and refine alternative methodology to conduct health assessments in deeper water for coastal and shelf cetaceans. Recommendations of refined methods to safely capture, assess, and tag small cetaceans in open water environments would be summarized.

The impacts from the project are largely beneficial and adverse impacts are minor. Benefits to the biological environment would result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.5.4.1 Physical Resources

Section 6.4.9.3.1 of the PDARP/PEIS, which describes the impacts to physical resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended to increase marine mammal survival through better understanding of causes of illness and death were described as causing short-term, minor adverse impacts to physical resources. Additional analysis of the project specific activities indicated that there would be no adverse impacts to physical resources.

There are no bottom-disturbing activities and no discharge-related activities planned that would affect substrates or water quality. There are no construction or noise-generating activities are anticipated to affect the noise environment.

4.4.5.4.2 Biological Resources

Section 6.4.9.3.2 of the PDARP/PEIS, which describes the impacts to biological resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended to increase marine mammal survival through better understanding of causes of illness and death were described as causing long-term benefits and short-term, minor adverse impacts to biological resources. This project is consistent with these findings.

This project may have short-term, adverse impacts on protected species as project activities include nonlethal takes of cetaceans. Field project activities would include performing veterinary assessments and deploying satellite tags on northern Gulf of Mexico coastal and continental shelf small cetaceans. Additionally, this project may benefit protected species as activities would collect data and fill data gaps to increase marine mammal survival through better understanding causes of illness, death, and of habitat use and movement patterns. Health assessment data may also identify key stressors to target for restoration in order to restore and support resilient populations. There may be no adverse impacts on habitats nor marine and estuarine fauna as project activities are focused primarily on the collection of data on individual cetaceans. This evaluation is consistent with the MMPA research permits held by the NOAA Southeast Fisheries Science Center.

4.4.5.4.3 Human Uses and Socioeconomics

Section 6.4.9.3.3 of the PDARP/PEIS, which describes the impacts to socioeconomic resources from restoration approaches intended to restore marine mammals, is incorporated here by reference. Impacts from projects intended to increase marine mammal survival through better understanding of causes of illness and death were described as causing long-term, minor adverse impacts and benefits to socioeconomic resources. Additional analysis of project specific activities indicated that it would have no effect on socioeconomics as the project would be focused primarily on the collection of data on individual cetaceans. This project does not anticipate the creation of job opportunities. Health and safety of personnel involved in the project would follow any permit requirements.

Table 4-7: Impact summary of evaluated alternatives for Marine Mammals.

ALTERNATIVE	PHYSICAL RESOURCES				BIOLOGICAL RESOURCES				HUMAN USE AND SOCIOECONOMIC RESOURCES								
	Geology and Substrates	Hydrology and Water Quality	Air Quality	Noise	Habitats	Wildlife Species (birds)	Marine and Estuarine Fauna	Protected Species	Socioeconomics/ Environmental Justice	Cultural Resources	Infrastructure	Land and Marine Management	Tourism and Recreational Use	Fisheries	Marine Transportation	Aesthetics and Visual Resources	Public Health and Safety
Marine Mammals																	
Reducing Impacts to Cetaceans during Disasters by Improving Response Activities	s	s	NE	NE	s	NE	s	+/s	+	NE	NE	NE	NE	NE	NE	NE	NE
Reduce Impacts of Anthropogenic Noise on Cetaceans	s	NE	NE	+/s	s	NE	NE	+/s	NE	NE	NE	NE	NE	NE	+/s	NE	NE
Reduce and Mitigate Vessel Strike Mortality of Cetaceans	NE	NE	NE	NE	NE	NE	+	+	NE	NE	NE	NE	NE	NE	l	NE	NE
Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns	NE	NE	NE	NE	NE	NE	NE	+/s	NE	NE	NE	NE	NE	NE	NE	NE	NE

Notes: + -Beneficial effect; NE -No effect; s - short-term, minor adverse effect; l – long-term, minor adverse effect

4.4.6 Mesophotic and Deep Benthic Communities Project Alternatives

The PDARP/PEIS Section 6.4.11 provides programmatic evaluation of the environmental consequences of the Restoration Approaches for the MDBC Restoration Type. That analysis is considered in this RP/EA and incorporated by reference here. This section presents the environmental consequences of the proposed actions in context of the affected environment described in Section 4.3. Table 4-8 provides a summary of the MDBC Restoration Type impacts analysis.

After preliminary review, some resource categories under the MDBC Restoration Type alternatives were determined to be either unaffected or minimally affected by the restoration actions being proposed for this Restoration Type. Accordingly, these resources are discussed briefly below. Only those resource categories for which potential, adverse impacts are expected are discussed in detail in this RP/EA. To avoid redundant or unnecessary information, resource categories and topics that are not expected to be affected by a proposed restoration alternative are not analyzed further under a given project.

Resource categories not analyzed in detail for the MDBC Restoration Type are identified below, with brief rationale for non-inclusion:

- **Hydrology and water quality:** Restoration alternatives related to the MDBC Restoration Type generally cause no discharge of harmful waste material into the water column and thus are expected to have no impact on hydrology and water quality. As a result, this resource area was not carried forward for detailed analysis.

- **Wildlife species (birds):** Restoration alternatives related to the MDBC Restoration Type occur in water depths ≥165 feet (≥50 meters) and would not impact wildlife species. As a result, this resource area was not carried forward for detailed analysis.
- **Socioeconomics and environmental justice:** Restoration alternatives related to the MDBC Restoration Type would not have any impact to the population, ethnicity, or jobs within the adjacent communities; therefore, this project would not result in impacts to socioeconomics and environmental justice. As a result, this resource area was not carried forward for detailed analysis.
- **Marine Transportation:** Restoration alternatives related to the MDBC Restoration Type do not involve shipping or military vessels. Research vessels already operate in the Gulf of Mexico regularly, therefore this resource area was not carried forward for detailed analysis.

The initial mapping and ground-truthing activities involving sonar and ROV to be performed for the MDBC projects have previously been evaluated in the following documents, which are incorporated by reference:

- Final Programmatic Environmental Assessment for the Office of Coast Survey Hydrographic Survey Project (NOAA 2013a).
- Integrated Ocean Observing System Program Programmatic Environmental Assessment (NOAA 2016c).
- Programmatic Environmental Assessment of Field Operations in the Southeast and Gulf of Mexico National Marine Sanctuaries (ONMS 2018).
- Flower Garden Banks National Marine Sanctuary Expansion Draft Environmental Impact Statement (ONMS 2016).
- Flower Garden Banks National Marine Sanctuary Final Management Plan Environmental Assessment (ONMS 2012).

All subsequent activities would be further evaluated to determine if activities were evaluated for previous authorizations and permits. Some activities depending on determination of locations for action would require coordination with or clearances from NMFS, BOEM/oil and gas industry operators, U.S. Navy, USCG, and/or the USACE.

4.4.6.1 Mapping, Ground-Truthing, and Predictive Habitat Modeling

The goals of this project would be to document the abundance and distribution of MDBC; to gain a better understanding of their extent, species composition, and habitat characteristics; and to inform future restoration planning. The planning stage would establish performance criteria for each of the specific implementation activities and site selection criteria, and would include a thorough assessment of existing data. Mission and mobilization plans with project sequencing and a logistics strategy would be developed with the intent to implement field work in a manner designed to minimize environmental consequences. The mapping and ground-truthing activities that would be undertaken through this project would include surface (i.e., ship-based) operations, subsurface (i.e., ROV, AUV, HOV, technical diving) operations, and sonar operations, and could also include electromagnetic operations and/or laser operations. Data collection and surveys would be conducted using an iterative process including high-resolution mapping and visual ground-truthing to document the distribution and abundance of MDBC habitats and to improve existing habitat suitability models. A full suite of available technologies would be evaluated for use in mapping: ship-mounted, towed, and AUV-mounted side scan sonars; synthetic aperture sonars; multibeam echosounders; sub-bottom profilers; water column acoustic profilers; and high-resolution downward-looking cameras and strobes for the assembly of photomosaics. Ground-truthing would be similarly expansive with the use of ROVs, towed optical sensors, technical divers, and/or human-occupied submersible vehicles. This project would also ground-truth existing predictive habitat models and produce refined northern Gulf of Mexico regional-scale predictive models of habitat suitability for mesophotic and deep water coral species. Ground-truthing would not only verify acoustic mapping but would also allow for the opportunistic collection of samples in support of biological assessments of genetic connectivity, life history characteristics, and trophodynamic linkages among ecosystem components. Data collected would provide fundamental information to prioritize and support protection and management activities and to target locations for direct restoration.

This project would have beneficial effects to physical and biological resources, and to human uses and socioeconomics; however, there may be some minor adverse impacts. BMPs identified in required permits, consultations, or environmental reviews would be followed to reduce or eliminate potentially adverse environmental impacts. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.6.1.1 Physical Resources

This project includes activities that are not specifically addressed in the PDARP/PEIS. Those actions are addressed here.

The project may have short-term, localized, and minor adverse impacts to geology, substrates, and noise, with long-term benefits to geology and substrates. Mapping, ground-truthing, and predictive habitat modeling project activities may result in short-term, localized, and minor adverse impacts to the benthos from which samples (e.g., rock samples, sediment cores) would be collected. Mapping, ground-truthing, and predictive habitat modeling project activities would provide fundamental information about the abundance and distribution of MDBC necessary to support their protection and management. In addition, the project would target locations for subsequent active restoration activities such as substrate placement and coral propagation. As described in the PDARP/PEIS, mapping existing MDBC can better inform restoration efforts including the use of protective measures and management to reduce threats to MDBC. Characterization of these communities would help maintain ecological integrity and increase ecosystem resilience resulting in long-term benefits to the geology and substrates within these communities as well as to associated communities. The mapping and ground-truthing activities that would be undertaken through this project would include sonar operations (e.g., ship-mounted, towed, and AUV-mounted side scan sonars; synthetic aperture sonars; multi-beam echo-sounders) that may result in short-term, minor adverse impacts to the acoustic environment in the areas that would be mapped. This evaluation is consistent with previous evaluations completed for similar NOAA actions involving sonar and ROVs (NOAA 2013a and 2016b).

4.4.6.1.2 Biological Resources

This project includes activities that are not specifically addressed in the PDARP/PEIS. Those actions are addressed here.

This project may have short-term, minor adverse impacts to marine fauna and protected species as well as long-term benefits to habitats, marine fauna, and protected species. The project activities may result in short-term, localized, minor adverse impacts to the benthic habitats and communities from which samples (e.g., coral fragments, sediment cores) would be collected. Project activities would provide fundamental information about the abundance and distribution of MDBC necessary to support their protection and management. These activities would also target locations for subsequent active restoration activities such as substrate placement and coral propagation. As described in the PDARP/PEIS, mapping existing MDBC can better inform restoration efforts including the use of protective measures and management to reduce threats to MDBC. Characterization of these communities would help maintain ecological integrity and increase ecosystem resilience in MDBC which may result in long-term benefits to these communities as well as to associated communities.

This project may also have short-term, minor adverse impact to protected species such as marine mammals and sea turtles based on the adverse impacts to the noise environment described in Section 4.3.1.3.1. However, there may be long-term benefits through the protection and management of these habitats utilized by protected species (e.g., sea turtles that utilize mesophotic coral communities as foraging habitats). This evaluation is consistent with previous evaluations completed for similar NOAA actions involving sonar and ROVs (NOAA 2013a and 2016b).

4.4.6.1.3 Human Uses and Socioeconomics

This project includes activities that are not specifically addressed in the PDARP/PEIS. Those actions are addressed here.

It is expected that this project would not adversely impact marine management, tourism and recreation, and fisheries resources but would have long-term benefits to these resources. This project would provide detailed information about known high-priority MDBC necessary to support their protection and management, as well as to target locations for subsequent active restoration activities, such as substrate placement and coral propagation, leading directly to long-term benefits to marine management. Project activities would likely lead to improved populations of marine organisms and subsequently increased recreational enjoyment of those resources which may result in long-term benefits by improving opportunities for tourism and recreation in these areas. Indirectly this project may provide long-term benefits to fish species that inhabit and utilize these habitats thus benefitting recreational and commercial fisheries such as grouper and snapper, red and golden crab, royal red shrimp, blackbelly rosefish, and wreckfish, among others.

The project may have long-term, minor adverse impacts to cultural resources, but also with potential long-term benefits to cultural resources. While disturbance to seafloor cultural resources (e.g. shipwrecks) could occur during offshore activities utilizing underwater equipment (i.e. ROVs), caution and use of industry best practices during subsea operations make impacts unlikely. In addition, existing mapping of cultural resources would be utilized as part of the planning for any activities where there is the potential for disturbance or positive benefit to these resources. Mapping could reveal previously unknown cultural resources. Coordination would be pursued during restoration planning if new cultural resources sites were identified or if activities would further analyze known cultural resource sites.

4.4.6.2 Habitat Assessment and Evaluation

The goal of this project would be to fill data gaps, identify ongoing impacts, inform and identify trends for future impacts, and determine baseline conditions through a series of periodic, multi-disciplinary, benthic surveys to examine the mesophotic and deep benthic environment and the organisms that live in those zones, including the ways they change naturally, or through direct restoration actions, in space and over time. This project would document changes to structure and function of MDBC impacted by the DWH oil spill and by other natural and anthropogenic threats, relative to healthy reference habitats (soft sediment communities and corals) using established methods and metrics. These include: defining the population structure and level of genetic diversity of mesophotic and deep-sea coral species the Trustees may consider for protection or active restoration in the northern Gulf of Mexico; revealing potential source/sink populations to identify source populations for natural recruitment and for restoration through transplantation; by filling gaps in understanding of the relative rate and directionality of genetic exchange among coral populations; establishing recovery trajectories and restoration targets (natural or restored) through high-resolution image analysis of individual coral colonies and by determining ages and growth rates of mesophotic and deep-sea corals; and monitoring changes to sediment communities to establish recovery trajectories for mesophotic and deep benthic habitats.

This project would determine environmental baseline conditions and changes over time around impacted and healthy deep-sea and mesophotic environments, and develop dispersal models for coral larvae. The project would require establishment and maintenance of long-term monitoring and sentinel sites based on documented injury (both oil spill related and resulting from other natural and anthropogenic threats), reference, and active restoration or protection as well as conducting and/or assimilating regional oceanographic characterizations.

The impacts from the project are largely beneficial and adverse impacts are minor. Benefits to the physical and biological resources, and human uses and socioeconomics may result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed to reduce or eliminate potentially adverse environmental impacts. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.6.2.1 Physical Resources

This project includes activities that are not specifically addressed in the PDARP/PEIS. Those actions are addressed here.

The project may have short-term, localized, and minor adverse impacts to geology, substrates, and noise, with long-term benefits to geology and substrates. Habitat assessment and evaluation activities may result in short-term, localized, minor adverse impacts to the benthos from which samples (e.g., rock samples, sediment cores) would be collected or on which/into which landers or moorings would be deployed. MDBC characterization as part of this project would better inform restoration efforts including the use of protective measures and management to reduce threats to

MDBC. Habitat assessments would help maintain ecological integrity and increase ecosystem resilience in MDBC which may result in long-term benefits to the geology and substrates within these communities as well as to associated biological communities. The habitat assessment and evaluation activities that would be undertaken through this project would include sonar operations (e.g., ship-mounted, towed, and AUV-mounted side scan sonars; synthetic aperture sonars; and multi-beam echo-sounders) that may result in temporary, short-term, minor changes to the acoustic environment in the areas that would be surveyed, leading to disturbances to fish, sea turtles, and marine mammals. This evaluation is consistent with previous evaluations involving sonar and ROVs (NOAA 2013a and 2016b).

4.4.6.2.2 Biological Resources

This project includes activities that are not specifically addressed in the PDARP/PEIS. Those actions are addressed here.

This project is expected to have long-term benefits as well as have short-term, minor adverse impacts to habitats, marine fauna, and protected species. The project activities may result in short-term, localized, minor adverse impacts to the coral colonies, or the benthic communities/habitats from which samples (e.g., coral samples for genetics or reproductive studies, sediment cores) would be collected or on which/into which landers or moorings would be deployed. Activities conducted as part of this project would better inform restoration efforts including the use of protective measures and management to reduce threats to MDBC. This project may also have short-term, minor adverse impact to protected species such as marine mammals and sea turtles based on the adverse impacts to the noise environment described in Section 4.3.1.3.1. However, project activities would help maintain ecological integrity and increase ecosystem resilience in MDBC that would result in long-term benefits to these communities as well as associated marine fauna and protected species that inhabit them (e.g., sea turtles that utilize mesophotic coral communities as foraging habitats). This evaluation is consistent with previous evaluations involving sonar and ROVs (NOAA 2013a and 2016b).

4.4.6.2.3 Human Uses and Socioeconomics

This project includes activities that are not specifically addressed in the PDARP/PEIS. Those actions are addressed here.

It is expected that this project would not adversely impact marine management, tourism and recreation, and fisheries resources but would have long-term benefits to these resources. This project would provide detailed information about known high-priority MDBC necessary to support their protection and management, as well as to target locations for subsequent active restoration activities, such as substrate placement and coral propagation, leading directly to long-term benefits to marine management. Project activities would likely lead to improved populations of marine organisms and subsequently increased recreational enjoyment of those resources which may result in long-term benefits by improving opportunities for tourism and recreation in these areas. Indirectly this project may provide long-term benefits to fish species that inhabit and utilize these habitats thus benefitting recreational and commercial fisheries such as grouper and snapper, red and golden crab, royal red shrimp, blackbelly rosefish, and wreckfish, among others.

The project may have long-term, minor adverse impacts to cultural resources, but also with potential long-term benefits to cultural resources. While disturbance to seafloor cultural resources (e.g. shipwrecks) could occur during offshore activities utilizing underwater equipment (i.e. ROV), caution and use of industry best practices during subsea operations make impacts unlikely. In addition, existing mapping of cultural resources would be utilized as part of the planning for any activities where there is the potential for disturbance or positive benefit to these resources. Mapping could reveal previously unknown cultural resources. Coordination would be pursued during restoration planning if new cultural resources sites were identified or if activities would further analyze known cultural resource sites.

4.4.6.3 Coral Propagation Technique Development

The goals of this project would be to develop methods and techniques for effective enhancement of coral recruitment and growth; to identify successful methods that could be applied at a large scale for restoration; and to directly compensate the loss of MDBC corals and associated benthic and water column communities injured by the DWH oil spill. Comprehensive implementation planning at the initiation of the project would develop detailed work plans and experimental designs, assessment of resource requirements, and budget organization. Field and lab work would test a variety of different substrates/techniques as potential colonization substrates and transplant methods to enhance the recruitment and growth of the target species identified above. These techniques may include direct *in situ* fragmentation and transplanting, among or within sites, or use of laboratory grown coral fragments. Additional *in situ* activities that would be undertaken through this project would include surface (i.e., vessel-based) operations and subsurface operations (i.e., employing ROVs, technical divers, instrumented landers or moored buoys). The *in situ* experiments would include deployments of instrumented landers at each experimental site in order to understand the environmental variables that may contribute to the success or failure of this approach and the health of the resident corals. Annual deployments would be conducted in conjunction with monitoring of earlier deployments, resident coral populations, and associated fauna. Monitoring would include use of established techniques to image the corals and communities, as well as sediment sampling for analysis of effects on the coral sediment infaunal communities. The project would identify valuable techniques and vital data for effective enhancement of coral communities across the northern Gulf of Mexico.

The impacts from the project are largely beneficial and adverse impacts are minor. Benefits to the physical and biological resources, and human uses and socioeconomics may result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed to reduce or eliminate potentially adverse environmental impacts. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.6.3.1 Physical Resources

Section 6.4.11.1.1 of the PDARP/PEIS, which describes the impacts to physical resources from restoration approaches intended to restore MDBC, is incorporated here by reference. Impacts from projects intended to place hard ground substrate and transplant corals were described as having benefits and causing short-term to long-term, minor to moderate adverse impacts to physical resources. Additional analysis of project specific activities indicated that, due to the scale of this project, there may be short-term and long-term, localized minor adverse impacts to physical resources.

The project may have short-term to long-term, localized, and minor adverse impacts to geology, substrates, and short-term minor adverse impacts to noise, with long-term benefits to geology and substrates. There may be short-term, minor adverse impacts to the substrate from sediment cores sampling and where landers or moorings would be deployed. The permanent placement of hard substrate would cover soft bottom substrate, causing long-term, minor adverse impacts to the localized area. The permanent placement of hard substrate, which is limited relative to the soft sediment substrate in the Gulf of Mexico, would provide substrate for corals to colonize, along with increased cover through transplantation leading to a long-term benefit to these coral species and associated reef fish and sessile and benthic organisms. This project may have short-term, minor adverse impacts from noise. The coral propagation technique development activities that would be undertaken through this project would include sonar operations (e.g., ship-mounted, towed, and AUV-mounted side scan sonars; synthetic aperture sonars; multi-beam echo-sounders) that may result in temporary, short-term, minor changes to the acoustic environment in the areas that would be surveyed, leading to disturbances to fish, sea turtles, and marine mammals. This evaluation is consistent with previous evaluations involving sonar and ROVs (NOAA 2013a and 2016b).

4.4.6.3.2 Biological Resources

Section 6.4.11.1.2 of the PDARP/PEIS, which describes the impacts to biological resources from restoration approaches intended to restore MDBC, is incorporated here by reference. Impacts from projects intended to place hard ground substrate and transplant corals were described as causing short-term to long-term, minor to moderate adverse impacts and long-term benefits to biological resources. Additional analyses of project specific activities indicated that there may be short-term, minor adverse impacts to habitat, marine fauna, and protected species.

Due to the small-scale of this pilot project, coral propagation technique development activities may result in short-term, localized, minor adverse impacts to the benthic habitats and communities (sessile marine fauna) from which samples (e.g., coral fragments, sediment cores) would be collected or on which/into which landers or moorings would be deployed. This project would restore injured MDBC corals and associated benthic and water column communities injured by the DWH oil spill through the development of techniques to directly restore MDBC. Direct restoration would lead to improvements to these habitats that may provide long-term benefits to these communities/habitats as well as to associated communities/habitats. Enhanced availability of substrate for corals to colonize, along with increased cover through transplantation, would not only benefit these coral species but would also benefit associated reef fish as well as sessile and benthic organisms that occur at these depths. This project could also have short-term, minor adverse impact to protected species such as marine mammals and sea turtles based on the adverse impacts to the noise environment described in Section 4.3.1.3.1. However, potential protected species that utilize these communities may also have long-term benefits if habitats are restored (e.g., sea turtles that utilize mesophotic coral communities as foraging habitats). This evaluation is consistent with previous evaluations involving sonar and ROVs (NOAA 2013a and 2016b).

4.4.6.3.3 Human Uses and Socioeconomics

Section 6.4.11.1.3 of the PDARP/PEIS, which describes the impacts to socioeconomic resources from restoration approaches intended to restore MDBC, is incorporated here by reference. Impacts from projects intended to place hard ground substrate and transplant corals were described as causing short-term to long-term, minor to moderate adverse impacts and short-term to long-term benefits to socioeconomic resources. Additional analyses of project specific activities indicated that the project would not result in any adverse impacts to marine management, tourism and recreation, nor fisheries, but may have long-term, minor adverse impacts to cultural resources.

Activities conducted as part of this project would develop techniques to directly restore mesophotic and deep coral communities allowing for more “industrial-scale” application of successful methods and techniques under future restoration plan(s) and management plans for these areas. Direct restoration of these communities may result in long-term benefits to marine management of these communities. Furthermore, these activities could lead to increased tourism and recreational opportunities in the project area. Benefits may be provided to recreational and commercial fisheries species that utilize the protected habitats (e.g. grouper and snapper).

The project may have long-term, minor adverse impacts to cultural resources, but also with potential long-term benefits to cultural resources. While disturbance to seafloor cultural resources (e.g. shipwrecks) could occur during offshore activities utilizing underwater equipment (i.e. ROVs), caution and use of industry best practices during subsea operations make impacts unlikely. In addition, existing mapping of cultural resources would be utilized as part of the planning for any activities where there is the potential for disturbance or positive benefit to these resources. Mapping could reveal previously unknown cultural resources. Coordination would be pursued during restoration planning if new cultural resources sites were identified or if activities would further analyze known cultural resource sites.

4.4.6.4 Active Management and Protection

The goals of this project would be to actively manage valuable MDBC to protect against multiple threats and to provide a framework for monitoring, education, and outreach. The project would extend education and outreach related to MDBC to the public generally; and engage agencies, stakeholders, and advisory groups with MDBC science and restoration. This would involve:

- Development of partnerships with education venues to create and display educational exhibits and associated programs about MDBC.
- Development and dissemination of content for K-12 education programs, social media, and traditional media sources.
- Assessment of educational and outreach outcomes with behavioral and attitudinal surveying.
- Collaboration with researchers to interpret science and produce educational materials.
- Evaluation of priority areas eligible for protection under various existing programs and mechanisms.
- Informing and supporting management and protection actions through data sharing and communications with strategic partners.

The project would also provide resource management and protection by directly addressing threats, including preventing damage from boat anchoring through mooring buoy installation and maintenance; improving understanding of visitor uses and reducing user conflict through evaluation and development of vessel registration and/or fishing endorsement programs; assessing and remediating threats of contaminant releases or physical impacts from abandoned or leaking oil and gas infrastructure; preventing damage by removing marine debris and derelict fishing gear where appropriate, (where site assessment indicates removal can be accomplished without resulting in more harm than benefit); supporting stable MDBC by removing invasive lionfish and other invasive species; and improving management through enhanced resource protection capacity.

The impacts from the project are largely beneficial and adverse impacts are minor. Benefits to the physical and biological resources, and human uses and socioeconomics may result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed to reduce or eliminate potentially adverse impacts. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.6.4.1 Physical Resources

Section 6.4.11.2.1 of the PDARP/PEIS, which describes the impacts to physical resources from restoration approaches intended to restore MDBC, is incorporated here by reference. Impacts from projects intended to protect and manage MDBC were described as causing short-term, minor adverse impacts and long-term benefits to physical resources depending on management actions. Additional analyses of project specific management actions indicated there may be short-term and long-term, minor adverse impacts and long-term benefits to physical resources.

The project may have short-term to long-term, localized, and minor adverse impacts to geology, substrates, and short-term minor adverse impacts to noise, with long-term benefits to geology and substrates. Short-term, localized, minor adverse impacts to the benthos may occur depending on which types of debris would be removed. The permanent placement of mooring buoys associated with the active management and protection project may cover soft bottom substrate, causing a long-term, minor adverse effect to the localized area, however the footprint of an anchoring mechanism is expected to be minimal in comparison to the benthic landscape and would not be placed on sensitive benthic habitat.

Additionally, this project may have short-term, minor adverse impacts from noise. The management activities that would be undertaken through this project would include sonar operations (e.g., ship-mounted, towed, and AUV-mounted side scan sonars; synthetic aperture sonars; multi-beam echo-sounders) that may result in temporary, short-term, minor changes to the acoustic environment in the managed areas, leading to disturbances to fish, sea turtles, and marine mammals. This evaluation is consistent with previous evaluations involving sonar and ROVs (NOAA 2013a and 2016b).

4.4.6.4.2 Biological Resources

Section 6.4.11.2.2 of the PDARP/PEIS, which describes the impacts to biological resources from restoration approaches intended to restore MDBC, is incorporated here by reference. Impacts from projects intended to protect and manage MDBC were described as causing short-term, minor adverse impacts and long-term benefits to biological resources. Additional analyses of project specific activities indicated that there may be both short-term and long-term, minor adverse impacts and long-term benefits to biological resources.

The permanent placement of mooring buoys associated with the active management and protection project may cover soft bottom substrate, causing long-term, minor adverse impacts to benthic habitats and short-term, minor adverse impacts to marine benthic fauna (e.g. sessile species) in the localized area. This project could also have short-term, minor adverse impacts to protected species such as marine mammals and sea turtles based on the adverse impacts to the noise environment described in Section 4.3.1.3.1. During planning stages, specific techniques would be reviewed and BMPs consulted to reduce these potential adverse effects. Benefits to MDBC include increases in coral cover over time (Selig and Bruno 2010) and benefits to resources such as fish biomass (Edgar et al. 2011; Harborne et al. 2008) and abundance (Jeffrey et al. 2012). Furthermore, there may be long-term benefits through the protection and management of these habitats utilized by protected species (e.g., sea turtles that utilize mesophotic coral communities as foraging habitats). This evaluation is consistent with previous evaluations completed for similar NOAA actions involving sonar and ROVs (NOAA 2013a and 2016b).

4.4.6.4.3 Human Uses and Socioeconomics

Section 6.4.11.2.3 of the PDARP/PEIS, which describes the impacts to socioeconomic resources from restoration approaches intended to restore MDBC, is incorporated here by reference. Impacts from projects intended to protect and manage MDBC were described as causing long-term moderate adverse impacts and long-term benefits to socioeconomic resources. Additional analyses of project specific activities indicated that the project would not result in any adverse impacts to marine management, tourism and recreation, nor fisheries, but may have long-term, minor adverse impacts to cultural resources but also with potential long-term benefits to cultural resources.

Increased marine management efforts may result in long-term benefits for the resource. This project would inform and enhance management actions and potential protected area designations. It would support data and content development; perform analysis and integration of data generated by other MDBC projects; coordinate relevant data sharing and communications with strategic partners such as FGBNMS, GMFMC, U.S. Navy, and BOEM; and conduct analyses such as studies of socioeconomic impacts to fishing, oil and gas, shipping, and ecosystem service/conservation value. This project would also extend the education and outreach components of existing protected area management frameworks to maintain ecological integrity and potentially increase ecosystem resilience leading to long-term benefits to marine management of these communities.

This project would build awareness among the US population of the value of, threats to, and need for protection and management of MDBC, disseminating content related to the DWH injury, importance of MDBC in the Gulf of Mexico ecosystem, species that are part of or benefit from these communities, and restoration and protection efforts. These activities may lead to improved health and conditions within MDBC and increased awareness of these communities would likely lead to an increase in visitation for recreation or tourism, resulting in positive long-term benefits to tourism and recreational use. Additionally, project activities may lead to improved populations of marine organisms living within and associated with these communities. As a result, long-term benefits may be provided to recreational and commercial fisheries (e.g. grouper and snapper).

The project may have long-term, minor adverse impacts to cultural resources, but also with potential long-term benefits to cultural resources. While disturbance to seafloor cultural resources (e.g. shipwrecks) could occur during offshore activities utilizing underwater equipment (i.e. ROV), caution and use of industry best practices during subsea operations make impacts unlikely. In addition, existing mapping of cultural resources would be utilized as part of the planning for any activities where there is the potential for disturbance or positive benefit to these resources. Mapping could reveal previously unknown cultural resources. Coordination would be pursued during restoration planning if new cultural resources sites were identified or if activities would further analyze known cultural resource sites.

4.4.6.5 Habitat Characterization at Known High Priority Sites

The objective of the habitat characterization project is to provide accurate bathymetric and habitat maps to increase knowledge of the abundance and distribution of deepwater coral communities. This would provide fundamental information to prioritize and support protection and management activities and to target locations for direct restoration. The project would conduct habitat characterization at approximately 50 known high-priority sites. These areas are distributed across the Gulf and total between 1,000 and 1,500 square miles. Habitat characterization work would use existing resources and protocols using dedicated resources (ships, ROVs, etc. engaged through cooperative agreements, interagency agreements, contracts, or and/grants). Mapping and ground-truthing could involve ship-mounted, towed and AUV-mounted side-scan sonars; synthetic aperture sonars; or multi-beam echosounders. Habitat assessment surveys would evaluate mesophotic and deep sediments, coral community condition, genetic connectivity, life history characteristics, and trophodynamic linkages. This would be accomplished through high-resolution imaging, video surveys, and biological sampling. Such characterization would facilitate, support, and evaluate performance of management, protection, and restoration activities (e.g., substrate placement, coral propagation). This would be accomplished utilizing the full suite of available technologies for mapping, ground-truthing, predictive habitat modeling, and habitat assessment and evaluation. The planning stage of this project would include an evaluation of the environmental consequences of techniques in the project's fieldwork design and identification of BMPs to minimize injury during high-resolution mapping, ground-truthing, and habitat assessment activities.

The impacts from the project are largely beneficial and adverse impacts are minor. Benefits to the physical and biological resources, and human uses and socioeconomics may result if this project was implemented. BMPs identified in required permits, consultations, or environmental reviews would be followed. Additionally, BMPs described in Appendix 6.A of the PDARP/PEIS that are relevant to this project would be applied. Through technical assistance with regulatory agencies, additional BMPs may be identified for implementation and would be catalogued in compliance documents.

4.4.6.5.1 Physical Resources

This project includes activities that are not specifically addressed in the PDARP/PEIS. This project was analyzed to have short-term, minor adverse impacts to geology, substrates, and noise with long-term benefits to geology and substrates.

Habitat characterization at known high-priority sites may result in short-term, localized, minor adverse impacts to the benthos from which samples (e.g., rock samples, sediment cores) would be collected. This project would provide detailed information about known high-priority MDBC necessary to support their protection and management and target locations for subsequent active restoration activities such as substrate placement and coral propagation. Additionally, the project would facilitate, support, and evaluate performance of management, protection, and restoration activities at high-priority sites by the management entities responsible for the sites or under by the DWH Trustees under a future restoration plan. These project activities may result in long-term benefits to the geology and substrates associated with these communities as well as to associated communities.

The mapping and ground-truthing activities that would be undertaken through this project would include sonar operations (e.g., ship-mounted, towed, and AUV-mounted side scan sonars; synthetic aperture sonars; multi-beam echo-sounders) that would result in temporary, short-term, minor adverse changes to the acoustic environment in the areas that would be mapped, leading to disturbances to fish, sea turtles, and marine mammals. This evaluation is consistent with previous evaluations completed for similar NOAA actions involving sonar and ROVs (NOAA 2013a and 2016b).

4.4.6.5.2 Biological Resources

This project includes activities that are not specifically addressed in the PDARP/PEIS. This project was analyzed to have short-term, minor adverse impacts to marine fauna and protected species as well as long-term benefits to habitats, marine fauna, and protected species.

Habitat characterization at known high-priority sites project activities could result in short-term, localized, minor adverse impacts to the coral colonies or the benthic communities from which samples (e.g., coral fragments, sediment cores) would be collected. This project could also have short-term, minor adverse impacts to protected species such as marine mammals and sea turtles based on the adverse impacts to the noise environment described in Section 4.3.1.3.1. Activities conducted as part of the project at known high-priority sites would provide detailed information about MDBC necessary to support their protection and management, as well as target locations for active restoration activities such as substrate placement and coral propagation. Project activities may lead to long-term benefits to these habitats as well as to marine fauna and protected species that utilize these communities (e.g., sea turtles that utilize mesophotic coral communities as foraging habitats). This evaluation is consistent with previous evaluations completed for similar NOAA actions involving sonar and ROVs (NOAA 2013a and 2016b).

4.4.6.5.3 Human Uses and Socioeconomics

This project includes activities that are not specifically addressed in the PDARP/PEIS. It was determined that this project may not result in any adverse impacts to marine management, tourism and recreation, nor fisheries, but there may be long-term benefits to these resources. There may be long-term, minor adverse impacts to cultural resources but the project also may result in positive benefits.

This project would provide detailed information about known high-priority MDBC necessary to support their protection and management, as well as to target locations for subsequent active restoration activities, such as substrate placement and coral propagation, leading directly to long-term benefits to marine management. Project activities would likely lead to improved populations of marine organisms and subsequently increased recreational enjoyment of those resources which may result in long-term benefits by improving opportunities for tourism and recreation in these areas.

Indirectly this project may provide long-term benefits to fish species that inhabit and utilize these habitats thus benefitting recreational and commercial fisheries (such as grouper and snapper).

While disturbance to seafloor cultural resources (e.g. shipwrecks) could occur during offshore activities utilizing underwater equipment (i.e. ROV), caution and use of industry best practices during subsea operations make impacts unlikely. In addition, existing mapping of cultural resources would be utilized as part of the planning for any activities where there is the potential for disturbance or positive benefit to these resources. Mapping could reveal previously unknown cultural resources. Coordination would be pursued during restoration planning if new cultural resources sites were identified or if activities would further analyze known cultural resource sites.

Table 4-8: Impact summary of evaluated alternatives for Mesophotic and Deep Benthic Communities.

ALTERNATIVE	PHYSICAL RESOURCES				BIOLOGICAL RESOURCES				HUMAN USE AND SOCIOECONOMIC RESOURCES								
	Geology and Substrates	Hydrology and Water Quality	Air Quality	Noise	Habitats	Wildlife Species (birds)	Marine and Estuarine Fauna	Protected Species	Socioeconomics / Environmental Justice	Cultural Resources	Infrastructure	Land and Marine Management	Tourism and Recreational Use	Fisheries	Marine Transportation	Aesthetics and Visual Resources	Public Health and Safety
Mesophotic and Deep Benthic Communities																	
Mapping, Ground-Truthing, and Predictive Habitat Modeling	+/s	NE	NE	s	+	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Habitat Assessment and Evaluation	+/s	NE	NE	s	+/s	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Coral Propagation Technique Development	+/s /l	NE	NE	s	+/s	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Active Management and Protection	+/s /l	NE	NE	s	+/l	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Habitat Characterization at Known High Priority Sites	+/s	NE	NE	s	+	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE

Notes: + - Beneficial effect; NE - No effect; s - short-term, minor adverse effect; l – long-term, minor adverse effect

4.4.7 No Action

Section 1502.14(d) of the CEQ Regulations requires the alternatives analysis to "include the alternative of No Action." CEQ states that in some cases "No Action" is "no change" from current management direction or level of management intensity. Therefore, the "No Action" alternative may be thought of in terms of continuing with the present course of action until that action is changed. Impacts of proposed actions would be compared to those impacts for the existing actions.

Under the No Action alternative, the Open Ocean TIG would not, at this time, select and implement the restoration alternatives in this restoration plan to compensate for lost natural resources or their services resulting from the DWH oil spill. Accordingly, the No Action alternative would not meet the purpose and need for implementing alternatives that address lost natural resources and their services as described in Section 5.3.2 of the PDARP/PEIS and in Section 2.2 of this document, because it would not help meet the restoration goals of the Fish, Sea Turtles, Marine Mammals, and MDBC Restoration

Types. If this plan was not implemented, none of the alternatives proposed as preferred alternatives would be selected for implementation and restoration benefits associated with these alternatives would not be achieved at this time. Under the No Action alternative past, present, and reasonably foreseeable future actions would be expected to continue. This alternative would not contribute to long-term restoration benefits to physical resources and would contribute to degradation of resources in the Gulf of Mexico. Under the No Action scenario, recovery would take much longer compared to a scenario in which restoration actions were undertaken. The impacts from the No Action alternative would largely have minor to moderate adverse impacts.

4.4.7.1 Physical Resources

Though some restoration activities have the potential to have short- and long-term, minor adverse impacts to physical resources, the overall benefits outweigh the impacts. Without the proposed restoration projects alternatives, activities related to the conservation of sea turtle nesting habitat; reducing the impacts of anthropogenic noise on cetaceans; mapping, ground-truthing, and predictive MDBC habitat modeling; MDBC habitat assessment and evaluation; enhancement of coral propagation techniques; and active management and protection of MDBC would not occur at this time. Under the No Action alternative, there would be no benefit to physical resources and short- and long-term, minor to moderate, adverse impacts would be anticipated from the continued degradation of project areas and the noise environment. Additionally, indirect impacts would include not gaining the knowledge that the proposed data collection and management activities would provide.

4.4.7.2 Biological Resources

Though some restoration activities have the potential to have short and long-term, minor adverse impacts to biological resources, the overall benefits outweigh the impacts. Without the proposed restoration project alternatives, activities related to the reduction of post-release mortality from barotrauma; improving BRDs; development of communication networks and mapping tools to reduce bycatch; restoring bluefin tuna populations; development of a Gulf of Mexico sea turtle Atlas; identifying methods for reducing sea turtle bycatch in the reef fish BLL fishery; development of methodology for in-water sea turtle data collection; development of sea turtle observation programs; reducing juvenile sea turtle bycatch in the southeast otter trawl shrimp fishery; conservation of sea turtle nesting habitat; improving cetacean disaster response activities; development of a CETACEAN platform to assess marine mammal data; reduction of impacts to cetaceans associated with anthropogenic noise; reduction of cetacean vessel strike mortality; mapping, ground-truthing, and predictive MDBC habitat modeling; MDBC habitat assessment and evaluation; enhancement of coral propagation techniques; and active management and protection of MDBC would not occur at this time. Biological resources such as sea turtles and marine mammals could require decades to fully recover naturally, while mesophotic and deep benthic habitats could take centuries. Under the No Action alternative, biological resources would not benefit from the conservation and enhanced survivorship proposed herein and would remain injured for a longer period of time. Under the no-action alternative, some recovery could result from other federal actions, but not from the federal actions being evaluated in this RP/EA. This alternative would have no beneficial impacts to biological resources and short- and long-term, moderate to major, adverse impacts would be anticipated. Additionally, indirect impacts would include not gaining the knowledge that the proposed data collection and management activities would provide.

4.4.7.3 Human Uses and Socioeconomics

Though some restoration activities have the potential to have short- and long-term, minor adverse impacts relating to human uses and socioeconomics as well as cultural resources, the overall benefits outweigh the impacts. Without the proposed Open Ocean restoration projects, activities related to the reduction of post-release mortality; improving BRDs; restoring bluefin tuna populations; identifying methods for reducing sea turtle bycatch in the reef fish BLL fishery; reducing juvenile sea turtle bycatch in the southeast otter trawl shrimp fishery; conservation of sea turtle nesting habitat; improving cetacean disaster response activities; reduction of impacts to cetaceans associated with anthropogenic noise; mapping, ground-truthing, and predictive MDBC habitat modeling; MDBC habitat assessment and evaluation; enhancement of coral propagation techniques; and active management and protection of MDBC would not occur at this time. The proposed activities would indirectly impact human uses and socioeconomics by benefitting socioeconomics and environmental justice, land and marine management, tourism and recreational use, fisheries, and marine transportation. Under the No Action alternative, there would be no benefit to human uses and socioeconomics and short- and long-term, minor to moderate, adverse impacts would be anticipated. Additionally, indirect impacts would include not gaining the knowledge that the proposed data collection and management activities would provide and undiscovered cultural resources would not be coincidentally found through the proposed survey actions, nor would adverse impacts occur from unintentional contact with survey instrumentation.

4.5 Comparison of Impacts of Proposed Alternatives

The environmental analysis demonstrated that there may only be minor adverse impacts as well as numerous environmental benefits from the proposed restoration alternatives. The No Action Alternative largely had minor to moderate adverse impacts. A summary of impacts is provided in Table 4-9.

As addressed in the PDARP/PEIS, alternatives which included E&D activities or equivalent (in this case planning and data collation activities) would cause no adverse impacts as they do not require physical activities in the environment. These six alternatives may benefit future actions by informing restoration planning. Adverse impacts to the physical environment may include minor disturbance from shrimp trawl pilot studies, deployment and maintenance of PAM arrays, and research activities related to MDBC. Adverse impacts to biological resources may include short-term minor disturbances to protected species and their habitats, through the activities specific to improving these resources. However the benefits far outweigh these disturbances and would be minimized by implementing well-established BMPs for these fishery and protected resources-related activities. There are very few adverse impacts to socioeconomic resources across all project alternatives and through proper outreach and collaboration, adverse impacts to fisheries and shipping industries would be minimized. Adverse impacts in all cases would be minimized by following BMPs (as found in Appendix 6.A of the PDARP/PEIS) and other guidance provided in previous authorizations and permits as well as following other relevant regulatory requirements.

Table 4-9: Summary of environmental consequences for alternatives considered in this RP/EA.

ALTERNATIVE	PHYSICAL RESOURCES				BIOLOGICAL RESOURCES				HUMAN USE AND SOCIOECONOMIC RESOURCES								
	Geology and Substrates	Hydrology and Water Quality	Air Quality	Noise	Habitats	Wildlife Species (birds)	Marine and Estuarine Fauna	Protected Species	Socioeconomics/ Environmental Justice	Cultural Resources	Infrastructure	Land and Marine Management	Tourism and Recreational Use	Fisheries	Marine Transportation	Aesthetics and Visual Resources	Public Health and Safety
Fish																	
Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries	NE	NE	NE	NE	s	NE	+/s	+/s	+	NE	NE	NE	+	+	NE	NE	NE
Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery	NE	NE	NE	NE	NE	+	+	+	+	NE	NE	NE	+	+	NE	NE	NE
Restoring for Bluefin Tuna via Fishing Depth Optimization	NE	NE	NE	NE	NE	NE	+/s	+/s	+	NE	NE	NE	+/s	+/s	NE	NE	NE
Reduce the Impacts of Ghost Fishing by Removing Derelict Fishing Gear from Marine and Estuarine Habitats	+/s	+/s	NE	NE	+/s	+	+/s	+/s	+	NE	NE	NE	+	+	NE	NE	NE
Sea Turtles																	
Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery	NE	NE	NE	NE	NE	NE	+	+	NE	NE	NE	NE	NE	NE	NE	NE	NE
Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing in Turtle Excluder Devices	s	s	NE	NE	s	NE	+/s	+	NE	NE	NE	NE	NE	NE	NE	NE	NE
Long-term Nesting Beach Habitat Protection for Sea Turtles	+	+	NE	NE	+	+	+	+	l	NE	NE	+	+	NE	NE	NE	NE
Reducing Sea Turtle Entanglement from Recreational Fishing Debris	NE	NE	NE	NE	+/s	+	+	+	+	NE	NE	NE	+	+	NE	NE	NE
Marine Mammals																	
Reducing Impacts to Cetaceans during Disasters by Improving Response Activities	s	s	NE	NE	s	NE	s	+/s	+	NE	NE	NE	NE	NE	NE	NE	NE
Reduce Impacts of Anthropogenic Noise on Cetaceans	s	NE	NE	+/s	s	NE	NE	+/s	NE	NE	NE	NE	NE	NE	+/s	NE	NE
Reduce and Mitigate Vessel Strike Mortality of Cetaceans	NE	NE	NE	NE	NE	NE	+	+	NE	NE	NE	NE	NE	NE	l	NE	NE
Assessment of Northern Gulf of Mexico Shelf Small Cetacean Health, Habitat Use, and Movement Patterns	NE	NE	NE	NE	NE	NE	NE	+/s	NE	NE	NE	NE	NE	NE	NE	NE	NE
Mesophotic and Deep Benthic Communities																	
Mapping, Ground-Truthing, and Predictive Habitat Modeling	+/s	NE	NE	s	+	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Habitat Assessment and Evaluation	+/s	NE	NE	s	+/s	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Coral Propagation Technique Development	+/s/l	NE	NE	s	+/s	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Active Management and Protection	+/s/l	NE	NE	s	+/l	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
Habitat Characterization at Known High Priority Sites	+/s	NE	NE	s	+	NE	+/s	+/s	NE	+/l	NE	+	+	+	NE	NE	NE
No Action	s/l	s/l	NE	S/L	**S/L**	S/L	S/L	S/L	s/l	+/l	NE	s/l	s/l	s/l	s/l	NE	NE

Notes: + Beneficial effect; NE No effect; s - short-term, minor adverse effect; S - short-term, moderate adverse effect; **S - short-term, major adverse effect**; l - long-term, minor adverse effect; L - Long-term, moderate adverse effect; **L - Long-term, major adverse effects**

4.6 Cumulative Impacts

4.6.1 Impact Methodology

CEQ regulations require the assessment of cumulative impacts in the decision making process for federal projects, plans, and programs. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR §1508.7). As stated in the CEQ handbook, "Considering Cumulative Effects" (CEQ 1997), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects on "important issues of national, regional, or local significance." Following the CEQ guidance, the goal of the cumulative impacts analysis below is not to capture every theoretically possible impact, but "to count what counts."

This cumulative impact analysis tiers from the Section 6.6 and Appendix 6 of the PDARP/PEIS analysis of the programmatic evaluation of environmental consequences (including cumulative impacts), which is incorporated by reference. The PDARP/PEIS describes and discusses the affected environment and evaluates the effects of restoration programs as well as programmatic development activities. Relevant local and site-specific past, present, and reasonably foreseeable future actions not analyzed in the PDARP/PEIS were identified through communications with agencies and organizations and review of publicly available databases of planned projects relevant to the proposed projects. The Open Ocean TIG determined whether the proposed projects would contribute substantially to adverse cumulative impacts when added to past, present, or reasonably foreseeable future actions.

4.6.2 Resources Affected by Proposed Alternatives

Section 6.6 and Appendix 6B of the PDARP/PEIS are incorporated by reference into the following: cumulative impacts analysis, including the methodologies for assessing cumulative impacts; identification of affected resources; and the cumulative impacts scenario.

In Section 4.2, six projects alternatives were determined to be planning and data collation projects. These activities fall within the PDARP/PEIS definition of an E&D project provided in Section 6.4.14 of the PDARP/PEIS and therefore, no further NEPA analysis was required. In Section 4.3, after a review of affected resources, several were expected to have no impacts. These included air quality; infrastructure; aesthetics and visual resources; and public health and safety. Section 4.4 includes an environmental consequences analysis for each of the proposed project alternatives (excluding planning projects) against the affected resource categories. Many resources were screened out before the NEPA analysis at the project level due to determination that there would be no effects to those resources across the range of projects. Upon conducting NEPA analyses against the remaining resources, it was determined that the project alternatives would mostly have negligible adverse effects with short- to long-term, localized, minor impacts across a few projects.

In summary, the following resources have been excluded from this cumulative impacts analysis:

- **Physical Resources:** hydrology and water quality; and air quality.
- **Biological Resources:** wildlife species.
- **Human Uses and Socioeconomics Resources:** socioeconomics and environmental justice; infrastructure; land and marine management; tourism and recreational uses; fisheries; marine transportation; aesthetics; and public health and safety.

This suite of project alternatives has a deliberate focus on restoring biological resources, specifically those that are wide-ranging (marine mammals and sea turtles), that utilize vast areas of the open ocean for different life stages (tuna, reef fish), and that can be affected by noise environment (marine mammals and sea turtles). Furthermore, the long-lived, MDBC encompass large, scarcely explored or completely unexplored areas across benthic habitats and substrates unique to the Gulf of Mexico open ocean area. Thus it is critical to determine cumulative impacts on the specific biological and physical resources that have been proposed to be restored/improved by the project alternatives, to ensure that the projects' benefits outweigh any potential cumulative adverse impacts. The cumulative environmental consequences from the proposed project alternatives were analyzed for the following resources:

- **Physical Resources:** geology and substrates (minor adverse impacts expected across all Restoration Types); and noise (minor adverse impacts expected in MDBC projects).
- **Biological Resources:** habitats, marine and estuarine fauna, and protected species (minor adverse impacts across numerous Restoration Type projects).
- **Human Uses and Socioeconomic Resources:** cultural resources (minor adverse impacts expected in MDBC projects).

4.6.3 Cumulative Action Scenarios

To effectively consider potential cumulative impacts, the Open Ocean TIG identified past, current, and reasonably foreseeable future actions which are considered relevant to identifying any cumulative impacts the alternatives may have on a local scale. These actions fall within the Open Ocean area which is within the established spatial boundaries identified in the PDARP/PEIS. For this RP/EA, the Open Ocean TIG considered the categories of cumulative actions presented in Section 6.6.4 of the PDARP/PEIS and identified past, present, and reasonably foreseeable future actions through outreach to local, state, and/or federal experts familiar with major environmental and development initiatives that have a potential to contribute significantly to cumulative impacts. Projects considered in previous restoration plans (Final Phase IV Early Restoration Plan and Environmental Assessment, and the PDARP/PEIS) were also reviewed to develop this list of actions. The Open Ocean TIG also relied on expert judgments, primarily qualitative, about the potential for adverse impacts, using publicly available information about the likely design and location of these actions. Table 4-10 provides the resulting list of past, present, and reasonably foreseeable future actions considered.

Table 4-10: Description of other past, present, and reasonably foreseeable future actions considered in the cumulative impact analysis.

Actions	Action Description	Key Resource Categories with Potential for Cumulative Impacts
Related to DWH Oil Spill		
DWH Funded Open Ocean Restoration (including RESTORE, NRDA, and NFWF GEBF, GOMRI)	These DWH oil spill associated funding programs will leverage other funding sources where available to achieve restoration. There some 50+ projects currently funded that would enhance fish, sea turtle populations, marine mammals, and MDBC. Approximately $215M+ has been invested in enhancing these Restoration Types. It is assumed that these programs will continue to focus on these resources over the next 15-20 years. • RESTORE Act ○ Fish Resources – there has numerous buckets of funding that are dedicated to improving fishery resources. Florida RESTORE projects focus on artificial reefs and fisheries monitoring. Texas has a shrimp fishery recover program. The NOAA Science Program for the RESTORE Act is focused on Gulf-wide projects for bluefin tuna larvae, red snapper decision support tool, *Sargassum* importance to fisheries, and monitoring and modeling to improve fisheries. ○ Marine Mammals – the NOAA Science Program has funded studies to assess the movement patterns and habitat of small cetaceans on the continental self as well as studies on the trophic interactions and habitat requirements of the Bryde's whales. ○ Sea Turtles – Florida has funded a response center for caring for injured sea turtles. ○ MDBC – the NOAA Science Program has funded a study on population connectivity of deepwater corals in the northern Gulf of Mexico ○ Gulf-wide – investment has been made in ocean monitoring, ecological health indicators and assessments, oceanographic observation networks, and modeling to provide foundational information on Gulf processes. • NFWF GEBF ○ Fish Resources - there has been a significant investment in assessing/monitoring fisheries in AL, FL, MS. ○ A Marine Mammals project in Florida is focused on increasing capacity for response activities and in Alabama and Mississippi projects are focused on conservation and recovery programs. ○ Sea turtles have been a primary focus for NFWF GEBF resulting in current projects in Florida, Alabama, and Mississippi that eliminate light pollution in nesting beaches, acquiring sea turtle nesting beaches, and enhancing response and monitoring programs. • NRDA ○ Early Restoration phases of NRDA funded a pelagic longline bycatch reduction project. Sea turtle projects included lighting retrofit projects in and a large project for Texas to enhance fisheries bycatch enforcement; reduce shrimp trawl bycatch, and enhance sea turtle stranding networks and emergency response. ○ The first few rounds of TIG Restoration Plans have started to approve marine mammal and sea turtle projects specifically in Alabama and Florida. Alabama's TIG projects focus on marine mammal stranding and response networks as well as health assessments and education. Alabama TIG sea turtle projects focus on coastal sea turtle triage, habitat use and population dynamic studies, and education. Florida will be expanding on improving the night sky in the Gulf Island National Sea Shore. ○ Significant amounts of money still remain in the NRDA for the Open Ocean Restoration Types and projects will continue to be developed to restore these injured resources. ○ Gulf of Mexico Research Initiative (GOMRI) ○ There are numerous associated research grants that fund academic institutions for projects related to Restoration Types in this plan. Results will further provided data and information to inform future restoration projects.	Geology and Substrates Noise Habitats Marine Fauna Protected Species Cultural Resources

Actions	Action Description	Key Resource Categories with Potential for Cumulative Impacts
Resource Stewardship Activities		
Sea Turtle and Marine Mammal Stranding and Salvage Networks	There are well-established, existing stranding network programs across Gulf of Mexico	Protected Species
Marine Protected Area Management	Existing management plans for marine protected areas would continue such as those that in place for the FBGNMS. These managed areas currently protect these geology and substrate resources as well as the marine fauna and protected species that may use the protected areas.	Geology and Substrates, Habitats, Marine Fauna, Protected Species, Cultural Resources
Protected Species Management	Protected species management plans are in place and would continue to be managed in the similar manner as they currently are.	Protected Species
Land Acquisition for Sea Turtles Nesting	Land acquisition by NGOs and federal and state agencies for the purpose of restoration and conservation has occurred and is likely to continue to occur across the Gulf of Mexico specifically for sea turtles nesting habitat.	Geology and Substrates, Habitats, Protected Species
Gulf-wide Restoration Programs Administered by Federal Agencies	Coastal Impact Assistance Program - Section 384 of the Energy Policy Act of 2005 (Public Law 109-58) establishes the Coastal Impact Assistance Program, which authorizes funds to be distributed to Outer Continental Shelf oil and gas producing states for the conservation, protection, and conservation of coastal areas, including wetlands. Gulf of Mexico Energy Security Act - This Act created revenue sharing provisions for the four Gulf oil and gas producing states of Alabama, Louisiana, Mississippi and Texas, and their coastal political subdivisions. Gulf of Mexico Energy Security Act funds are to be used for coastal conservation, restoration and hurricane protection.	Geology and Substrates, Habitats, Marine Fauna, Protected Species, Cultural Resources
EFH and HAPC Designations	GMFMC is mandated to identify, describe, map and protect EFH. Deep coral HAPC are being evaluated.	Geology and Substrates, Habitats, Marine Fauna, Protected Species
Gulf-wide Restoration Programs by NGOs (NFWF)	The Gulf Coast Conservation Grants Program seeks to build and maintain the resilience of the Gulf Coast's ecosystems, living resources and communities by supporting critical gaps in conservation and catalyzing conservation solutions that can be taken to scale. It is a competitive grants program that supports priority conservation needs of the Gulf Coast that are not otherwise expected to be funded under NFWF GEBF or other funding opportunities associated with the DWH oil spill.	Protected Species
Fisheries		
Recreational Fishing	In 2016, 2.7 million residents of Gulf Coast states participated in marine recreational fishing. All participants, including visitors, took almost 21 million trips and caught over 144 million fish. Nearly 64 percent of the trips were made in west Florida, followed by more than 12 percent in Alabama, nearly 11 percent in Louisiana, over 7 percent in Mississippi, and almost 6 percent in Texas. The most commonly caught non-bait species (numbers of fish) were spotted seatrout, gray snapper, red drum, sand seatrout, and red snapper. The largest harvests by weight were for spotted seatrout, red snapper, red drum, king mackerel, Spanish mackerel, and striped mullet (NOAA 2017b).	Marine Fauna Protected Species
Commercial Fishing	Commercial fisheries represent a multi-billion dollar industry to the northern Gulf Coast region and have traditionally included finfish, shrimp, oysters, and crabs. State, federal, and international agencies regulate fishery resources within their jurisdiction of the Gulf of Mexico. For species that are not managed by federal regulations, states have the authority to extend state rules into federal waters for residents of that state or vessels landing a catch in that state. The GMFMC is tasked with developing FMPs in order to manage fish resources in the Gulf of Mexico from the state territorial waters to the EEZ. Several plans are managed jointly with the SAFMC.	Marine Fauna Protected Species

Actions	Action Description	Key Resource Categories with Potential for Cumulative Impacts
	1. Coastal Migratory Pelagics of the Gulf of Mexico and South Atlantic FMP 2. Coral and Coral Reefs of the Gulf of Mexico FMP 3. Red Drum Fishery of the Gulf of Mexico FMP 4. Shrimp Fishery of the Gulf of Mexico FMP 5. Spiny Lobster in the Gulf of Mexico and South Atlantic FMP (joint w/SAFMC) 6. Reef Fish Resources of the Gulf of Mexico FMP 7. Regulating Offshore Marine Aquaculture in the Gulf of Mexico FMP 8. Consolidated Atlantic Highly Migratory Species FMP (managed by NMFS)	
Land and Marine Management		
Marine Protected Areas Management	There are approximately 295 MPAs, managed under different jurisdictions and regulations, located within the northern Gulf of Mexico region. These MPAs cover nearly 40 percent of the Gulf of Mexico U.S. marine waters. Roughly 77 percent of the Gulf of Mexico MPAs is managed by state governments, but the majority of the area within MPAs in the Gulf of Mexico is managed by federal agencies. These MPAs are mostly controlled for fishery management by NMFS and the GMFMC. The MPAs in the Gulf of Mexico include areas located within the Gulf states, the National Estuarine Research Reserve System, the NWR System, and two National Marine Sanctuaries. De facto Marine Protected Areas (DFMPAs) are marine areas that are established for reasons other than conservation, such as economic use, human health or safety, and protection of government or private property. The USCG, U.S. Army, and U.S. Navy manage DFMPAs.	Geology and Substrates Noise Habitats Marine Fauna Protected Species Cultural Resources
Marine Transportation		
Vessels	There are seven deepwater commercial ports that can handle fully laden Panamax ships are located in the restoration area: Houston, Corpus Christi, Beaumont, and Galveston, Texas; New Orleans, Louisiana; Mobile, Alabama; and Tampa, Florida. Military vessels operating in the restoration area are associated with training and testing activities. Commercial business craft include support vessels, fishing vessels, and ferries. Commercial recreational craft include cruise ships and fishing charters. Recreational boating is also prevalent within coastal areas.	Marine Fauna Protected Species Noise
Energy Activities		
Ongoing Oil and Gas Exploration and Production	During 2017, wells in the Western and Central Planning areas produced 30,546,441 bbl and 582,783,892 bbl of crude oil respectively. These planning areas also produced 92,649,820 MCF (Western Planning Area) and 986,423,550 MCF (Central Planning Area) of natural gas. As of October 1, 2018, there were 2,517 active leases in the Gulf of Mexico outer continental shelf (BOEM 2018). The Gulf of Mexico outer continental shelf region currently oversees approximately 3,400 offshore oil and natural gas facilities, accounting for nearly 30 percent of the Nation's domestic oil production and approximately 11 percent of domestic natural gas production (USDOI 2014). Since 2016, there have been 84 permits issued in the Gulf of Mexico (BSEE 2018) for exploration activities such as seismic surveys and geotechnical exploration. Transport of staff, equipment and supplies necessary to support this exploration and production effort requires a large number of surface vessels and helicopters.	Geology and Substrates Noise Habitats Marine Fauna Protected Species Cultural Resources

4.6.4 Cumulative Impacts Analysis

The following section describes the cumulative impacts of the alternatives being considered when combined with other past, present, and reasonably foreseeable future actions which were identified in Section 4.6.3. In many situations, implementation of the project alternatives within this RP/EA would likely help reduce overall adverse impacts by providing a certain level of offsetting benefits, especially when considered in concert with the numerous other present and reasonably foreseeable future actions in the area. For example, there are already some 50+ projects that pertain to fish, sea turtles, marine mammals, and/or MDBC as a result of various oil spill funds and funding will continue to be expended over the 15 to 20 years.

4.6.4.1 Physical Resources: Geology and Substrates and Noise

Implementation of the proposed alternatives would cause short-term to long-term, minor adverse impacts to physical resources. Geology and substrates would be impacted by sea turtles, marine mammals, and MDBC project alternatives while noise would only be adversely impacted by MDBC project alternatives. Potential disturbances include field testing of gear, marine mammal stranding response activities, deployment of monitoring equipment, sediment sampling, installation of moorings, placement of hard substrate, debris removal, and sonar operations. Geology and substrates would recover quickly and the limited long-term, adverse impacts would be localized to very small geographic areas. Overall, long-term effects to physical resources would be beneficial. Geology and substrates would be preserved through land acquisition and marine area management. Placement of hard substrate would provide opportunity for corals to colonize. Reductions in anthropogenic noise (e.g., noise from commercial ships and recreational watercraft) would be a benefit anticipated as a result of the eventual implementation of marine mammal strategic plans and protected area management that would be used to reduce ambient or acute noise. Furthermore, project activities involving data collection would fill important data gaps and provide fundamental information that would benefit noise, geology and substrates, and the associated biological communities, in subsequent restoration activities.

Many of the actions described in Table 4-10 have the potential to affect physical resources with varying intensity and duration. Past, current, and future implementation of oil spill-related projects associated with these Restoration Types would continue to have short-term, minor adverse impacts on geology and substrates as well as the noise environment over the next few decades. Other anthropogenic sources of noise in the Gulf of Mexico are numerous including shipping vessels, commercial and recreational fishing vessels, military and national defense operations, and oil and gas industry exploration. Cumulatively, these activities already produce short-term to long-term, minor to major adverse impacts to the noise environment in localized areas of the Gulf of Mexico. Based on this current noise environment and vast area of geology/substrates, the project alternatives would not contribute substantially to cumulative adverse impacts. Furthermore, the current and future foreseeable restoration project alternatives would support marine protected area management; other open ocean restoration programs; and other land acquisition efforts. The long-term beneficial cumulative impacts to physical resources would far outweigh any cumulative impact from past, present, and foreseeable future actions.

4.6.4.2 Biological Resources: Habitats, Marine Fauna, and Protected Species

Implementation of the proposed alternatives would cause short-term to long-term, minor adverse impacts to biological resources. Habitats, marine fauna, and protected species would be impacted by fish, sea turtles, marine mammals, and MDBC project alternatives. Potential disturbances include field testing of gear, marine mammal stranding response activities, deployment of monitoring equipment, sampling, and changes in fishing and boating practices. No moderate or major adverse impacts would affect marine fauna or protected species. Resources would recover quickly and only a small fraction of any local population would be adversely impacted. Overall, long-term impacts would be beneficial. Biological resources would benefit from the proposed alternatives as the purpose of these projects is to restore and enhance these resources. Anticipated benefits include increased survivorship and reproductive success of various species of fish, sea turtles, marine mammals, and coral communities. This would ultimately be accomplished through reduced bycatch, protection and conservation of valuable habitat, enhanced emergency response activities, reduced anthropogenic noise, reduced vessel collisions, enhanced ecosystem resilience, habitat restoration, and debris removal. Furthermore, project activities involving data collection would fill data gaps and provide fundamental information that would benefit biological resources in subsequent restoration activities.

All of the actions described in Table 4-10 have the potential to affect biological resources with varying intensity and duration. Past, current, and future implementation of oil spill-related projects associated with these Restoration Types would continue to have short-term, minor adverse impacts on biological resources for decades to come. However, since the purpose of these projects is to have long-term benefits to these Restoration Types, it is expected that the benefits would far outweigh the adverse impacts. There are numerous past and current resource stewardship activities that occur across the Gulf of Mexico for sea turtle and marine mammal stranding and salvage networks that would be enhanced through the activities described in this RP/EA. Data collation project alternatives for marine mammals (with potential extension to sea turtles) would help to bring together and organize past and future project data that in turn would inform future project implementation. Marine protected areas management, protect species management, and fisheries management efforts would continue in the manner in which they currently operate. Land acquisition projects have and would continue to cumulatively benefit nesting sea turtle habitat. Other Gulf-wide restoration programs would continue to complement oil spill-related restoration projects. Vessels associated with energy exploration and production activities and with general marine transportation would operate in a similar manner or improved manner with the implementation of these project alternatives.

When the proposed project alternatives are analyzed in combination with other past, present, and reasonably foreseeable future actions, short- and long-term cumulative adverse impacts to biological resources would likely occur. Those effects however, are unlikely to be substantial because the spatial extent of the area of impacts to biological resources is small in comparison to resource availability and other past, present, and reasonably foreseeable future actions. The alternatives would not contribute substantially to cumulative adverse impacts. The alternatives, carried out in conjunction with other restoration projects and programs, would result in extensive long-term beneficial cumulative impacts to biological resources.

4.6.4.3 Human Uses and Socioeconomic Resources: Cultural Resources

Implementation of the MDBC project alternatives would cause long-term, minor adverse impacts to cultural resources. While disturbance to seafloor cultural resources (e.g. shipwrecks) could occur during offshore activities utilizing underwater equipment (i.e. ROVs), caution and use of industry best practices during subsea operations make impacts unlikely. In addition, existing mapping of cultural resources would be utilized as part of the planning for any activities where there is the potential for disturbance or positive benefit to these resources. Mapping could reveal previously unknown cultural resources. Consultation would be pursued at the time of staged restoration planning if new cultural resources sites were identified or if activities would further analyze known cultural resource sites.

Some of the actions described in Table 4-10 have the potential to affect cultural resources with varying intensity and duration. Past, current, and future implementation of oil spill-related projects associated with this Restoration Type would continue to have minor adverse impacts on cultural resources over the next few decades. Cumulatively, these activities may produce short-term to long-term, minor adverse impacts to the cultural resources. Those effects however, are unlikely to be substantial as the area of potential impact may be quite small. Furthermore, the current and future foreseeable restoration project alternatives would support marine protected area management to protect these resources if they are discovered. The long-term beneficial cumulative impacts to cultural resources would far outweigh any cumulative impact from past, present, and foreseeable future actions.

4.7 Compliance with Other Environmental Laws and Regulations

Chapters 3 and 4 of this RP/EA provide detailed information and OPA and NEPA analyses for each proposed restoration alternative, environmental consequences and its consistency with the PDARP/PEIS. In addition, coordination and reviews to ensure compliance with other legal authorities potentially applicable to the preferred alternatives have begun. While compliance reviews are complete for some of the projects, others remain in progress. Progress to date suggests that the preferred alternatives will be able to meet permitting and other environmental compliance requirements. All alternatives will be implemented in accordance with applicable laws and regulations.

Federal environmental compliance responsibilities and procedures follow the Trustee Council SOP, which are laid out in Section 9.4.6 of that document. Following this SOP, the Implementing Trustees for each alternative will ensure that the status of environmental compliance (e.g., completed vs. in progress) is tracked through the Restoration Portal. The Implementing Trustees will keep a record of compliance documents (e.g., ESA biological opinions, USACE permits) and ensure that they are submitted for inclusion in the Administrative Record.

4.7.1 Additional Federal Laws

Additional federal laws may apply to the preferred alternatives considered in this RP/EA. Legal authorities applicable to restoration alternative development were fully described in the context of the DWH restoration planning in the PDARP/PEIS, Section 6.9 Compliance with Other Applicable Authorities and Appendix 6.D Other Laws and Executive Orders. That material is incorporated by reference here.

Examples of applicable laws or Executive Orders include, but are not necessarily limited to those listed below. Additional detail on each of these laws or Executive Orders can be found in Chapter 6 of the PDARP/PEIS.

- Endangered Species Act (16 U.S.C. §§1531 et seq.)
- Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §§1801 et seq.)
- Marine Mammal Protection Act (16 U.S.C. §§1361 et seq.)
- Coastal Zone Management Act (16 U.S.C. §§1451 et seq.)
- National Historic Preservation Act (16 U.S.C. §§470 et seq.)
- Coastal Barrier Resources Act (16 U.S.C. §§3501 et seq.)
- Migratory Bird Treaty Act (16 U.S.C. §§703 et seq.)
- Bald and Golden Eagle Protection Act (16 U.S.C. §§668 et seq.)
- Clean Air Act (42 U.S.C. §§7401 et seq.)
- Federal Water Pollution Control Act (CWA, 33 U.S.C. §§1251 et seq.) and/or Rivers and Harbors Act (33 U.S.C. §§401 et seq.)
- Marine Protection, Research and Sanctuaries Act
- Estuary Protection Act
- Archaeological Resource Protection Act
- National Marine Sanctuaries Act
- Farmland Protection Policy Act
- Paperwork Reduction Act (44 USC §3501 et seq.)
- Executive Order 11988: Floodplain Management (now as augmented by Executive Order 13690, January 30, 2015)
- Executive Order 11990: Protection of Wetlands
- Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
- Executive Order 12962: Recreational Fisheries
- Executive Order 13112: Safeguarding the Nation from the Impacts of Invasive Species
- Executive Order 13175: Consultation and Coordination with Indian Tribal Governments
- Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds
- Executive Order 13693: Planning for Federal Sustainability in the Next Decade

4.7.2 Compliance for Long-Range Activities

As described in this RP/EA, there are a number of proposed projects developed as long-range actions structured to include a full lifecycle of activities such as initial project design and assessment, tool design and testing, through long-term site-specific project implementation (Section 4.1.2). When specific methodologies and locations are determined, necessary compliance actions will be evaluated further once project planning is underway and sufficient site-specific information is developed. The appropriate regulatory agencies will be involved in early coordination to identify any future compliance needed. The status and outcomes of such compliance actions will be tracked in a manner consistent with TIG requirements for project compliance and will be publicly available through the DWH Administrative Record[22], DIVER[23], and from the Gulf Spill Restoration Environmental Compliance[24] webpage.

4.7.3 Next Steps for Compliance

The Open Ocean TIG will ensure compliance with all applicable state and local laws and other applicable federal laws and regulations relevant to the preferred restoration alternatives, including technical assistance from appropriate regulatory agencies during E&D evaluation to identify any compliance issues. The Open Ocean TIG is currently engaged in technical assistance with regulatory agencies on the preferred projects in this restoration plan. A detailed compliance update for each project will be provided in the final restoration plan.

Documentation of regulatory compliance will be available in the Administrative Record that can be found at the DOI's Online DWH Administrative Record[19]. The current status of environmental compliance by project can be viewed at any time on the Trustee Council's website[21].

Existing consultations or permits are being reviewed to determine if the consultations/permits are applicable to the actions in this RP/EA and will be current at the time of any implementation or if a re-initiation of the consultations is necessary for preferred alternatives. Implementing Trustees are required to implement alternative-specific mitigation measures (including BMPs) identified in the RP/EA and completed consultations/permits. Implementing Trustees will ensure no unanticipated effects to listed species and habitats occur including ensuring that BMPs are implemented.

[22] DWH Administrative Record can be found here: https://www.doi.gov/deepwaterhorizon/adminrecord
[23] DIVER can be found here: https://www.diver.orr.noaa.gov/deepwater-horizon-nrda-data
[24] Gulf Spill Environmental Compliance information can be found here: https://www.gulfspillrestoration.noaa.gov/environmental-compliance

Appendix A: Draft Monitoring and Adaptive Management Plans

Monitoring and Adaptive Management (MAM) was identified as one of the programmatic goals in the PDARP/PEIS. The DWH NRDA MAM Framework provides a flexible, science-based approach to effectively and efficiently implement restoration over several decades to provide long-term benefits to the resources and services injured by the DWH oil spill. The project MAM plans identify the monitoring needed to evaluate progress toward meeting project objectives and to support adaptive management of the restoration project. The plans identify key sources of uncertainty, incorporate monitoring data needs and decision points that address these uncertainties, and establish a decision-making process for making adjustments, if needed. MAM plans are living documents and would be updated as needed to reflect changing conditions and/or new information. For example, a MAM plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design is inadequate, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any significant future revisions to MAM plans would be made publicly available through the NOAA Restoration Portal.

MAM are major responsibilities for the Open Ocean TIG. As described in the PDARP/PEIS (Section 7.5.1), TIGs are responsible for both resource- and project-level MAM activities. The Open Ocean TIG has developed and would implement MAM plans for all restoration projects consistent with guidance provided by the Trustee Council. Data generated through monitoring would provide the basis for annual project reporting that keeps the public fully informed about project progress and for adaptive management and corrective action decisions. Monitoring data would also be applied to improve the likelihood of success and benefits of future projects.

All of the projects in this RP/EA identified as preferred have associated MAM plans. Many of the projects in this RP/EA would be implemented in partnership with entities that have deep expertise in their fields; this collaborative approach would leverage and expand existing efforts and increase confidence in outcomes and approaches for future restoration work.

The content of each MAM plan depends on the type of project, the level of uncertainty, and the proposed activities. Some of the projects in this RP/EA include activities associated with data gathering to fill critical information gaps that would reduce uncertainties and support the Open Ocean TIG in future work to develop and implement restoration projects successfully. Because the primary objective of these data gathering projects is to gain new knowledge, the associated MAM plans may or may not contain performance criteria or corrective actions. The Open Ocean TIG does not expect to conduct project-level adaptive management for these data gathering projects, but they are integral to the Open Ocean TIG's commitment to adaptive management at the program/resource level because the completion of these projects would provide important knowledge that would inform future restoration actions.

The MAM plans have three primary purposes:

1. The first purpose is to identify how restoration managers would measure and track progress toward achieving restoration goals and objectives. This work is accomplished via monitoring specific parameters that, individually and collectively, help the Open Ocean TIG understand the extent to which a project is achieving its restoration objectives.

2. The second purpose is to increase the likelihood of successful implementation through identification, before a project begins, of potential corrective actions that could be undertaken if a project does not proceed as expected. This is accomplished by conceptually outlining the reasons why a project might fail to meet its objectives and possible responses by the Open Ocean TIG that could be undertaken to correct these problems. The focus is on uncertainties for project planning and how these uncertainties may be best addressed through project design and implementation.
3. The third purpose is to capture, in a systematic way, lessons learned or new information acquired that can be incorporated into future project selection, design, and implementation. The evaluation section of each plan contains basic questions that the Open Ocean TIG would answer to help understand whether a project achieved its objectives and the unanticipated issues that were encountered during implementation and how such issues were addressed. Such information would provide insights for future project development. This section would be updated with additional information as monitoring methods are determined for each project. In the future, the Open Ocean TIG would identify ways to evaluate the overall success of the DWH restoration effort by incorporating feedback from project-level evaluations into a larger resource-level framework to understand how projects contribute collectively to restoration of injured resources and improved ecosystem conditions and functions in the Open Ocean Restoration Area.

The Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0 provides detailed information regarding the importance and use of adaptive management.

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Fish and Water Column Invertebrates Restoration Type

Draft MAM Plans

Monitoring and Adaptive Management Plan for the *Deepwater Horizon* NRDA Project: Reduction of Post-release Mortality from Barotrauma in Gulf of Mexico Reef Fish Recreational Fisheries

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's restoration objectives and to support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project would restore recreationally important reef fish populations adversely affected by the *Deepwater Horizon* oil spill by reducing the mortality from regulatory discards and catch-and-release fishing. Although fishing may be focused on catching and retaining fish, fish are also released for a variety of reasons such as season closures, bag limits being reached, or catching undersized fish. These fish are referred to as regulatory discards. There is a certain amount of mortality associated with these discards and reduction in this mortality could help populations to recover. If the survivorship of released fish can be increased, then the survivors can contribute to the recovery of a population. This project focuses on making recreational anglers aware of the problem and providing the tools and education necessary for anglers to release fish in a way that improves survival.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources
- Restoration Type: Fish and Water Column Invertebrates
- Restoration approach: Reduce bycatch and post release mortality
- Restoration technique: Reduce Post-release Mortality of Red Snapper and Other Reef Fishes in the Gulf of Mexico Recreational Fishery Using Fish Descender Devices
- TIG: Open Ocean
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment

The project would be located across the northern Gulf of Mexico. Project activities include 1) Project management, 2) Distribute descender device and educate, 3) Monitor use and restoration, and 4) Validate fish descender device effectiveness and estimate post-release mortality. This project is intended to restore reef fish injured by the *Deepwater Horizon* oil spill, including snappers and groupers. This project may also provide enhanced recreation opportunities. The implementing agency is the National Oceanic Atmospheric Agency (NOAA). Partner agencies include Gulf States Marine Fisheries Commission, Gulf of Mexico Fishery Management Council, Florida, Alabama, Mississippi, Louisiana, and Texas.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, are to:

- Restore injured fish and invertebrate species across the range of coastal and oceanic zones by reducing direct sources of mortality.
- Increase the health of fisheries by providing fishing communities with methodologies and incentives to reduce impacts to fishery resources.

The specific restoration objectives for this project are to:

- Provide tools, including descender devices, and training to Gulf of Mexico recreational anglers and angling community to reduce post-release mortality.
- Measure use of tools (including descender devices), including prevalence and trends of use in the fishery.
- Validate post-release mortality rates and effectiveness of fish descender devices in a range of oceanographic conditions and across affected species.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives in Section 5.0.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

The influence diagram below (Figure 1-1) shows that descender devices affect fish populations through mortality rates. Usage of descender devices would depend upon training, cost effectiveness, and ease of use, and these factors may interact differently for the various types of recreational fishing boats (private, charter, headboat). For instance, using “fish elevator” type devices on headboats may be the only practical device given the volume of fish that could be caught. Besides recreational fishing, there are many factors influencing fish populations, including food availability, habitat, and predation. Large scale environmental drivers such as climate may affect all of these variables, and this must be kept in mind when assessing project performance.

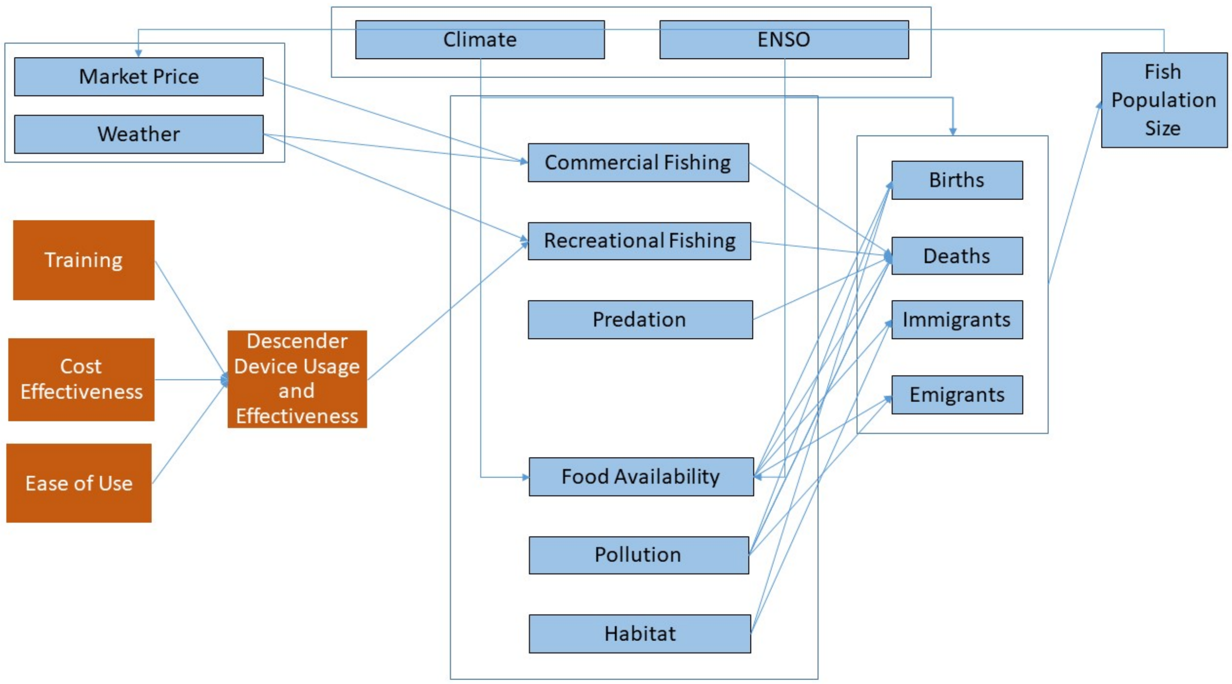

Figure 1-1: Influence diagram for the descender device project

1.3.1 Potential Sources of Uncertainty

Potential sources of uncertainty are defined as those that may affect the ability of a project to achieve its restoration objectives. Sources of uncertainty, the degree of uncertainty, and the level of uncertainty associated may vary by project.

There are a number of potential sources of uncertainty that could affect project performance and success. Potential sources of uncertainty include:

- Potential fisheries management actions.
- Potential for Exempted Fisheries Permits (e.g., flexibility of headboat retention limits need to implement with headboats).
- Effects of large scale environmental perturbations.
- Effectiveness of outreach actions to encourage voluntary participation.
- New technologies that influence monitoring and post-release methods.

2.0 Project Monitoring

Performance monitoring would be conducted to evaluate project success and identify the need for potential corrective actions or adaptive management. Below, a list of parameters is proposed to be monitored, organized by each restoration objective. For each of the identified monitoring parameters, information is provided on the intended purpose, monitoring methods, timing and frequency, duration, sample size, and sites. The parameters listed below may or may not be tied to performance criteria and/or corrective actions (see Section 5.0: Project-Level Decisions).

Objective #1: Provide tools, including descender devices, and training to Gulf of Mexico recreational anglers and angling community to reduce post-release mortality

Parameter #1: Number of devices disseminated and training events

a) Purpose: Evaluate project performance, inform implementation, track deliveries, outreach, and training events.
b) Method: Count.
c) Timing, Frequency, and Duration: For each event for the duration of the project.
d) Sample size: N/A.
e) Sites: throughout the Gulf.

Parameter #2: Perceptions of fish descender devices

a) Purpose: Evaluate project outcomes. Determine change in perception of devices across gulf. Help overcome barriers.
b) Method: Survey the percent change.
c) Timing, Frequency, and Duration: Twice – years 1 and 4.
d) Sample size: N/A.
e) Sites: through-out the Gulf.

Objective #2: Measure use of tools (including descender devices), including prevalence and trends of use in the fishery

Parameter #3: Prevalence of use of fish descender devices by sector (private, charter, headboat)

a) Purpose: Evaluate project performance, inform implementation.
b) Methods – determine uses/trips and percent change through the following options:
    i. MRIP Dockside intercept/mail survey.
    ii. Charter and headboat logbooks.
    iii. At-sea observers.
c) Timing, Frequency, and Duration: For duration of season, in two week waves, per trip, and as observers are placed. For the duration of the project.
d) Sample size: TBD.
e) Sites: Sites determined to maximize intercepts with private reef fish trips – analysis needed. Gulf wide for logbooks and observers.

Parameter #4: Reduction in angler driven fish mortality

a) Purpose: Evaluate project performance, inform outcomes. Determine the percentage of benefit of the project to reef fish.
b) Method: Derived from prevalence of use and estimates of post release mortality.
c) Timing, Frequency, and Duration: Calculated on an annual basis.
d) Sample size: N/A.
e) Sites: N/A.

Parameter #5: Biological information

a) Purpose: Evaluate if tools are being used correctly. Characterize discards by species and depth (size, release disposition, location).
b) Method: Determine the count, length, and mass by species utilizing at-sea observers and also citizen science (if implemented).
c) Timing, Frequency, and Duration: Place on vessels on an on-going basis.
d) Sample size: Sub-sample of total estimated trips.
e) Sites: through-out the Gulf.

Parameter #6: Fishery wide Post-release mortality rate

a) Purpose: Evaluate overall benefit of the project.
b) Method: Experiments that compare the percentage change of mortality rates using descending devices to controls for red snapper, red grouper, vermillion snapper, and gag.
c) Timing, Frequency, and Duration: Within first three years of project. Sampling design not determined.
d) Sample size: Not determined.
e) Sites: Throughout the Gulf.

Objective #3: Validate post-release mortality rates and effectiveness of fish descender devices in a range of oceanographic conditions and across affected species

Parameter #7: Number of release mortality experiments successfully completed, and number of mortality estimates improved

a) Purpose: Help improve estimates of total reduction in dead discard counts.
b) Method: Derived from prevalence of use and estimates of post release mortality.
c) Timing, Frequency, and Duration: Calculated on an annual basis.
d) Sample size: N/A.
e) Sites: N/A.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000; Thom et al. 2005). Performance may be evaluated in terms of implementation of the project plan, expected project outputs, or the ability of the project to achieve the desired restoration outcomes.

For this project, the principles of adaptive management would be applied in a number of areas and ways.

- Project would be initially implemented in a constrained geography and with a subset of recreational fishing sectors. The project would then be scaled up and broadened over time. This approach would allow us to apply early lessons to subsequent phases.
- Information on angler sentiment collected through surveys would help to address training needs and knowledge gaps.
- Coordination and use of existing forums would allow us to communicate with the angler community to get qualitative feedback on implementation.
- Project would be evaluated on an annual basis to determine if restoration targets are being achieved.

4.0 Evaluation

Evaluation of project performance would be conducted to ensure the project is meeting the restoration objectives and inform the need for adaptive management or corrective actions. Specific analyses that would be conducted include:

Evaluation of Project Implementation and Outputs:
Project implementation would be evaluated annually and be based on factors such as:

- Parameter #2 Number of workshops, training, and outreach sessions held.
- Parameter #2 Number of gear packages disseminated.
- Parameter #1 Number of for-hire participants in project.
- Parameter #7 Number of release mortality experiments successfully completed.
- Parameter #7 Improvement in estimates of post release mortality rates.

These factors would be evaluated by comparing the appropriate numbers to performance criteria that would be defined as part of the planning process.

Evaluation of Project Outcomes:
The Project would be evaluated annually or as necessary based on factors such as:

- Parameter #3 Change in perception and attitudes towards post-release handling.
  - Measured using surveys in years 1 and 4.
  - Successful implementation would show improved attitudes toward post-release handling methods.
  - Specific methodology would be determined.
- Parameter #1 Change in prevalence of proper use of fish descender devices.
  - Evaluated by multiple methods and data sources.
- Parameter #6 Number of fish estimated not killed because of the project.
  - Based upon change in prevalence of FDD usage and updated estimates of post-release mortality.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

In this section, we describe how knowledge gained from the evaluation of monitoring data would be used at the project-level to determine whether the project, once implemented, is considered successful or whether corrective actions are needed during project implementation. A project may not be achieving its intended objectives because of previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

Table 5-1 provides the list of performance criteria for each performance monitoring parameter and potential corrective actions that can be taken if performance criteria are not met. This table may not include all possible options; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions.

Monitoring Parameters	Performance Criteria	Potential Corrective Actions
Prevalence of use of FDD by sector	• 50 percent of private boat use (when appropriate) in 8 years • 75 percent of charter boat use (when appropriate) in 8 years • 90 percent of head boat use (when appropriate) in 8 years	Revisit outreach and training Alter contracts
Number of post-release mortality estimates improved	Four species with improved estimates. Estimates meet standards to be considered in SEDAR	Alter contracts
Number of devices disseminated and training events	To be determined	Improve methods of marketing and dissemination
Perceptions of FDD	Improved perceptions of FDD	Improve methods of marketing and training

6.0 Monitoring Schedule

The schedule for project monitoring has not yet been determined and would be described in project implementation plans and used to amend this monitoring plan.

7.0 Data Management

7.1 Data Description

Data collection would occur on an ongoing basis and be compiled within 18 to 24 months. The data collection would occur across the Gulf of Mexico.

To the extent practicable, all environmental and biological data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record Project-specific data, then Project-specific datasheets would be drafted prior to conducting any Project monitoring activities. Original hardcopy datasheets and notebooks and photographs would be retained by the Implementing Trustee.

Relevant Project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format. All field datasheets and notebook entries would be scanned to PDF files. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents). Geospatial data would adhere to FGDC/ISO standards.

7.2 Data Review and Clearance

All collected data would undergo proper QA/QC protocols, following the process outlined in Section 3 of the MAM Manual Version 1.0. In summary, the following steps would be taken: 1) For data that have been transcribed, the electronic data sheets would be verified against the original hardcopy datasheets and/or notebooks. Any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed outside of the Implementing Trustee's agency. 2) Implementing Trustees would verify and validate MAM data and information and would ensure that all data is i) entered or converted into agreed upon/commonly used digital format, ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with Implementing Trustee agency requirements.

After identified errors have been addressed, the Implementing Trustee would give the other TIG members time to review the data before making the data publicly available. The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

7.3 Data Storage and Accessibility

Some MAM data compiled and analyzed as part of this project would be stored or referenced on the Data Integration, Visualization, Exploration, and Reporting (DIVER) Restoration Portal. The data would be submitted to the DIVER Restoration Portal as soon as possible and no more than two years from when data are collected.

Other data compiled and analyzed as part of this project would be stored on the existing platforms used to store fishing data. Data are submitted to the recreational fishing data platforms and logbook platforms in a standardized fashion. In addition, either a link to the database would be provided in the DIVER Restoration Portal, or the data would be imported into the DIVER Restoration Portal on a yearly basis.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy and other laws governing the use of fishing data, through the DIVER Explorer Interface within two years of when the data collection and analysis occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG trustees prior to releasing any project data that is the subject of the request.

Some of the data collected are protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or fishing information collected under, Magnuson–Stevens Fishery Conservation and Management Act [MSFCMA], etc.) and therefore would not be publicly distributed in an un-aggregated form.

8.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan has been finalized and updated annually to reflect the status of the MAM activities.

Interim monitoring reports would be developed at Years 3 and 6 of the project. The final monitoring report would be developed within one year of monitoring activities being concluded. These reports would be made publicly available through the DIVER Restoration Portal.

9.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

10.0 References

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Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Better Bycatch Reduction Devices for the Gulf of Mexico Commercial Shrimp Trawl Fishery

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's restoration objectives and to support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The overall goal of this project is to restore fish biomass through actions that are expected to reduce finfish bycatch in the commercial shrimp trawl fishery. Commercial fishing removes biomass of both targeted and non-targeted bycatch species; a reduction in this bycatch would create a restoration benefit for fish biomass lost as a result of exposure to DWH oil and related dispersants. The objectives of this project are to identify and develop bycatch-reducing technology to reduce commercial shrimp trawl fishing pressure on finfish populations and to develop cost-effective solutions and effective incentives to maximize use of improved technology. Specifically, this project would identify, develop, evaluate, and certify new innovative bycatch reduction devices (BRDs), BRD combinations, and/or BRD/Turtle Exclusion Device (TED) combinations for use in U.S. Gulf of Mexico shrimp trawl fishery and/or distribute currently certified BRDs that are underutilized in Gulf of Mexico fisheries under an incentivized program.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Fish and Water Column Invertebrates.
- Restoration approach: Incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship; voluntary fisheries-related actions to increase fish biomass.
- Restoration technique: Technological solutions to reduce bycatch.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

The project would be located in northern Gulf of Mexico, but some activities including data gathering could occur outside that range. Project activities include 1) project management, 2) comprehensive BRD innovation survey and 3) engagement with bycatch reduction researchers, 4) proof of concept testing, 5) certification testing of BRDs, 6) outreach and training on new BRDs, 7) incentivize new BRD use, 8) conduct dockside outreach and training with Gear Monitoring Team. This project is intended to restore Fish and Water Column Invertebrates injured by the *Deepwater Horizon* oil spill, including red snapper, lane snapper, vermilion snapper, king mackerel and Spanish mackerel, in addition to millions of pounds of estuarine dependent species such as Atlantic croaker and sea trout. This project may also develop greater resilience for gulf shrimp industry by providing for more tools for the industry. The implementing agency is the National Oceanic and Atmospheric Agency (NOAA). Partner agencies include state resource management departments.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, are to:

Restore injured fish and invertebrate species across the range of coastal and oceanic zones by reducing direct sources of mortality; Increase the health of fisheries by providing fishing communities with methodologies and incentives to reduce impacts to fishery resources

The specific restoration objectives for this project are to:

- Identify new advances in BRD systems via regional surveys and domestic and international outreach.
- Evaluate bycatch reduction capabilities of new BRDs and certify BRDs that would provide a restoration benefit via bycatch reduction.
- Increase use of new BRD systems in the U.S. Gulf of Mexico shrimp fishery via outreach and incentives.
- Evaluate bycatch reduction capabilities of new BRDs in the commercial shrimp fishery.
- Increase bycatch reduction by ensuring BRDs are used according to operational recommendations via outreach by the Gear Monitoring Team.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii)). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives in Section 5.0.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

The influence diagram below (Figure 1-1) shows that BRDs affect fish populations through mortality rates. Usage of BRDs would depend upon training, cost effectiveness, efficiency, and ease of use. Besides commercial fishing, there are many factors influencing fish populations, including food availability, habitat, and predation. Large scale environmental drivers such as climate may affect all of these variables, and this must be kept in mind when assessing project performance.

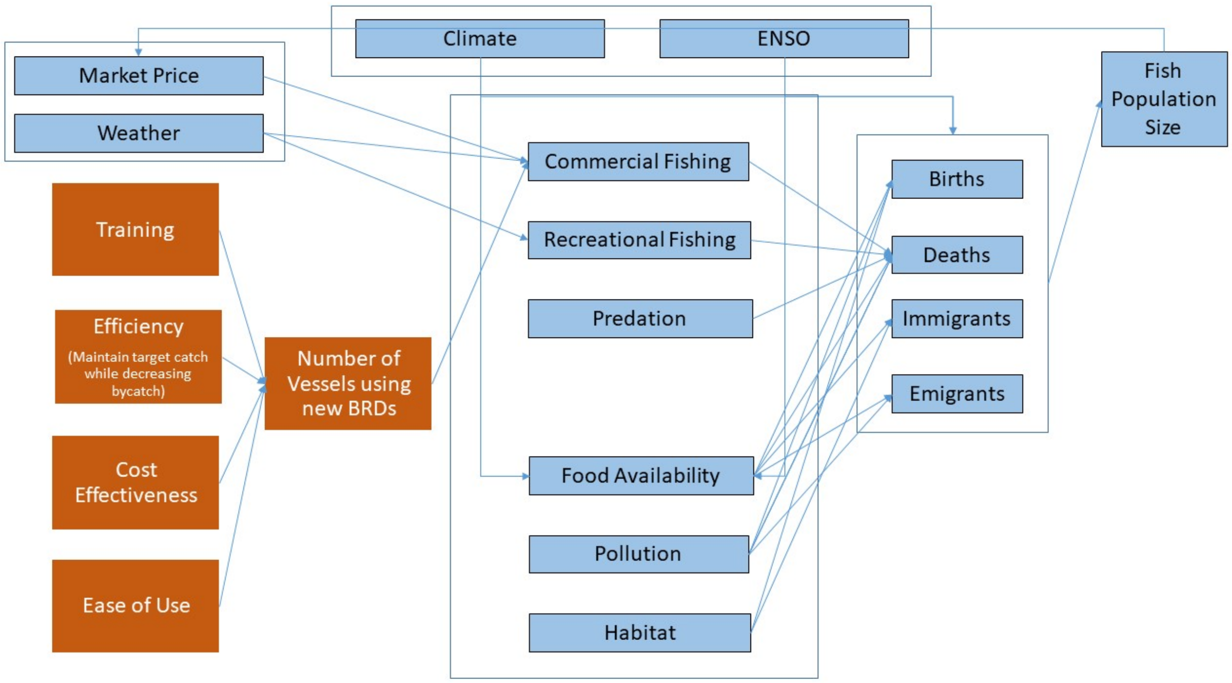

Figure 1-1: Influence diagram for the bycatch reduction project

1.3.1 Potential Sources of Uncertainty

Potential sources of uncertainty are defined as those that may affect the ability of a project to achieve its restoration objectives. Sources of uncertainty, the degree of uncertainty, and the level of uncertainty associated with projects would vary.

As this project relies on voluntary participation in surveys and voluntary adoption of new technology, there are a number of potential sources of uncertainty that could affect project performance and success. Potential sources of uncertainty include:

- Can we identify the appropriate people/entities to target and recruit for surveys and outreach?
- Can we attract enough eligible people to participate in the incentivized use of BRD systems?
- Can we develop BRD systems that industry would want to use?
- Can we develop cost effective BRDs that maintain target catch while reducing bycatch?

2.0 Project Monitoring

Performance monitoring would be conducted to evaluate project success and identify the need for potential corrective actions or adaptive management. Below, a list of parameters is proposed to be monitored, organized by each restoration objective. For each of the identified monitoring parameters, information is provided on the intended purpose, monitoring methods, timing and frequency, duration, sample size, and sites. The parameters listed below may or may not be tied to performance criteria and/or corrective actions (see Section 5.0: Project-Level Decisions).

Objective #1: Identify new advances in BRD system technology via regional surveys and domestic and international outreach

Parameter #1: Number of survey responses from regional sources

a) Purpose: This parameter would be used to determine success of project implementation. This parameter would determine the usefulness of the survey process and the level of engagement of the fishery, which could be used for adaptive management purposes.
b) Method: Opportunistic outreach via dockside surveys to Gulf shrimp fleet. Number of responses received would be recorded.
c) Timing, Frequency, and Duration: Once following the completion of the survey, and again a few months later to account for late responses.
d) Sample size: Target of 20 percent of the Gulf-wide fleet including a minimum of 50 percent of the white shrimp fleet.
e) Sites: N/A.

Parameter #2: Number of domestic and international research entities engaged with project team in information/technology transfer

a) Purpose: This parameter would be used to determine success of project implementation. This parameter would determine the level of engagement of the research community, whose members could be consulted for adaptive management purposes.
b) Method: Record the number of entities that engage with the project team.
c) Timing, Frequency, and Duration: Once following initial outreach, and again a few months later after subsequent outreach efforts.
d) Sample size: Based on number of appropriate research entities identified.
e) Sites: N/A.

Parameter #3: Number of BRDs identified that show promise to reduce bycatch over the BRDs currently certified for use in the U.S. shrimp fishery

a) Purpose: This parameter would be used to determine success of project implementation and inform adaptive management. This parameter would ensure there would be enough new BRDs for proof of concept testing, with a goal of 2-6 new BRDs identified.
b) Method: Record the number of new BRDs identified from the survey and outreach.

c) Timing, Frequency, and Duration: Once following the completion of the survey, and once a few months later to account for late responses.
d) Sample size: All BRDs identified from survey and outreach.
e) Sites: N/A.

Objective #2: Evaluate bycatch reduction capabilities of new BRDs and certify BRDs that would provide a restoration benefit via bycatch reduction

Parameter #1: Target catch retention and bycatch rates of new BRDs

a) Purpose: This parameter would be used to evaluate the performance of new BRDs and inform adaptive management.
b) Method: Record the total shrimp weight and total catch from trawls with a new BRD to trawls with no BRD. Samples would be divided into catch categories including shrimp, finfish, non-shrimp crustaceans, other invertebrates, and debris.
c) Timing, Frequency, and Duration: Catch rates for target and bycatch species would be calculated following each trial.
d) Sample size: Minimum of 20 tows for each BRD system.
e) Sites: Gulf of Mexico

Parameter #2: Number of BRD systems that move forward for certification testing

a) Purpose: This parameter would be used to determine success of project implementation of proof of concept testing and inform adaptive management. This parameter would ensure there would be new BRD systems for certification testing.
b) Method: Record the number of BRD systems that have reduced bycatch rates over BRD systems currently in use in the Gulf.
c) Timing, Frequency, and Duration: Once following the completion of the proof of concept testing.
d) Sample size: All BRD systems tested in during proof of concept phase.
e) Sites: Gulf of Mexico.

Parameter #3: Number of new BRDs certified with bycatch reduction capabilities greater than BRDs currently in use in the fishery

a) Purpose: This parameter would be used to determine success of project implementation by ensuring there are BRDs that provide a restoration benefit. This parameter would inform adaptive management, used to identify the need to make modifications to improve the BRD system.
b) Method: Record the number of BRDs certified via certification testing with bycatch reduction capabilities greater than the BRDs currently in use.
c) Timing, Frequency, and Duration: Evaluated annually during project years 3-4.
d) Sample size: All BRDs tested in certification phase.

e) Sites: Gulf of Mexico.

Objective #3: Increase use of new BRD systems in the U.S. Gulf of Mexico shrimp fishery via outreach and incentives

Parameter #1: Number of fully executed agreements with vessel owners to use state-of-the-art BRD systems

a) Purpose: This parameter would be used to determine success of project implementation, would determine level of participation and changes in participation rate.
b) Method: Record number of agreements.
c) Timing, Frequency, and Duration: Annually during project years 2-7.
d) Sample size: Target of 20 percent of the federally permitted Gulf shrimp fleet.
e) Sites: Gulf of Mexico.

Parameter #2: Number of vessels that install new BRD systems

a) Purpose: This parameter would be used to determine success of project implementation and would validate contract compliance.
b) Method: Record number of participating vessels actively using new BRD systems.
c) Timing, Frequency, and Duration: Annually during project years 2-7.
d) Sample size: All participating vessels.
e) Sites: Gulf of Mexico.

Objective #4: Evaluate bycatch reduction of the new BRDs in the commercial shrimp fishery

Parameter #1: Bycatch quantity (weight, size) and disposition of bycatch of select species and broad species categories

a) Purpose: This parameter would evaluate the performance of new BRD systems on participating commercial vessels by estimating percent reduction in bycatch and dead discards by species caught with new and old BRDs.
b) Method: An on-board observer would record bycatch weight and length for tows using new and old BRD systems. Samples would be divided into catch categories including finfish, non-shrimp crustaceans, other invertebrates, and debris.
c) Timing, Frequency, and Duration: Annually during project years 2-7.
d) Sample size: A minimum of 30 tows each trip. Tows exceeding 70 kg would be subsampled according the protocol in the NOAA BRD manual.
e) Sites: Gulf of Mexico.

Parameter #2: Shrimp catch with old and new BRDs under actual usage conditions

a) Purpose: To determine if target catch is maintained with new BRD systems.
b) Method: Weigh the shrimp catch from tows using old and new BRDs.

c) Timing, frequency, and duration: Annually during project years 2-7.
d) Sample size: A minimum of 30 tows each trip. Tows exceeding 70 kg would be subsampled according the protocol in the NOAA BRD manual.
e) Sites: Gulf of Mexico.

Parameter #3: Annual expenses per vessel with new and old BRD systems

a) Purpose: This parameter would evaluate changes in vessel expenses due to the use of new BRD systems on commercial vessels.
b) Method: Cost tracking.
c) Timing, Frequency, and Duration: Annually during project years 2-7.
d) Sample size: All participants.
e) Sites: Gulf of Mexico

Parameter #4: Annual net profit with new and old BRD systems

a) Purpose: To estimate financial effects of adopting use of new BRD systems.
b) Method: Cost tracking of shrimp catches.
c) Timing, Frequency, and Duration: Annually during project years 2-7.
d) Sample size: All participants.
e) Sites: Gulf of Mexico.

Objective #5: Increase bycatch reduction by ensuring new BRD systems are used according to operational recommendations via outreach by the Gear Monitoring Team

Parameter #1: Number of dockside or at-sea courtesy outreach and inspections performed

a) Purpose: To determine level of effort of Gear Monitoring Team (GMT).
b) Method: Record the number of dockside or at-sea courtesy inspections conducted by the GMT.
c) Timing, Frequency, and Duration: Monthly during project years 1-7.
d) Sample size: Target of 20 percent of the Gulf shrimp fleet annually.
e) Sites: Gulf of Mexico.

Parameter #2: Percentage of vessels using BRD systems according to operational recommendations

a) Purpose: To track the frequency of proper installation and use of certified BRDs as a performance metric for the GMT. This metric would inform implementation on compliance issues and help direct training and outreach.
b) Method: Record number of vessels not using BRD systems according to operational recommendations identified via GMT outreach.
c) Timing, Frequency, and Duration: Monthly during project years 1-7.
d) Sample size: Target of 20 percent of the Gulf shrimp fleet.
e) Sites: Gulf of Mexico.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000; Thom et al. 2005). Performance may be evaluated in terms of implementation of the project plan, expected project outputs, or the ability of the project to achieve the desired restoration outcomes.

An adaptive management approach would be applied to all aspects of the project but would be most robust during BRD proof of concept testing and certification. For example, results of proof of concept testing would be monitored daily during evaluations to ensure proper sample sizes are achieved for each prototype. If the BRD fails testing, the BRD would be reconfigured to improve performance and tested again.

4.0 Evaluation

Evaluation of project performance would be conducted to ensure the project is meeting the restoration objectives and inform the need for adaptive management or corrective actions. Objective-specific parameters identified above would be used to evaluate each objective.

Evaluation of Objective 1: Identify new advances in BRD technology via regional surveys and domestic and international outreach.

Identification of advances in BRD technology would be evaluated based on the number of new BRD configurations identified during outreach activities (surveys and engagement with international organizations) that may be applicable to the Gulf of Mexico shrimp fishery. The project goal is to identify 2-6 BRDs for further testing.

Evaluation of Objective 2: Evaluate bycatch reduction capabilities of new BRDs and certify BRDs that would provide a restoration benefit via bycatch reduction.

The number of BRD configurations with potential to provide restoration benefits would be evaluated based on the number that are certified for use by the shrimp fishery in the Exclusive Economic Zone of the southeastern United States. Analysis would include evaluation of BRD performance through measurements of shrimp catch retention and bycatch rates, as well as comparison to current BRDs. For a BRD to be certified, it must reduce finfish bycatch of at least 30 percent by weight (NMFS 2016).

Evaluation of Objective 3: Increase use of new BRD systems in the U.S. Gulf of Mexico shrimp fishery via outreach and incentives.

Usage of new BRD systems would be evaluated based on the number of agreements with vessel owners and the number of vessels installing new BRD systems. The goal is to have 20 percent of the federally-permitted Gulf of Mexico use new BRD systems.

Evaluation of Objectives 4 and 5: Evaluate bycatch reduction of the new BRDs in the commercial shrimp fishery and increase bycatch reduction by ensuring BRDs are used according to operational recommendations via outreach by the Gear Monitoring Team.

Proper use of BRDs would be evaluated based on inspections by the GMT. Data on improper use of BRDs would be used to calculate missed restoration benefits and help direct training to increase proper use.

Reduction of bycatch in the Gulf of Mexico shrimp fishery using new BRDs would be evaluated based on the number of vessels using the new BRDs, target catch, and the reduction in dead discards avoided relative to older BRD configurations. Expenses and profits of vessels using new BRDs would be estimated to better understand economic factors that may affect the use of new BRD systems.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

In this section, we describe how knowledge gained from the evaluation of monitoring data would be used at the project-level to determine whether the project, once implemented, is considered successful or whether corrective actions are needed during project implementation. A project may not be achieving its intended objectives because of previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

Table 5-1 provides the list of performance criteria for monitoring parameters and potential corrective actions that can be taken if performance criteria are not met. This table may not include all possible options; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions.

Monitoring Parameter	Performance Criteria	Potential Corrective Actions
Number of survey responses	20 percent of Gulf-wide fleet, including minimum of 50 percent of white shrimp fleet	Contact those who received survey and encourage them to complete and return it
Number of research entities engaged	To be determined based on number of appropriate research entities identified	Increase outreach to research organizations
Number of promising BRDs identified	2-6	Increase outreach to research organizations
Target catch retention and bycatch rates	Same or equal catch and lower bycatch rates	No corrective action as this is a screening for those BRDs going to certification testing
BRDs going to certification testing	Minimum of 1	Reconfigure BRDs so that they decrease bycatch while maintaining target catch
Number of new BRDs certified	Minimum of 1	Reconfigure BRDs so that they decrease bycatch while maintaining target catch

Monitoring Parameter	Performance Criteria	Potential Corrective Actions
Number of executed agreements	20 percent of federally permitted Gulf shrimp fleet	Increase incentives for participation
Number of vessels that installed new BRDs	20 percent of federally permitted Gulf shrimp fleet	Increase incentives for participation
Bycatch quantity and disposition	Less bycatch than with existing BRDs	Adjust gear configuration as necessary
Shrimp catch	Same or greater than with existing BRDs	Adjust gear configuration as necessary
Annual expenses per vessel	Same or less than with existing BRDs	Adjust gear configuration as necessary
Annual net profit	Same or greater than with existing BRDs	Adjust gear configuration as necessary
Number of inspections	20 percent of Gulf shrimp fleet annually	Increase at-sea and dockside inspections
Percentage of vessels using BRDs according to recommendations	20 percent of Gulf shrimp fleet	Increase dockside and at-sea outreach and training efforts. Seek feedback to determine cause of improper use.

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 6-1, separated by activity. Performance monitoring activities would be conducted in Years 1-7.

Table 6-1: Monitoring schedule.

Monitoring Activities	Year						
	1	2	3	4	5	6	7
Monitor survey and outreach	X						
Monitor testing, data collection, and analysis activities		X	X	X	X	X	X
Monitor outreach efforts by GMT	X	X	X	X	X	X	X

7.0 Data Management

7.1 Data Description

Data collection would occur by observers and NOAA personnel on several aspects of the projects throughout the year (Years 1-7) and be compiled within 6 months after collection. The data collection would occur at various sites across Gulf of Mexico.

To the extent practicable, all environmental and biological data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record Project-specific data, then Project-specific datasheets would be drafted prior to conducting any Project monitoring activities. Original hardcopy datasheets and notebooks and photographs would be retained by the Implementing Trustee.

Relevant Project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format. All field datasheets and notebook entries would be scanned to PDF files. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Geospatial data would adhere to FGDC/ISO standards.

7.2 Data Review and Clearance

All collected data would undergo proper QA/QC protocols, following the process outlined in Section 3 of the MAM Manual Version 1.0. In summary, the following steps would be taken: 1) For data that have been transcribed, the electronic data sheets would be verified against the original hardcopy datasheets and/or notebooks. Any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed outside of the Implementing Trustee's agency. 2) Implementing Trustees would verify and validate MAM data and information and would ensure that all data is i) entered or converted into agreed upon/commonly used digital format, ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with Implementing Trustee agency requirements.

After identified errors have been addressed, the Implementing Trustee would give the other TIG members time to review the data before making the data publicly available. Before submitting the monitoring data and information package, co-Implementing Trustees shall confirm with one another that the package is approved for submission (as applicable). The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

7.3 Data Storage and Accessibility

All data compiled and analyzed as part of this project would be stored on the Data Integration, Visualization, Exploration, and Reporting (DIVER) Restoration Portal. The data would be submitted to the DIVER Restoration Portal as soon as possible and no more than one year from when data are collected.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG trustees prior to releasing any project data that is the subject of the request (as applicable).

Some of the data collected are protected from public disclosure under federal and state law, e.g. personally identifiable information under the Privacy Act or observer information collected under, Magnuson–Stevens Fishery Conservation and Management Act, and therefore would not be publicly distributed.

8.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan has been finalized and updated annually to reflect the status of the MAM activities.

A final monitoring report would be developed within one year of the conclusion of monitoring activities. This report would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the report would follow the outline in the MAM Manual Version 1.0.

9.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

10.0 References

NRC. 2004. "Adaptive Management for Water Resources Project Planning." National Research Council. The National Academies Press, Washington, DC.

Pastorok, R.A., A. MacDonald, J.R. Sampson, P. Wilber, D.J. Yozzo, and J.P. Titre. 1997. "An ecological decision framework for environmental restoration projects." Ecological Engineering 9:89–107.

Steyer, G.D. and D.W. Llewellyn. 2000. "Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management." Ecological Engineering 15(3–4):385–395.

Thom, R.M., G. Williams, A. Borde, J. Southard, S. Sargeant, D. Woodruff, J.C. Laufle, and S. Glasoe. 2005. "Adaptively addressing uncertainty in estuarine and near coastal restoration projects." Journal of Coastal Research Special Issue No. 40. Coastal restoration: Where have we been, where are we now, and where should we be going? (Winter):94–108. Available: http://www.jstor.org/stable/25736618.

Williams, B.K. 2011. "Adaptive management of natural resources – framework and issues." Journal of Environmental Management 92:1346–1353.

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Communications Networks and Mapping Tools to Reduce Bycatch – Phase 1

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's restoration objectives and to support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The objective of this project is to reduce bycatch in Gulf of Mexico and Highly Migratory Species (HMS) fisheries by developing a system to create near-real time, spatially explicit maps of bycatch hotspots coupled with a communication tool that informs fishermen of the high bycatch potential in those areas. This "phase 1" or "engineering and design" phase would stop short of implementation of fishermen agreements. The hotspot tool would allow information communicated by fishermen to be incorporated into the maps to improve and evaluate prediction performance. This project would primarily focus on species that are of interest to pelagic longline, bottom longline, and shrimp trawl fisheries. Priority species would be determined based upon injury from the *Deepwater Horizon* oil spill, including juveniles and adults of billfish, swordfish, tunas, and reef fishes. Species and fishery prioritization would be determined in coordination with the fishing industry to take advantage of perceived opportunities. Also, the project would map the locations of high fish densities at spawning aggregation sites for snapper and grouper. Prioritization would be an iterative process based on analysis and stakeholder and industry feedback.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill Natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Fish and Water Column Invertebrates.
- Restoration approach: Voluntary fisheries-related actions to increase fish biomass.
- Restoration technique: Support emerging fishing technologies to provide tools that fishermen can use to reduce bycatch.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/ Environmental Assessment.

The project would be located in Gulf of Mexico region. Project activities include 1) General project planning, management, and coordination, 2) Conduct scoping workshops, 3) Conduct implementation workshop, 4) Compile information and develop predictive maps. This project is intended to restore Fish and Water Column Invertebrates injured by the *Deepwater Horizon* oil spill, including reef fish and Highly Migratory Species. This project may also benefit protected resources. The implementing trustee is the National Oceanic Atmospheric Agency (NOAA).

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, are to restore injured fish and invertebrate species across the range of coastal and oceanic zones by reducing direct sources of mortality and increase the health of fisheries by providing fishing communities with methodologies and incentives to reduce impacts to fishery resources.

The specific restoration objective for this project is to determine the feasibility of developing a system to create near-real time, spatially explicit maps of bycatch hotspots, coupled with a communication tool that informs fishermen of the high bycatch potential in those areas.

This initial phase includes conducting scoping workshops to identify fisheries, regions, and/or ports that would benefit from a bycatch identification system, the development of maps to identify areas of potentially high bycatch, and a workshop to discuss requirements for the use of a communication network to avoid bycatch. The project would result in determination of feasibility for an approach that could reduce bycatch in multiple fisheries, including longline and shrimp trawl fisheries. If feasible, future phases of the project would iteratively develop, implement, and refine the monitoring system and communication network. Reducing bycatch would result in restoration of fish biomass.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii).

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

Voluntary or regulatory hotspot closures are currently being implemented in U.S. fisheries on both the east and west coasts (e.g., Bethony et al. 2017). Hotspot identification and communication tools were implemented through a voluntary program in trawl fisheries in the northeast to limit the capture of river herring and butterfish. The program is credited as helping avoid closures to herring and squid fisheries. The program received additional funding to expand to bottom trawl fisheries as well. Other examples of avoidance of bycatch areas include recent regulations in HMS fisheries that require longline fishermen and gillnetters to communicate interactions to other nearby fishermen with dusky shark and then relocate fishing operations at least one nautical mile from encounter locations. There are some specific challenges to implementing real-time bycatch avoidance projects including attracting participants to collective action and risk of cheating within the program. There must be ample coordination with regulatory authorities to ensure appropriate incentives for participation. Real-time avoidance programs need adequate monitoring and observation systems to avoid cheating and to measure success.

1.3.1 Potential Sources of Uncertainty

Potential sources of uncertainty are defined as those that may affect the ability of a project to achieve its restoration objectives. Sources of uncertainty, the degree of uncertainty, and the level of uncertainty associated with projects would vary.

This project would be primarily an engineering and design project. As this project relies on compiling data from external sources and on the participation and buy-in of the fishing community, there are a number of potential sources of uncertainty that could affect project performance and success. Potential sources of uncertainty include:

- Availability of data to conduct analyses.
- Willingness of the community to participate.
- Time requirements for data processing and regulatory analysis.

2.0 Project Monitoring

Performance monitoring would be conducted to evaluate project success and identify the need for potential corrective actions or adaptive management. Project implementation would be evaluated based on accomplishment of the outcomes identified for each Activity in the Project Description within the specified timeframes. Additional parameters to gauge feedback from participants would be developed as part of the process of planning the scoping workshops, and would be added to this plan. Similarly, parameters to evaluate the performance of the mapping system and communications network (e.g., timeliness, accuracy, cost) and the performance of the fishers (e.g., participation level, bycatch levels) would be developed and incorporated in the plans for future phases of the project.

Objective #1: determine the feasibility of developing a system to create near-real time, spatially explicit maps of bycatch hotspots, coupled with a communication tool that informs fishermen of the high bycatch potential in those areas

Parameter #1: Number of scoping workshops conducted

a) Purpose: To determine the effort made in identifying potential fisheries in which to implement the project.
b) Method: Count the number of workshops conducted.
c) Timing, Frequency, and Duration: Tally annually.
d) Sample Size: All workshops conducted.
e) Sites: All sites where workshops are held.

Parameter #2: Number of fisheries that may benefit from a bycatch identification system

a) Purpose: To determine which fisheries would be good candidates for implementation of a bycatch identification system.
b) Method: Review the results of the scoping workshops and determine which fisheries are suitable for project implementation.
c) Timing, Frequency, and Duration: After scoping workshops are held.
d) Sample Size: All workshops conducted.
e) Sites: All locations where workshops are held.

Parameter #3: Bycatch map development

a) Purpose: To determine if maps identifying potential bycatch areas are produced.
b) Method: Count the number of fisheries for which bycatch maps are produced.
c) Timing, Frequency, and Duration: N/A.
d) Sample Size: All fisheries for which bycatch maps are developed.
e) Sites: All sites for which bycatch maps are developed.

Parameter #4: Identification of areas/fisheries with potentially high bycatch

a) Purpose: To determine potential locations for project implementation.
b) Method: Count the number of areas/fisheries with areas of potential bycatch.
c) Timing, Frequency, and Duration: N/A.
d) Sample Size: All maps produced.
e) Sites: All areas mapped.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000; Thom et al. 2005). Performance may be evaluated in terms of implementation of the project plan, expected project outputs, or the ability of the project to achieve the desired restoration outcomes.

For this project, adaptive management may be applied to determine to best methods for hosting workshops and would be an integral part of the cycle of development, implementation, and refinement of the system in future phases. The information gained from the workshops and maps would help determine the best fisheries and locations in which to implement the project.

4.0 Evaluation

Evaluation of Objective 1: **Determine the feasibility of developing a system to create near-real time, spatially explicit maps of bycatch hotspots, coupled with a communication tool that informs fishermen of the high bycatch potential in those areas.**

The feasibility of developing mapping tools and communications networks to reduce bycatch would be evaluated based on the number of fisheries identified in workshops as having potential to benefit from a bycatch identification system coupled with the identification of fisheries and areas with potentially high bycatch.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

As this is a Phase 1 project aiming to assess the feasibility of developing mapping tools and a communications network to reduce bycatch, no corrective actions are necessary.

6.0 Monitoring Schedule

Table 6-1: Monitoring schedule.

Monitoring Activities	Year		
	1	2	3
Conduct scoping workshops	X	X	
Conduct implementation workshops		X	X
Compile information and develop predictive maps		X	X

7.0 Data Management

7.1 Data Description

A number of existing datasets would be compiled as part of this project. The project would compile metrics of the physical environment including ocean heat content and distance to fronts, chlorophyll, and other information inferred from satellite and buoy data. The project would also compile (or use other compiled sources) existing habitat, fishery–dependent data, independent data, and other environmental data to estimate species distribution, population density including catch statistics, and size frequencies of populations.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Geospatial data would adhere to FGDC/ISO standards.

7.2 Data Review and Clearance

Since all data would be compiled from existing data sources, it would be assumed that the datasets have been properly cleared using QA/QC procedures. However, additional data checks may be conducted, such as:

- Checking units.

- Comparing values to expected value ranges (e.g., existing datasets, reports).
- Checking date and time.
- Performing geospatial checks (e.g., latitude and longitude coordinates).
- Ensuring data columns and rows line up properly.
- Looking for missing or irregular data entries.
- Looking for blank entries.
- Performing statistical analyses.
- Noting any data qualifiers.
- Checking for outliers.

The Implementing Trustee would verify that the dataset is labeled with metadata in accordance with Implementing Trustee agency requirements to the extent practicable, and that geospatial data follow FGDC/ISO standards.

After identified errors are addressed, the Implementing Trustee would give the other TIG members time to review the data before making the data publicly available. The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

7.3 Data Storage and Accessibility

All MAM data compiled and analyzed as part of this project would be stored or referenced on the Data Integration, Visualization, Exploration, and Reporting (DIVER) Restoration Portal. The data would be submitted to the DIVER Restoration Portal as soon as possible and no more than one year from when data are collected.

All data compiled and analyzed as part of this project would be stored on the fisheries or data specific platforms. These platforms are not currently known. Future planning would include data management plans.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG trustees prior to releasing any project data that is the subject of the request as applicable.

Some of the data collected are protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under, Magnuson–Stevens Fishery Conservation and Management Act [MSFCMA], etc.) and therefore would not be publicly distributed.

8.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan has been finalized and updated annually to reflect the status of the MAM activities.

An interim monitoring report would be developed at Year 2. The final monitoring report would be developed within one year of monitoring activities being concluded. These reports would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the interim and final monitoring reports would follow the outline in the MAM Manual Version 1.0.

9.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

10.0 References

NRC. 2004. Adaptive Management for Water Resources Project Planning. National Research Council. The National Academies Press, Washington, DC.

Pastorok, R.A., A. MacDonald, J.R. Sampson, P. Wilber, D.J. Yozzo, and J.P. Titre. 1997. "An ecological decision framework for environmental restoration projects." Ecological Engineering 9:89–107.

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Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Restoring for Bluefin Tuna via Fishing Depth Optimization

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's restoration objectives and to support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The objective of this project is to restore pelagic fish biomass through actions that are expected to show that bluefin tuna bycatch and bycatch mortality can be reduced in the pelagic longline (PLL) fishery operating in the Gulf of Mexico. A demonstration study would be conducted within the Gulf of Mexico PLL fishery to evaluate the effects of increasing PLL gear set depth in the water column on bluefin tuna bycatch mortality. Based on previous findings, the expected result would be reduced bluefin tuna interactions with PLL gear, leading to decreased bluefin tuna bycatch and bycatch mortality. Contingent on the finding of a restoration benefit, the results would be disseminated to Gulf of Mexico PLL fishermen at workshops in the United States and Mexico. It is anticipated that PLL fishermen would adopt this fishing technique voluntarily, due to the economic benefit of avoiding bluefin tuna bycatch, and thus institute a long-term continued restoration benefit to bluefin tuna.

This project would be implemented as restoration for the *Deepwater Horizon* oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Fish and Water Column Invertebrates.
- Restoration approach: Voluntary fisheries-related actions to increase fish biomass.
- Restoration technique: Technological solutions to reduce bycatch.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

The project would be located in the northern Gulf of Mexico off Louisiana, Mississippi, and Alabama. No field sampling would be conducted in closed fishing areas near Dulac, LA, and Panama City, FL. Project activities include 1) project management, 2) a demonstration study to evaluate the effects of setting pelagic longlines deeper than typically fished, 3) determination of restoration benefit of this fishing practice, and 4) dissemination of results and training. This project is intended to benefit Fish and Water Column Invertebrates injured by the *Deepwater Horizon* oil spill, including bluefin tuna and other pelagic species. This project may also benefit sea turtles and marine mammals and would benefit the pelagic longline fishery by providing increased knowledge regarding the fishery. The implementing trustee is the National Oceanic Atmospheric Agency (NOAA). The National Marine Fisheries Service's Restoration Center of the Office of Habitat Conservation, Highly Migratory Species (HMS) Management Division, and Southeast Fisheries Science Center (SEFSC) – Mississippi Laboratories would be involved in implementation and monitoring. The SEFSC Pelagic Observer Program would conduct the onboard observing. Potential non-agency implementation partners include The Nature Conservancy, National Fish and Wildlife Foundation, and Ocean Conservancy.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, is:

- Voluntary fisheries-related actions to increase fish biomass;

The specific restoration objectives for this project are to:

- Conduct a demonstration study within the Gulf of Mexico commercial PLL fishery to evaluate the effects of setting PLL gear deeper than typically fished including:
    - evaluating bluefin and yellowfin tuna interactions with PLL gear by deploying hook timer and temperature/depth recorders on the PLL gear to determine time and depth that bluefin tuna become hooked on the longline.
    - evaluating bluefin tuna mortality rates caught on PLL gear at varying depths.
    - evaluating distribution, migration, and other behavioral information by deploying PSAT tags on approximately 40 caught bluefin and yellowfin tuna.
- Determine the restoration benefit of this fishing practice.
- Disseminate results at workshops and other outreach events for industry and scientific community.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives in Section 5.0.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

This project involves a relatively simple adjustment to fishing technique. By changing the depth at which pelagic longlines are set, bycatch may be reduced. If this change proves effective, people would be likely to adopt it if it incurs no additional costs. The demonstration component of this project would examine the effectiveness of adjusting set depth at reducing bycatch.

1.3.1 Potential Sources of Uncertainty

Potential sources of uncertainty are defined as those that may affect the ability of a project to achieve its restoration objectives. Sources of uncertainty, the degree of uncertainty, and the level of uncertainty associated with projects varies.

As this project relies on voluntary participation by commercial vessel owners, a potential source of uncertainty lies in the ability to engage eligible vessel owners to participate and adopt the proposed fishing methods. The other sources of uncertainty are those that the project is designed to test, including the relative effectiveness, bycatch levels, and cost of fishing at the two depths.

2.0 Project Monitoring

Performance monitoring would be conducted to evaluate project success and identify the need for potential corrective actions or adaptive management. Below is a list of parameters to be monitored, organized by each restoration objective. For each of the identified monitoring parameters, information is provided on the intended purpose, monitoring methods, timing and frequency, duration, sample size, and sites. The parameters listed below may or may not be tied to performance criteria and/or corrective actions (see Section 5.0: Project-Level Decisions).

Objective #1: Conduct a demonstration study within the Gulf of Mexico commercial PLL fishery to evaluate the effects of setting PLL gear deeper than typically fished

Parameter #1: Number of vessels under contract to participate

a) Purpose: To determine success of project implementation--would determine level of participation and changes in participation rate.
b) Method: Record number of agreements.
c) Timing, Frequency, and Duration: Once/year for project years 2-5.
d) Sample size: 1; the expected total number of vessels is 4.
e) Sites: N/A.

Parameter #2: Number of paired sets (normal and deep) per vessel

a) Purpose: To determine success of project implementation, sample size of study.
b) Method: Count number of paired sets made.
c) Timing, Frequency, and Duration: Every trip from March - June for project years 2-6.
d) Sample size: Minimum of 40 deep sets and 40 regular set per project year, or an average of 10 deep sets and 10 regular set per month per project year.
e) Sites: To be determined based on established fishing practices.

Parameter #3: Number of PSAT tags deployed on bluefin and yellowfin tuna

a) Purpose: To determine success of project implementation.
b) Method: Record number of PSAT tags successfully deployed.
c) Timing, Frequency, and Duration: Once/year in project year 2.

d) Sample size: Expected total of 40 tags deployed.
e) Sites: N/A.

Parameter #4: Number of PSAT data points obtained

a) Purpose: This would be used to evaluate PSAT data quality.
b) Method: TBD.
c) Timing, Frequency, and Duration: For as long as tags transmit data.
d) Sample size: All PSAT tags deployed.
e) Sites: N/A.

Objective #2: Determine the restoration benefit of this fishing practice

Parameter #1: Physical Characteristics: Temperature and Depth

a) Purpose: These measurements would be used to evaluate interactions between the species and fishing depths.
b) Method: Temperature (degrees C) and Depth (m) would be recorded every 2 minutes by TDRs deployed on each line.
c) Timing, Frequency, and Duration: March-June each year, for 4 years. Data would be collected for every paired gear deployment.
d) Sample size: Minimum of 40 deep sets and 40 regular set per project year, or an average of 10 deep sets and 10 regular set per month per project year.
e) Sites: To be determined based on established fishing practices.

Parameter #2: Capture Time

a) Purpose: This would be used to evaluate interactions between the species and fishing depths.
b) Method: Time in minutes between gear deployment and capture of each animal would be recorded in minutes by hook timers deployed on each gangion.
c) Timing, Frequency, and Duration: March-June each year, for 4 years. Data would be collected for every paired gear deployment.
d) Sample size: Minimum of 40 deep sets and 40 regular set per project year, or an average of 10 deep sets and 10 regular set per month per project year.
e) Sites: To be determined based on established fishing practices.

Parameter #3: Regulatory Discards and Bycatch by Species

a) Purpose: This parameter would be used to test the hypothesis that the deeper gear set reduces bycatch and to evaluate the potential restoration value of adoption of the deeper gear set.
b) Method: On-board observers would count and collect standard size measurements of each individual (such as weight in kg and length in cm), as appropriate for the species.
c) Timing, Frequency, and Duration: Every trip from March - June for project years 2-6.
d) Sample size: Minimum of 40 deep sets and 40 regular set per project year, or an average of 10 deep sets and 10 regular set per month per project year.
e) Sites: N/A.

Parameter #3: Average biomass of bycatch avoided

a) Purpose: This parameter would evaluate the effectiveness of the deep set fishing technique to reduce bycatch by estimating the average regulatory discards and other bycatch avoided.
b) Method: Compare the difference between biomass of bycatch (kg per vessel per year) from normal and deep set sets using the observer data from Parameter #3.
c) Timing, Frequency, and Duration: Every trip from March - June for project years 2-6.
d) Sample size: Minimum of 40 deep sets and 40 regular set per project year, or an average of 10 deep sets and 10 regular set per month per project year.
e) Sites: N/A.

Parameter #4: Targeted Catch by Species

a) Purpose: This parameter would be used to evaluate the relative effectiveness of fishing at each depth and to detect interactions between the fishing depth and species.
b) Method: On-board observers would count and measure the weight (kg) and length (cm) of each individual.
c) Timing, Frequency, and Duration: Every trip from March - June for project years 2-6.
d) Sample size: Minimum of 40 deep sets and 40 regular set per project year, or an average of 10 deep sets and 10 regular set per month per project year.
e) Sites: N/A.

Parameter #5: Net Profit

f) Purpose: This would be used to estimate the effect of the deep set technique on profit, which may incentivize its use.
g) Method: Cost tracking of catch.
h) Timing, Frequency, and Duration: Once/year/vessel in project years 2-6.
i) Sample size: All participants.
j) Sites: N/A.

Objective #3: Disseminate results at workshops and other outreach events for industry and scientific community

Parameter #1: Number of outreach events conducted

a) Purpose: To determine level of outreach effort.
b) Method: Count the number of outreach events held.
c) Timing, Frequency, and Duration: TBD.
d) Sample size: All outreach events held.
e) Sites: All locations where outreach events are held.

Parameter #2: Attendance at outreach events

a) Purpose: To determine the proportion of the fishing community reached by the outreach effort.
b) Method: Count the number of people attending outreach events.
c) Timing, Frequency, and Duration: TBD.

d) Sample size: All outreach events held.
e) Sites: All locations where outreach events are held.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000; Thom et al. 2005). Performance may be evaluated in terms of implementation of the project plan, expected project outputs, or the ability of the project to achieve the desired restoration outcomes.

An adaptive management approach would be applied to all aspects of the project. One example is the evaluation of tuna interactions between normal and deep sets could show an optimal depth for avoiding bluefin tuna interactions. This depth could then be the target set depth for the remainder of the project. Other examples include the corrective actions identified for each performance criterion in Section 5.0.

4.0 Evaluation

Evaluation of project performance would be conducted to ensure the project is meeting the restoration objectives and inform the need for adaptive management or corrective actions. Objective-specific evaluations are described below.

Objective 1: Conduct a demonstration study

This objective would be evaluated based on the number of paired sets made, and whether sufficient data were obtained to determine if there are differences in target catch and bycatch by set depth. The tagging portion of the project would be evaluated based on the number of tags deployed, the number of data points obtained from those tags, and whether the data substantially contribute to our knowledge of tuna distribution and migration patterns.

Objective 2: Determine restoration benefits of deep sets

This objective would be evaluated based on the differences in bycatch between regular and deep sets, as determined by the change in quantity (weight and size) of regulatory discards and other bycatch by species and average biomass of bycatch avoided. Change in quantity of target catch by species and change in net profit would also be examined as people would only be likely to adopt alternative set depths if their profits remain the same or increase relative to standard set depth.

<u>Comparison of Bycatch by Fishing Depth</u>

The differences in regulatory discards and bycatch by species between regular and deep sets would be analyzed to determine whether deeper sets result in less bycatch. If so, the average amount of bycatch avoided would be estimated for different levels of adoption of the deeper set depth in the fishery.

Comparison of Catch by Fishing Depth

The differences in targeted catch by species for each regular and deep set gear pair would be calculated and analyzed using standard statistical techniques to determine whether, on average, deeper sets result in differences in catch of bluefin or yellowfin tuna.

Tuna Interactions with Gear

Capture time would be used to identify the depth and temperature at which each individual tuna is caught. Patterns in catch by depth and temperature for each species would be detected by standard graphical and statistical tests.

Change in Net Profit

Change in net profit may be estimated by comparing catch of target species between regular and deep-set gears.

Objective 3: Disseminate results

This objective would be evaluated based on whether or not the number of outreach events held and attendance at those events meet the performance criteria defined below.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

In this section, we describe how knowledge gained from the evaluation of monitoring data would be used at the project-level to determine whether the project, once implemented, is considered successful or whether corrective actions are needed during project implementation. A project may not be achieving its intended objectives because of previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework. As this project represents an exploratory step in the potential pelagic longline set depths, performance criteria would be based on whether or not data collected were sufficient to address the questions for which they were collected, rather than any particular outcome.

Table 5-1 provides the list of performance criteria for each performance monitoring parameter and potential corrective actions that can be taken if performance criteria are not met. This table may not include all possible options; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions.

Monitoring Parameters	Performance Criteria	Potential Corrective Actions
Number of vessels under contract	4	Increase incentives for participating in program
Number of paired sets per vessel	Initially the criterion would be deployment 40 pairs. However, the resulting data must be sufficient to detect minimum differences in Regulatory Discards, Total Bycatch, Catch of Bluefin Tuna, Catch of Yellowfin Tuna, and Net Profit, to be determined following analysis of data from previous years.	Conduct more trials
Number of PSAT tags deployed	40	Deploy more tags if funds permit
Number of outreach events conducted	4 events to allow interested Gulf-wide stakeholders to attend	Adjust number of outreach events according to stakeholder feedback
Outreach event attendance	Attendance by at least 50 percent of pelagic longline vessel owners	Adjust number of outreach events according to stakeholder attendance

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 6-1, separated by activity. Performance monitoring activities would be conducted in Years 2-10.

Table 6-1: Monitoring schedule.

Monitoring activities	Year									
	1	2	3	4	5	6	7	8	9	10
Monitor implementation of demonstration study		X	X	X	X					
Monitor data collection and analysis activities		X	X	X	X	X				
Monitor outreach and education						X	X	X	X	X

7.0 Data Management

7.1 Data Description

Data collection would be performed by observers from NOAA's Pelagic Observer Program from March through June (Years 2-5) and be compiled within 6 months after collection. The data collection would occur at sites selected by contracted vessels across the Gulf of Mexico. Data from approximately 40 paired pelagic longline sets would be collected per vessel each year for four years.

To the extent practicable, all environmental and biological data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record Project-specific data, then Project-specific datasheets would be drafted prior to conducting any Project monitoring activities. Original hardcopy datasheets and notebooks and photographs would be retained by the Implementing Trustee.

Relevant Project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format. All field datasheets and notebook entries would be scanned to PDF files. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents). Geospatial data would adhere to FGDC/ISO standards.

7.2 Data Review and Clearance

All collected data would undergo proper QA/QC protocols, following the process outlined in Section 3 of the MAM Manual Version 1.0. In summary, the following steps would be taken: 1) For data that have been transcribed, the electronic data sheets would be verified against the original hardcopy datasheets and/or notebooks. Any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed outside of the Implementing Trustee's agency. 2) Implementing Trustees would verify and validate MAM data and information and would ensure that all data is i) entered or converted into agreed upon/commonly used digital format, ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with Implementing Trustee agency requirements.

After identified errors have been addressed, the Implementing Trustee would give the other TIG members time to review the data before making the data publicly available. Before submitting the monitoring data and information package, co-Implementing Trustees shall confirm with one another that the package is approved for submission (as applicable). The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

7.3 Data Storage and Accessibility

All data compiled and analyzed as part of this project would be stored on the Data Integration, Visualization, Exploration, and Reporting (DIVER) Restoration Portal. The data would be submitted to the DIVER Restoration Portal as soon as possible and no more than one year from when data are collected.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG trustees prior to releasing any project data that is the subject of the request (as applicable).

Some of the data collected are protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under, Magnuson–Stevens Fishery Conservation and Management Act [MSFCMA], etc.) and therefore would not be publicly distributed.

8.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan has been finalized and updated annually to reflect the status of the MAM activities.

A final monitoring report would be developed within one year of the conclusion of monitoring activities. These reports would be made publicly available through the DIVER Restoration Portal. To the extent practicable, report would follow the outline in the MAM Manual Version 1.0.

9.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

10.0 References

NRC. 2004. Adaptive Management for Water Resources Project Planning. National Research Council. The National Academies Press, Washington, DC.

Pastorok, R.A., A. MacDonald, J.R. Sampson, P. Wilber, D.J. Yozzo, and J.P. Titre. 1997. "An ecological decision framework for environmental restoration projects*." Ecological Engineering* 9:89–107.

Steyer, G.D. and D.W. Llewellyn. 2000. "Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management." Ecological Engineering 15(3–4):385–395.

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Sea Turtles Restoration Type Draft MAM Plans

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Gulf of Mexico Sea Turtle Atlas

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to 1) evaluate progress toward meeting the project's objectives, including sufficiently addressing specific questions that would inform restoration planning, implementation, and/or evaluation, and 2) support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project would develop a near-real time 'Gulf of Mexico Sea Turtle Atlas' tool to provide restoration planners, resource managers, and responders with key spatial datasets for understanding sea turtle presence, abundance and/or density, and habitat use. This Atlas tool would aim to integrate and display available sea turtle datasets from the Gulf of Mexico including nesting data, aerial survey and in-water capture data, telemetry data, and stranding data. It would also include available data on relevant environmental conditions, distribution and intensity of anthropogenic threats, and status and summaries of existing monitoring and restoration projects.

This project would be implemented as restoration for the *Deepwater Horizon* (DWH) oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Sea Turtles.
- Primary restoration approach: Increase sea turtle survival through enhanced mortality investigation and early detection of and response to anthropogenic threats and emergency events.
- Restoration technique: Enhanced investigation of mortality sources.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

The Sea Turtle Atlas would include key datasets of sea turtle distribution, habitats, and other relevant information Gulf-wide. Project activities include: 1) Identifying datasets to include in the sea turtle Atlas, 2) Developing and launching the Sea Turtle Atlas, and 3) Monitoring and maintaining the Atlas. This project is intended to benefit all sea turtle species injured by the DWH oil spill. In particular, it would provide critical data to implement the restoration approach of increasing sea turtle survival through enhanced mortality investigation and response to anthropogenic threats and emergency events; support implementation of the ongoing early restoration project based on this approach;

support emergency response coordination: and contextualize restoration benefits with other conservation activities designed to restore sea turtles in the Gulf. The implementing agency is NOAA. Partner agencies include DOI and Trustee agencies.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal of the project is to develop a 'Gulf of Mexico Sea Turtle Atlas' tool that provides the Trustees, restoration planners, conservation managers, and responders with key spatial datasets for understanding sea turtle presence, abundance and/or density, and habitat use.

This project was designed to primarily address the Sea Turtles Restoration Type, defined in the PDARP/PEIS. The goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS § 5.5.10, are:

- Implement an integrated portfolio of restoration approaches to address all injured life stages (hatchling, juvenile, and adult) and species of sea turtles.
- Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats.
- Restore sea turtles in the various geographic and temporal areas within the Gulf of Mexico and Atlantic Ocean that are relevant to injured species and life stages.
- Support existing conservation efforts by ensuring consistency with recovery plans and recovery goals for each of the sea turtle species.

The specific objectives for this project are to:

- Provide a centralized location for biogeographical data related to sea turtle distribution, habitats, and threats. This would inform restoration planning, project prioritization, adaptive management, and monitoring.
- Support efforts to enhance mortality investigation and response to anthropogenic threats and emergency events.
- Develop the Atlas in collaboration with existing data providers and data portal managers to streamline and standardize the presentation of sea turtle data and ensure the Atlas' role as a data resource that addresses restoration needs and complements existing repositories.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives in Section 5.0.

1.3 Conceptual Setting

As with many other living coastal and marine resources, information on sea turtle distribution, important habitats, and other relevant factors is needed to support the planning, implementation, and evaluation of actions aimed at restoring this resource in the Gulf of Mexico. In addition to gaps in information, there is no centralized location to access all relevant datasets. To address these needs, this project would develop a Sea Turtle Atlas with a user-friendly, web-based interface that includes key spatial datasets that provide information on sea turtle presence, abundance and/or density, habitat use, and threats in the Gulf of Mexico. The tool is intended to be used by restoration planners, resource managers, and responders to support restoration efforts as well as deployment of resources when responding to sea turtle threats.

Specific questions that this project aims to address include:

- Does the Atlas include all relevant, available datasets?
- Does the Atlas provide a user-friendly centralized location for datasets?
- Is the Atlas providing a platform to enhance restoration planning and implementation (e.g., enhanced mortality investigations of sea turtles)?

As with other MAM-type projects, a key factor that affects project effectiveness and future benefits is how effectively the Atlas tool is used to inform restoration decisions, which may be influenced by the quality, accessibility, and applicability of the data as well as the type and interest of the end users.

1.3.1 Potential Sources of Uncertainty

This project would use existing sea turtle data and would provide users access to the data in a web-based data portal. As this project relies on existing data and user application, there are several potential sources of uncertainty that could affect project performance and success. Potential sources of uncertainty include:

- The ability to obtain data from different data holders and existing data repositories.
- The quality, availability, and usability of existing data.
- The frequency with which datasets are updated.
- The functionality and usability of the web-based interface.
- The interest of key users in using the web-based tool.
- The degree to which information provided through the Atlas would be used to improve restoration decision-making and reduce threats to sea turtles.

2.0 Project Monitoring

Performance monitoring would be conducted to facilitate evaluation of project success and inform the need for potential corrective actions or adaptive management. Proposed monitoring parameters are listed below, these are designed to monitor progress toward achieving all the project objectives. Information is also provided on the intended purpose, monitoring methods, timing and frequency, and duration. The specific analyses for the parameters are described in Section 4.0 (Evaluation). Section 5.0 (Project-Level Decisions) discusses how these parameters may be tied to performance criteria and/or corrective actions.

Parameter #1: Number and types of datasets included in the Atlas

a) Purpose: This parameter would be used to determine success of project implementation; i.e., to determine if relevant, priority datasets are successfully obtained and made accessible through the Atlas (Objectives 1 and 2). It would also indicate successful collaboration with data providers and data portal managers (Objective 3).

b) Method: Compile the list of datasets included in the Atlas as well as other relevant information (e.g., source, collector, location, time, data type).
c) Timing, Frequency, and Duration: Upon receipt of all data sets to be included in the first version of the Atlas, then upon acquisition of each new data set; annually after release, from Years 3-15.
d) Sample size: N/A.
e) Sites: N/A.

Parameter #2: Number of datasets adequately updated

a) Purpose: Determine if relevant, priority datasets contained and displayed through the Atlas are updated in a timely manner, as appropriate (Objectives 1 and 2). It would also indicate successful collaboration with data providers and data portal managers (Objective 3).
b) Method: Review original data sources through collaboration with data providers and data portal managers to determine whether datasets in the Atlas require updates.
c) Timing: Annual, as appropriate.
d) Sample size: N/A.
e) Sites: N/A.

Parameter #3: Number of users (by general group), number and types of use (e.g., restoration planning, mortality investigation, crisis response), frequency of use, and effectiveness of the Atlas for supporting the intended uses (yes/no)

a) Purpose: This parameter would be used to assess project performance and inform adaptive management. Project success would be evaluated by determining if the Atlas is used as a project- and resource-level MAM tool to provide guidance to Gulf restoration (Objectives 1 and 2) and other uses related to sea turtle research, conservation planning, and management (Objective 3).
b) Method: Use periodic surveys of different user groups and semiannual meetings of the steering committee (and key users, as feasible) to determine the number of users, the general user groups (e.g., affiliation, type of user), type(s) of use(s), frequency of use(s), and whether the Atlas effectively supported the intended use(s). Surveys could initially target DWH NRDA Trustee users, and then expand to include non-Trustee users (including data providers) as the Atlas is made publicly accessible. One approach would be for users to set up profiles using an email address to enter the Atlas application, and those emails can be used to deliver surveys and to make direct contact with users to solicit feedback.
c) Timing, Frequency, and Duration: Once during beta development of the web-based tool (Year 2); annually after the tool is complete, from Years 3-15.
d) Sample size: N/A.
e) Sites: N/A.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997;

Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000; Thom et al. 2005). Performance may be evaluated in terms of implementation of the project plan, expected project outputs, or the ability of the project to achieve the desired restoration outcomes.

For this project, an adaptive management approach would be taken to ensure the product contains all the relevant datasets, is user-friendly, and is readily accessible to support a variety of applications. Beta testing of the Sea Turtle Atlas would be conducted among potential users and any identified refinements would be incorporated in the final version. Once released, the Sea Turtle Atlas would be evaluated annually among different user groups with targeted improvements to the system, possibly including additional datasets, based on user feedback (as appropriate).

4.0 Evaluation

Evaluation of project performance would be conducted to ensure the project is meeting the project objectives and inform the need for adaptive management or corrective actions.

Evaluation of Project Implementation:

For this project, three parameters would be evaluated to determine success of project implementation and inform adaptive management. The specific parameters and associated analyses are provided below.

- **Parameter #1: Number and types of datasets included in the Atlas:** This parameter would be evaluated by comparing the datasets successfully obtained and displayed with the list of potentially relevant datasets (and their custodians or managers) identified in Activity 1 by the Atlas steering committee.
- **Parameter #2: Number of datasets adequately updated:** This parameter would be evaluated by reviewing the list of potentially relevant datasets (and their custodians or managers) identified in Activity 1 by the Atlas steering committee, which would include information about the regularity with which each dataset is expected to be updated.
- **Parameter #3: Number of users (by general group), number and types of use (e.g., restoration planning, mortality investigation, emergency response), frequency of use, and effectiveness of the Atlas for supporting the intended uses:** This parameter would be evaluated through analyses of responses gathered through periodic surveys of different user groups and semiannual meetings of the steering committee (and key users, as feasible). Analyses of responses would evaluate the total number of users, different uses, efficacy of the Atlas in supporting those uses. The information collected would also allow for identification of data gaps and opportunities to improve functionality of the Atlas.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Knowledge gained from the evaluation of monitoring data would be used at the project-level 1) to determine whether the project, once implemented, is considered successful, and/or 2) to inform the need for potential corrective actions. Project success would be determined by comparing monitoring data to project-specific performance criteria for key parameters related to the project's objectives. The monitoring parameters and project-specific performance criteria are presented in Table 5-1.

The evaluation of project success may determine that a project has not met its performance criteria. A variety of factors including previously identified uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers may all influence project success. Table 5-1 presents potential corrective actions that can be taken if performance criteria are not met. This table may not include all possible options; rather, it includes a list of potential actions for each individual parameter to be considered if the project has not met its performance criteria. Other corrective actions may be identified post-implementation, as appropriate. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions.

Monitoring Parameters	Performance Criteria	Potential Corrective Actions
Number and types of datasets included in the Atlas	The Atlas includes datasets that are similar to those originally proposed (at least 75 percent by Year 3).	1) If appropriate missing datasets are identified, they would be acquired or document why they are not included, 2) if the missing datasets are not identified, then no action would be taken.
Number of datasets adequately updated	All datasets displayed through the Atlas web application are updated, as appropriate.	1) If appropriate outdated datasets are identified, they would be updated, 2) if all datasets are updated, then no action would be taken.
Number of effective and non-effective uses for mortality investigation or response to threats	The Atlas is used by a range of users across relevant user groups and applications (e.g., planning and monitoring restoration projects), particularly for mortality investigation or response to threats. There are >75 percent effective uses of the Atlas.	Conduct targeted outreach to increase use by specific user groups and/or applications. Modify tool based on user comments. Consult users to find out why the Atlas use was not effective (e.g., necessary data missing, could not view data) and obtain necessary data (if possible) or modify interface accordingly.

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 6-1, separated by activity. Performance monitoring activities would be conducted in Years 2-15.

Table 6-1: Monitoring schedule.

Monitoring Activities	Year									
	1	2	3	4	5	6	7	8	9	10-15
Incorporated datasets reviewed and updated		X	X	X	X	X	X	X	X	X
User survey (beta version)		X	X							
User survey (final version)			X	X	X	X	X	X	X	X

7.0 Data Management

7.1 Data Description

Several existing datasets would be compiled as part of this project, as discussed in the project description. All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin and data owner, usage, and format – can reference different documents). Geospatial data would adhere to FGDC/ISO standards. All data would conform to data sharing, management, and use agreements drafted by the Atlas steering committee and agreed to by data providers.

7.2 Data Review and Clearance

Since all data would be compiled from existing data sources, it would be assumed that the datasets have been properly subjected to QA/QC. However, additional data checks may be conducted, such as:

- Checking units.
- Comparing values to expected value ranges (e.g., existing datasets, reports).
- Checking date and time.
- Performing geospatial checks (e.g., latitude and longitude coordinates).
- Ensuring data columns and rows line up properly.
- Looking for missing or irregular data entries.
- Looking for blank entries.
- Performing statistical analyses.
- Noting any data qualifiers.
- Checking for outliers.

The Implementing Trustee would verify that the dataset is labeled with metadata in accordance with Implementing Trustee agency requirements to the extent practicable, and that geospatial data follow FGDC/ISO standards.

7.3 Data Storage and Accessibility

Identification of a storage platform, development of a database, and creation of a long-term data management plan are components of the project. Once this work is done, the information would be provided to the public in a report accessible on the Atlas's public-facing, web application.

7.4 Data Sharing

Data would be made publicly available — where appropriate — in accordance with the Federal Open Data Policy, through the chosen data platform within one year following the completion of Phase 2. Some proprietary datasets would not be made publicly available, but would be viewable within the Atlas's web application. Some of the data collected are protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under, Magnuson–Stevens Fishery Conservation and Management Act [MSFCMA], etc.) and therefore would not be publicly distributed. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG Trustees prior to releasing any project data that is the subject of the request.

8.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan has been finalized and updated annually to reflect the status of the MAM activities. The final monitoring report would be developed within one year of monitoring activities being concluded and would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the final monitoring report would follow the outline in the MAM Manual Version 1.0.

9.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

10.0 References

NRC. 2004. Adaptive Management for Water Resources Project Planning. National Research Council. The National Academies Press, Washington, DC.

Pastorok, R.A., A. MacDonald, J.R. Sampson, P. Wilber, D.J. Yozzo, and J.P. Titre. 1997. "An ecological decision framework for environmental restoration projects." Ecological Engineering 9:89–107.

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Williams, B.K. 2011. “Adaptive management of natural resources — framework and issues.” Journal of Environmental Management 92:1346–1353.

Monitoring and Adaptive Management Plan: for *Deepwater Horizon* NRDA Project: Identifying Methods to Reduce Sea Turtle Bycatch in the Reef Fish Bottom Longline Fishery

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed 1) to evaluate progress toward meeting the project's restoration objectives, and 2) to support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project aims to reduce sea turtle bycatch and at-vessel mortality in the bottom long line (BLL) fishery. This project would be implemented as restoration for the *Deepwater Horizon* (DWH) oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources
- Restoration Type: Sea turtles
- Restoration approach: Reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures
- Restoration technique: Evaluate, develop, and implement conservation measures in commercial BLL fisheries
- TIG: Open Ocean
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment

This project would serve as Phase 1 of a multi-phased approach to reducing sea turtle bycatch. It would involve completing a full assessment of available data to identify factors involved in the bycatch of sea turtles in the reef fish BLL fishery and would fill critical data gaps to design and implement future voluntary bycatch reduction restoration alternatives. Phase 2 would include any subsequent data collection needs, stakeholder outreach, and implementation of voluntary programs to reduce sea turtle bycatch based on the factors described in Phase 1. This project is intended to restore loggerhead sea turtles injured by the DWH oil spill.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to primarily address the Sea Turtle Restoration Type, defined in the PDARP/PEIS. The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS § 5.5.10, are:

- Implement an integrated portfolio of restoration approaches to address all injured life stages (hatchling, juvenile, and adult) and species of sea turtles.
- Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats.
- Restore sea turtles in the various geographic and temporal areas within the Gulf of Mexico and Atlantic Ocean that are relevant to injured species and life stages.

The specific restoration objectives for this project are to:

1. Conduct a robust analysis of all existing observer data from the Gulf of Mexico reef fish BLL fishery.
2. Evaluate environmental variables and fishing practices associated with sea turtle bycatch.
3. Develop a framework and design Phase 2 efforts. Depending on the findings of Phase 1, Phase 2 may include data gathering to fill additional gaps, stakeholder outreach, gear modification testing, pilot implementation efforts, and/or implementation of voluntary and/or incentive-based bycatch reduction programs within the fishery.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii)). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives where appropriate.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting aids adaptive management of the project, as well as future projects of a similar type, by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

The most significant anthropogenic threat to sea turtle populations in the marine environment is bycatch in fishing gear (NMFS and USFWS 2008; NMFS et al. 2011). While several studies have investigated factors affecting sea turtle bycatch in commercial fishing gear, very little effort has been focused on reducing bycatch of sea turtles in bottom longline gear. To address this need, this project aims to improve understanding of the factors that affect sea turtle bycatch in the bottom longline fishery and identify changes to fishing practices that are anticipated to reduce sea turtle bycatch in fishing gear. For example, potential fishing behaviors that could be modified include the soak times and the number of hooks per set. Following the implementation of these practices, the anticipated long-term outcome is a reduction in sea turtle bycatch. As with other fisheries-related projects, a key factor that affects project effectiveness and future benefits includes the willingness of fishers to participate in the fisheries practices, which may be influenced by perception, cost, or logistical constraints.

Project performance would be evaluated based on fulfilment of the objectives. The objectives are to conduct a robust analysis of existing data from the Gulf of Mexico reef fish BLL fishery, evaluate environmental variables and fishing practices associated with sea turtle bycatch, and develop a framework for Phase 2 efforts.

1.3.1 Potential Sources of Uncertainty

This project depends on existing data, therefore, the only significant source of uncertainty is whether or not the data analysis would identify sufficient bycatch co-factors for testing and for Phase II efforts.

2.0 Project Monitoring

Project monitoring would consist of evaluation of the products of the project. See Section 4.0 Evaluation.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000; Thom et al. 2005). Performance may be evaluated in terms of implementation of the project plan, expected project outputs, or the ability of the project to achieve the desired restoration outcomes.

Due to the nature of the activities planned for Phase 1, which inherently incorporate adaptive management, no additional need for adaptive management is anticipated during this phase. An adaptive management approach would be incorporated in the framework and development of design alternatives for Phase 2, which would also include a monitoring and adaptive management plan.

4.0 Evaluation

Evaluation of project performance would be conducted to ensure the project meets the restoration objectives specified above. The project would be deemed successful if an analysis of existing data identifies co-factors contributing to the rates of sea turtle bycatch in the reef fish BLL fishery and if the analysis provides sufficient information to develop the framework for Phase 2.

5.0 Data Management

5.1 Data Description

The monitoring data would consist of the results of an analysis of all existing observer data from the Gulf of Mexico reef fish BLL fishery, including the identification of environmental variables and fishing practices associated with sea turtle bycatch.

All data used for this analysis would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents). Geospatial data would adhere to FGDC/ISO standards.

5.2 Data Review and Clearance

All data compiled and analyzed would undergo QA/QC protocols, following the process outlined in Section 3 of the MAM Manual Version 1.0. In summary, the following steps would be taken. For data that have been transcribed, the electronic data sheets would be verified against the original hardcopy datasheets and/or notebooks. Any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed outside of the Implementing Trustee's agency. The Implementing Trustee would review MAM data and information and ensure that all data is entered or converted into agreed upon/commonly used digital format and labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with Implementing Trustee agency requirements.

After identified errors have been addressed, the Implementing Trustee would give the other TIG members time to review the data before making any data publicly available. The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

5.3 Data Storage and Accessibility

All data compiled and analyzed as part of this project would be stored on the DIVER Restoration Portal and/or the NMFS Observer Program database. The data would be submitted to the DIVER Restoration Portal as soon as possible and no more than one year from when data are collected.

5.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface and/or the NMFS Observer Program database within one year of when the data collection occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG trustees prior to releasing any project data that is the subject of the request.

Some of the data collected are protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act and observer information collected under the Magnuson–Stevens Fishery Conservation and Management Act) and therefore would not be publicly distributed.

6.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan was finalized and updated annually to reflect the status of the MAM activities.

The final monitoring report would be developed within one year of monitoring activities being concluded. These reports would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the final monitoring reports would follow the outline in the MAM Manual Version 1.0.

7.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

8.0 References

NMFS and USFWS. 2008. "Recovery plan for the northwest Atlantic population of the Loggerhead sea turtle (*Caretta caretta*), second revision." Silver Spring, MD: National Marine Fisheries Service.

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Thom, R.M., G. Williams, A. Borde, J. Southard, S. Sargeant, D. Woodruff, J.C. Laufle, and S. Glasoe. 2005. "Adaptively addressing uncertainty in estuarine and near coastal restoration projects." Journal of Coastal Research Special Issue No. 40. Coastal restoration: Where have we been, where are we now, and where should we be going? (Winter):94–108. Available: http://www.jstor.org/stable/25736618.

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Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Developing a Gulf-wide Comprehensive Plan for In-Water Sea Turtle Data Collection

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to 1) evaluate progress toward meeting the project's objectives, including sufficiently addressing specific questions that would inform restoration planning, implementation, and/or evaluation, and 2) support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project aims to develop a comprehensive plan and guidance for in-water sea turtle population surveys to better understand population and vital rate trends in sea turtle populations. To do this, this project would first assess existing data to determine gaps in coverage and gaps in data collection to better inform an enhanced monitoring effort. Then, the project would develop an in-water survey plan to standardize sampling methods and sampling strategies within a coordinated network to inform restoration priorities and contribute to monitoring success of restoration projects. A future restoration phase would aim to implement the Gulf-wide sea turtle monitoring plan.

This project is being implemented as restoration for the *Deepwater Horizon* (DWH) oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Sea Turtles.
- Restoration approach: This project would provide support for several restoration approaches.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

Development of the in-water survey plan would occur through a series of in-person meetings. The scale of project implementation would be Gulf-wide, including coastal, nearshore, and offshore waters throughout the entire Gulf of Mexico. Project activities include 1) convening a small working group to identify data needs, survey methodology, and data management alternatives, and 2) developing a strategic plan describing a framework for an in-water survey sea turtle data collection network. This project is intended to fill a critical data gap and support restoration of sea turtles injured by the DWH oil spill. The implementing agency is NOAA. Partner agencies include Department of the Interior.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to primarily address the Sea Turtle Restoration Type, defined in the PDARP/PEIS. The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS § 5.5.10, are:

- Implement an integrated portfolio of restoration approaches to address all injured life stages (hatchling, juvenile, and adult) and species of sea turtles.
- Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats.
- Restore sea turtles in the various geographic and temporal areas within the Gulf of Mexico and Atlantic Ocean that are relevant to injured species and life stages.
- Support existing conservation efforts by ensuring consistency with recovery plans and recovery goals for each of the sea turtle species.

The project objective is to develop a statistically sound plan for the establishment of a coordinated Gulf-wide network for collection and compilation of abundance, demographic, and biological information on all sizes and life stages of turtles in the Gulf of Mexico. Gulf-wide monitoring of sea turtle populations and the implementation of standardized monitoring protocols for specific activities and life stages would provide important context for project-level monitoring at individual sites where restoration is implemented, allow comparisons across multiple projects, and may allow assessment of the success of restoration and long-term effectiveness of restoration activities in restoring injured sea turtle species.

Project performance would be evaluated based on the development of a statistically sound plan for the establishment of a coordinated Gulf-wide network for collection and compilation of critical abundance, demographic, and biological information on all sizes and life stages of turtles.

1.3 Conceptual Setting

Five species of sea turtles occur throughout the Gulf of Mexico, all of which exhibit complex life histories involving multiple habitat shifts and highly migratory behavior. While all five of these species are listed as either threatened or endangered under the U.S. Endangered Species Act, there are still critical data gaps in regard to sea turtle populations and habitat utilization that are needed to be filled to better inform restoration planning, implementation, and evaluation. This project aims to address critical data gaps by identifying key information needs, and then developing a strategic plan to address the identified needs.

2.0 Project Monitoring

Project monitoring would consist of evaluation of the products of the project. See Section 4.0: Evaluation.

3.0 Adaptive Management

No adaptive management is anticipated to be needed during the development of the initial strategic plan. However, adaptive management would be incorporated in the strategic plan.

4.0 Evaluation

Project performance would be evaluated based on successful development of a statistically sound plan for the establishment of a coordinated Gulf-wide network for collection and compilation of critical abundance, demographic, and biological information on all sizes and life stages of turtles.

5.0 Data Management

No data would be collected or generated as part of this project.

6.0 Reporting

Project activities would be reported in the DIVER Restoration Portal and updated annually to reflect the status of the project.

The final report would be developed within one year of project activities being concluded. This report would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the report would follow the outline in the MAM Manual Version 1.0.

7.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Developing Methods to Observe Sea Turtle Interactions in the Gulf of Mexico Menhaden Purse Seine Fishery

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed 1) to evaluate progress toward meeting the project's restoration objectives, and 2) to support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project aims to develop a new methodology to effectively monitor the Gulf of Mexico menhaden purse seine fishery to allow for data collection to better understand the bycatch of sea turtles in the fishery. The initial phase of the project would include running trials on a small number of active fishing vessels using a combination of a variety of alternative observation techniques and human observers. Once a satisfactory methodology is established, the monitoring can be expanded within the fishery.

This project is being implemented as restoration for the *Deepwater Horizon* (DWH) oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Sea Turtles.
- Restoration approach: Reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures.
- Restoration technique: Expand existing or develop new observer programs and enhance analytical capacity within the program.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

The project would potentially be conducted in the waters of Texas, Louisiana, Mississippi, and/or Alabama. Project activities include: 1) coordinating and developing concepts to test, 2) conducting proof-of-concept testing, and 3) implementing a pilot observer program. This project is intended to restore sea turtles injured by the DWH oil spill. This project may also reduce bycatch of other marine resources, such as dolphins. The implementing agency is the NOAA.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to primarily address the Sea Turtle Restoration Type, defined in the PDARP/PEIS. The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS § 5.5.10, are:

- Implement an integrated portfolio of restoration approaches to address all injured life stages (hatchling, juvenile, and adult) and species of sea turtles.
- Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats.
- Restore sea turtles in the various geographic and temporal areas within the Gulf of Mexico and Atlantic Ocean that are relevant to injured species and life stages.
- Support existing conservation efforts by ensuring consistency with recovery plans and recovery goals for each of the sea turtle species.

The specific restoration objectives for this project are to:

1. Work with industry to identify opportunities to observe the fishery and develop an effective methodology for monitoring sea turtle bycatch in the fishery.
2. Implement a 7-day proof of concept observer trial on active fishing sets using a combination of alternative observation techniques (video monitoring systems, drones, etc.) and human observers, looking at the feasibility and effectiveness of each technique and making modifications to the trial, as necessary.
3. Implement a 2-year pilot observer program, based on results of the trial and modifying the protocol through time, to monitor the Gulf of Mexico menhaden purse seine fishery for sea turtle bycatch, and provide recommended next steps for bycatch reduction based on data collected.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii)). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives in Section 5.0

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

The Gulf of Mexico menhaden purse seine fishery currently lacks an effective observer program to determine if protected species takes are occurring. A pilot observer study was conducted in 2011, however the placement of observers within the fishing operation may not have allowed the observers to adequately observe for sea turtle bycatch. This project aims to develop a methodology to effectively monitor the menhaden purse seine fishery in the northern Gulf of Mexico for sea turtle bycatch. If a satisfactory methodology is established, the monitoring could be expanded within the fishery, which would allow for more informed and appropriate management of the fishery to reduce potential interactions with sea turtles. If sufficient data were collected through this project, it could directly inform potential bycatch reduction strategies that could be implemented through a voluntary incentivized program, without the need for continued observer monitoring. As with most fisheries-related projects, a key factor that affects project effectiveness and future benefits includes the willingness of the industry to adopt the recommended practices, which may be influenced by perception, cost, or logistical constraints.

1.3.1 Potential Sources of Uncertainty

Potential sources of uncertainty are defined as those that may affect the ability of a project to achieve its restoration objectives. Sources of uncertainty, the degree of uncertainty, and the level of uncertainty associated with projects would vary.

This project would first conduct proof-of-concept testing to determine potentially feasible alternative observation techniques. The most feasible and effective observation method would then be used in a 2-year pilot study to begin to monitor the menhaden purse seine fishery. The data collected through the pilot would ideally provide enough data to determine appropriate next steps for this fishery. Next steps, and future restoration projects, could include continuation of the observer program within a larger segment of the fishery, or development and implementation of bycatch reduction strategies within the fishery. As this project relies on industry participation and buy-in, there are several potential sources of uncertainty that could affect project performance and success. Potential sources of uncertainty include:

- The ability to develop feasible alternative monitoring techniques, such as video cameras or drones.
- The ability to collect robust, high-quality, usable data from observers and alternative monitoring techniques.
- The ability to develop a recommended monitoring methodology based on the pilot study.
- The interest of the industry in participation in the pilot study.
- The interest of the industry in utilization of the recommended monitoring methodology.
- The likelihood that the monitoring results would lead to the development of bycatch reduction strategies.
- The likelihood that future bycatch reduction strategies would reduce sea turtle bycatch in the menhaden purse seine fishery.

2.0 Project Monitoring

Performance monitoring would be conducted to evaluate project success and identify the need for potential corrective actions or adaptive management. Below, a list of proposed monitoring parameters is provided, organized by each restoration objective. For each of the identified monitoring parameters, information is provided on the intended purpose, monitoring methods, timing and frequency, duration, sample size, and sites. The specific analyses for each parameter are described in Section 4.0 (Evaluation). Section 5.0 (Project-Level Decisions) discusses how these parameters may be tied to performance criteria and/or corrective actions.

Objective #1: Work with industry to identify opportunities to observe the fishery and develop an effective methodology for monitoring sea turtle bycatch in the fishery

Parameter #1: Number of alternative observation methods identified for testing (combinations of different technologies and their configurations)

a) Purpose: This parameter would be used as a measure of successful project implementation.
b) Method: The number of combinations of direct and remote observation methods and their configurations (e.g., camera locations) that are identified for proof-of-concept testing would be counted.
c) Timing, Frequency, and Duration: Once, at the end of the proof-of-concept testing phase of the project.
d) Sample size: N/A.
e) Sites: N/A.

Objectives #2: Implement a 7-day proof of concept observer trial on active fishing sets using a combination of alternative observation techniques (video monitoring systems, drones, etc.) and human observers, looking at the feasibility and effectiveness of each technique and making modifications to the trial, as necessary

Parameter #2: Effectiveness of Bycatch Detection Methods

a) Purpose: This parameter would be used to compare the effectiveness of the alternative observation methods identified under Objective 1.
b) Method: A standard set of measurements and counts would be collected for each proof-of-concept trial. Throughout the trial, and when evaluating the data post-trial, expert opinion from NOAA's Observer program would provide an assessment of the effectiveness based on observer reports, bycatch observed, and visibility of each component of the operation.
c) Timing, Frequency, and Duration: TBD, dependent on the number and nature of the alternative methods identified.
d) Sample size: TBD, dependent on the number of alternative methods identified and the number of vessels and fishing days available for testing.
e) Sites: TBD, dependent on the fishing operation at the time of testing.

Parameter #3: Cost to the Observer Program

a) Purpose: This parameter would be used to compare the cost feasibility of the alternative observation methods identified under Objective 1.
b) Method: The costs of observer time, equipment purchase, equipment maintenance/replacement, and data analysis would be estimated for each method.
c) Timing, Frequency, and Duration: See Bycatch Reduction.
d) Sample size: See Bycatch Reduction.
e) Sites: N/A.

Parameter #4: Socio-economic Cost to the Fishery

a) Purpose: This parameter would be used to compare the feasibility of the alternative observation methods identified under Objective 1.
b) Method: The fishing crew would report any difficulty, time delay, etc., they experienced due to the observation method being tested.
c) Timing, Frequency, and Duration: Each trip.
d) Sample size: The number of crew members on each trip.
e) Sites: N/A.

Parameter: #5 Identification of an observation approach for use in the 2-year pilot program

a) Purpose: This parameter would determine whether a pilot program can be established and if the project is viable.
b) Method: Alternative observation methods would be identified in collaboration with the NMFS Observer Program and industry representatives.
c) Timing, Frequency, and Duration: TBD, but the intention is to complete the development of alternative methods by the end of Year 2.
d) Sample size: N/A
e) Sites: N/A

Objective #3: Implement a 2-year pilot observer program, based on results of the trial and modifying the protocol through time, to monitor the Gulf of Mexico menhaden purse seine fishery for sea turtle bycatch, and provide recommended next steps for bycatch reduction based on data collected

Parameter #6: Days at sea achieved per year for the 2-year pilot observer program

a) Purpose: This parameter would be used to track the 2-year pilot efforts.
b) Method: Data would be collected on the observer effort expended.
c) Timing, Frequency, and Duration: Data would be collected continuously during the 2-year pilot program.
d) Sample size: N/A
e) Sites: N/A

Parameter #7: Development of a viable, effective observation method for future observer program implementation

a) Purpose: This parameter would be used to establish whether a basis for an effective, standardized observer methodology for the Gulf of Mexico menhaden purse seine fishery has been successfully developed.
b) Method: Data from the 2-year pilot program would be analyzed to determine whether any of the final methods can serve as the basis for establishing a full-scale observer program for the fishery.
c) Timing, Frequency, and Duration: Assessments, and changes to methodologies, would occur regularly during the 2-year pilot program (Years 3-4). The final assessment and

determination of the best methodology would occur in Year 4, following completion of the pilot program.

d) Sample size: N/A.
e) Sites: N/A.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000; Thom et al. 2005). Performance may be evaluated in terms of implementation of the project plan, expected project outputs, or the ability of the project to achieve the desired restoration outcomes.

An adaptive management approach would be applied to all aspects of the project. For example, during the initial phase of the project, the project manager would work closely with industry representatives and video monitoring companies to identify the recommended methodology and refine the approach as needed based on feedback. Then, during the pilot program, the project manager would maintain close coordination with the participating fishers to 1) ensure that the recommended methodology is collecting robust, high-quality, and usable data, and 2) understand potential concerns or issues with implementing this methodology in the fishery. If problems are encountered, the methodology would be modified to enhance the feasibility and effectiveness of the program. Following the pilot study, the program manager would reconvene with the industry to go over the results and discuss any problems and possible changes. This would inform the final methodology necessary to conduct a full observer program across the fishery.

4.0 Evaluation

Evaluation of project performance would be conducted to ensure the project is meeting the restoration objectives and informs the need for adaptive management or corrective actions. The specific parameters and associated analyses that would be used are provided below.

1. **Number of alternative observation methods (combinations of different technologies and their configurations) identified for testing:** If the number of combinations of direct and remote observation methods and their configurations (e.g., camera locations) that are identified for proof-of-concept testing meets or exceeds the criterion value, this aspect of implementation would be considered to have been successful.

2. **Identification of an observation approach for use in a 2-year pilot program:** This would determine whether a pilot program can be established and if the project would advance. If a pilot is developed, this aspect of implementation would be considered to have been successful.

3. **Development of a viable, effective observation method for future observer program implementation:** Feasibility of each method tested in the pilot program would be compared based on Effectiveness of Bycatch Detection Methods, Cost to the Observer Program, and Socio-economic Cost to the Fishery. This determination would be made by the NMFS Observer Program and the NMFS SE Fishery Science Center (SEFSC). The final assessment and determination of the best methodology would occur in Year 4, following completion of the pilot program.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Knowledge gained from the evaluation of monitoring data would be used at the project-level 1) to determine whether the project, once implemented, is considered successful, and/or 2) to inform the need for potential corrective actions. Project success would be determined by comparing monitoring data to project-specific performance criteria for key parameters related to the project's restoration objectives. The monitoring parameters and project-specific performance criteria are presented in Table 5-1.

The evaluation of project success may determine that a project has not met its performance criteria. A variety of factors including previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers may all influence project success. Table 5-1 presents potential corrective actions that can be taken if performance criteria are not met. This table may not include all possible options; rather, it includes a list of potential actions for each individual parameter to be considered if the project has not met its performance criteria. Other corrective actions may be identified post-implementation, as appropriate. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions, organized by restoration objective.

Monitoring Parameters	Performance Criteria	Potential Corrective Actions
Objective #1: Work with industry to identify opportunities to observe the fishery and develop an effective methodology for monitoring sea turtle bycatch in the fishery		
Number of alternative observation methods (combinations of different technologies and their configurations) identified for testing.	To be determined in consultation with the NMFS Observer Program and Fishing Industry representatives.	Consider new technique concepts or test different variations of the concepts tested previously until one or more is deemed feasible and worthy of full-scale testing in a pilot program. If no alternative techniques appear to be feasible, the pilot program would be based on human observers only.
Objective #2: Implement a 7-day proof of concept observer trial on active fishing sets using a combination of alternative observation techniques (video monitoring systems, drones, etc.) and human observers, looking at the feasibility and effectiveness of each technique and making modifications to the trial, as necessary		
Identification of an observation approach for use in the 2-year pilot program.	The most viable and effective observation method is identified.	Extend testing phase if other ideas are available for testing or determine if changes to the methods can be made to meet viability needs while still providing the information necessary; otherwise, terminate the project.
Objective #3: Implement a 2-year pilot observer program, based on results of the trial and modifying the protocol through time, to monitor the Gulf of Mexico menhaden purse seine fishery for sea turtle bycatch, and provide recommended next steps for bycatch reduction based on data collected		
Development of a viable, effective observation method for future observer program implementation.	Data from the 2-year pilot program would be analyzed to determine whether any of the final methods could serve as the basis for establishing a full-scale observer program for the fishery.	If insufficient information is collected to determine next steps, extend pilot program to get the needed information. If no feasible full-scale observer program can be developed using the methods of the pilot program, new concepts would be developed and tested.

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 6-1, separated by activity. Performance monitoring activities would be conducted in Years 1-4.

Table 6-1: Monitoring schedule.

Monitoring Activities	Year			
	1	2	3	4
Document development of a methodology	X	X	X	X
Determine if feasible techniques to test in a pilot study have been developed (proof-of-concept)		X		
Implement 2-year Pilot and determine if a viable and effective methodology for observing the fishery has been developed			X	X

7.0 Data Management

7.1 Data Description

Sea turtle and other protected species bycatch data would be collected by alternative monitoring techniques and human observers during the pilot program. The data may consist of written notes and comments, digital photographs, and digital video streams.

To the extent practicable, all environmental and biological data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks, photographs, and video recordings would be retained by the Implementing Trustee.

Relevant project data that are handwritten on hardcopy datasheets or notebooks would be transcribed into standard digital format. All field datasheets and notebook entries would be scanned to PDF files. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents). Geospatial data would adhere to FGDC/ISO standards.

7.2 Data Review and Clearance

All collected data would undergo proper QA/QC protocols, following the process outlined in Section 3 of the MAM Manual Version 1.0. In summary, the following steps would be taken. For data that have been transcribed, the electronic data sheets would be verified against the original hardcopy datasheets and/or notebooks. Any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed outside of the Implementing Trustee's agency. The Implementing Trustee would review MAM data and information and ensure that all data is entered or converted into agreed upon/commonly used digital format and labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with Implementing Trustee agency requirements.

After identified errors have been addressed, the Implementing Trustee would give the other TIG members time to review the data before making any data publicly available. The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

7.3 Data Storage and Accessibility

All data compiled and analyzed as part of this project would be stored on the DIVER Restoration Portal and/or the NMFS Observer Program database. The data would be submitted to the DIVER Restoration Portal as soon as possible and no more than one year from when data are collected.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface and/or the NMFS Observer Program database within one year of when the data collection occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG Trustees prior to releasing any project data that is the subject of the request.

Some of the data collected are protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act and observer information collected under the Magnuson–Stevens Fishery Conservation and Management Act) and therefore would not be publicly distributed.

8.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan has been finalized and updated annually to reflect the status of the MAM activities.

Interim monitoring reports would be developed at the end of each project activity. The final monitoring report would be developed within one year of monitoring activities being concluded. These reports would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the interim and final monitoring reports w follow the outline in the MAM Manual Version 1.0.

9.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

10.0 References

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Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Reducing Juvenile Sea Turtle Bycatch through Development of Reduced Bar Spacing Turtle Excluder Devices (TEDs)

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed 1) to evaluate progress toward meeting the project's restoration objectives, and 2) to support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project aims to reduce bycatch of small sea turtles in TED-equipped shrimp otter trawls throughout the Gulf of Mexico. Using fishery observer data with results of previous TED testing, this project would develop prototype TED configurations for otter trawls that would be evaluated and certified via the NMFS small sea turtle TED testing protocol. The results of this project would help guide the development of future restoration projects to reduce sea turtle bycatch in the shrimp otter trawl fishery thereby achieving restoration through reduced mortality of small sea turtles in otter trawls.

This project is being implemented as restoration for the *Deepwater Horizon* (DWH) oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Sea Turtles.
- Restoration approach: Reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures.
- Restoration technique: Evaluate, develop, and implement conservation measures in trawl (shrimp and non-shrimp) fisheries.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

This project would be conducted in two locations along the Gulf coast: the NMFS Galveston, TX Laboratory and the NMFS Panama City, FL laboratory. The Texas laboratory would oversee sea turtle collection and rearing, and the Florida laboratory would oversee TED testing.

Project activities include collecting hatchlings and captive rearing turtles; conducting TED development and evaluations; and conducting fishery independent proof-of-concept, and fishery dependent, commercial target catch retention and fish/invertebrate bycatch reduction trials. This project is intended to restore sea turtles injured by the DWH oil spill by reducing mortality associated with sea turtle bycatch. The implementing agency is NOAA.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to primarily address the Sea Turtle Restoration Type, defined in the PDARP/PEIS. The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS § 5.5.10, are:

- Implement an integrated portfolio of restoration approaches to address all injured life stages (hatchling, juvenile, and adult) and species of sea turtles.
- Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats.
- Restore sea turtles in the various geographic and temporal areas within the Gulf of Mexico and Atlantic Ocean that are relevant to injured species and life stages.
- Support existing conservation efforts by ensuring consistency with recovery plans and recovery goals for each of the sea turtle species.

The specific restoration objectives for this project are to:

1. Develop and evaluate reduced bar spacing TEDs designed to exclude small (body depths < 4 inches [10.16 centimeters]) sea turtles in the shrimp otter trawl fishery.
2. Test and certify small bar spacing TED prototypes through the NMFS small turtle testing protocol.
3. Conduct fishery independent and dependent bycatch reduction (fish/invertebrates) and target catch retention testing.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii)). Where appropriate, specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives in Section 5.0.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

The most significant anthropogenic threat to sea turtle populations in the marine environment is bycatch in fishing gear (NMFS and FWS 2008; NMFS et al. 2011). This project aims to develop TED prototypes designed to protect small sea turtles encountered in the otter trawl shrimp fishery. Previous research has found that small sea turtle (less than 20 cm straight carapace lenght) exclusion from trawls was not as simple as mechanical prevention of passing through reduced bar spacing but was influenced by the turtles' physical ability to push through the TED opening (Gearhart 2013). Thus, besides bar spacing, other aspects of the TED that may facilitate sea turtle exclusion include the TED size, angle, opening, and flap design/configuration. Once completed, this project would provide researchers and fisheries managers with a better understanding of sea turtle/TED interactions and the factors that influence TED performance. Furthermore, results would help guide the development of future restoration projects to reduce sea turtle bycatch in the shrimp otter trawl fishery.

To benefit sea turtles injured by the DWH oil spill, the TED must be capable of reducing sea turtle bycatch and must also be widely adopted in the fishery. As with most fisheries-related projects, a key factor that affects project effectiveness and future benefits includes the willingness of fishers to adopt the recommended practices, which may be influenced by perception, cost, or logistical constraints. Future incentive programs in conjunction with outreach efforts that provide information to fishers about operating costs, catch retention, and bycatch reduction of the new TED design relative to current practices may increase the willingness of fishers to adopt the new design.

1.3.1 Potential Sources of Uncertainty

Potential sources of uncertainty are defined as those that may affect the ability of a project to achieve its restoration objectives. Sources of uncertainty, the degree of uncertainty, and the level of uncertainty associated with projects would vary.

This project would be developing and testing a TED prototype aimed at reducing small sea turtle bycatch in the shrimp trawl fishery. As this project relies on sea turtle rearing and field testing, there are several potential sources of uncertainty that could affect project performance and success. Potential sources of uncertainty include:

- The effectiveness of each of the new TED designs in reducing bycatch.
- The effectiveness of each of the new TED designs in retaining catch.
- The cost of purchase, installation, use, and maintenance of the TEDs to the fishery.

2.0 Project Monitoring

Performance monitoring would be conducted to evaluate project success and identify the need for potential corrective actions or adaptive management. Below, a list of proposed monitoring parameters is provided, organized by each restoration objective. For each of the identified monitoring parameters, information is provided on the intended purpose, monitoring methods, timing and frequency, duration, sample size, and sites. The specific analyses for each parameter are described in Section 4.0 (Evaluation). Section 5.0 (Project-Level Decisions) discusses how these parameters may be tied to performance criteria and/or corrective actions where appropriate.

Objectives #1 and #2: Develop and evaluate reduced bar spacing TEDs designed to exclude small (body depths < 4 inches [10.16 centimeters]) sea turtles in the shrimp otter trawl fishery; and test and certify small bar spacing TED prototypes through the NMFS small turtle testing protocol.

Parameter #1: Number and size of sea turtles reared

a) Purpose: This parameter would be used to determine success of project implementation.
b) Method: Count and measure sea turtles reared per permitted standard operating procedures.
c) Timing, Frequency, and Duration: Once, prior to testing.
d) Sample size: One sample of at least 100 sea turtles.
e) Sites: Captive rearing facility.

Parameter #2: Number of TED designs tested for certification

a) Purpose: This parameter would be used to determine success of project implementation.
b) Method: Record the number of TED designs tested.
c) Timing, Frequency, and Duration: Once per year for at least one year.
d) Sample Size: N/A.
e) Sites: Florida.

Parameter #3: Number of TED designs certified for use in accordance with established NMFS protocol for small turtle testing

a) Purpose: This parameter would be used to report on progress in certifying TED designs.
b) Method: Record the number of TED designs certified in accordance with established NMFS protocol for small turtle testing.
c) Timing, Frequency, and Duration: Once per year after testing is completed for the year.
d) Sample size: N/A.
e) Sites: N/A.

Objective #3: Conduct independent and dependent bycatch reduction (fish/invertebrate) and target catch retention testing

Parameter #4: Number of TED designs tested for proof of concept (fishery independent) evaluation

a) Purpose: This parameter would be used to determine success of project implementation.
b) Method: Document the number of TED designs tested.
c) Timing, Frequency, and Duration: Once, at the end of Activity 3.
d) Sample size: N/A.
e) Sites: Gulf of Mexico.

Parameter #5: Number of TED designs subjected to commercial (fishery dependent) evaluation

a) Purpose: This parameter would be used to determine success of project implementation.
b) Method: Document the number of TED designs tested.
c) Timing, Frequency, and Duration: Once, at the end of Activity 3.
d) Sample size: N/A.
e) Sites: Gulf of Mexico.

Parameter #6: Catch Retention

a) Purpose: This parameter would be used to evaluate the performance of the TED designs move to catch retention testing.

b) Method: Record the total weight of shrimp.
c) Timing, Frequency, and Duration: Each trip, with the number of trips TBD, based on the number of TED designs to be tested and the level of participation of the fishery.
d) Sample size: At least 30 tows for paired candidate and control TEDs.
e) Sites: Gulf of Mexico.

Parameter #7: Non-Sea Turtle Bycatch Reduction, by Category

a) Purpose: This parameter would be used to evaluate the performance of the TED prototypes and to estimate the restoration potential of each design.
b) Method: Record the total weight of animals caught in each of the following categories: finfish, non-shrimp crustaceans, other invertebrates, and debris.
c) Timing, Frequency, and Duration: Each trip, with the number of trips TBD, based on the number of TED designs to be tested and the level of participation of the fishery.
d) Sample size: At least 30 tows for paired candidate and control TEDs.
e) Sites: Gulf of Mexico.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000; Thom et al. 2005). Performance may be evaluated in terms of implementation of the project plan, expected project outputs, or the ability of the project to achieve the desired restoration outcomes.

An adaptive management approach is incorporated in the standard sea turtle rearing procedures employed by the rearing facility, such as adjusting feeding regimes to ensure that the targeted size distribution of sea turtles to be used for testing is achieved. Similarly, the TED testing and redesign cycle described in the project description inherently incorporates an adaptive approach to deal with uncertainties associated with performance of the TED designs. Therefore, no additional adaptive management would be necessary for this project.

4.0 Evaluation

Evaluation of project performance would be conducted to ensure the project is meeting the project objectives and inform the need for adaptive management or corrective actions.

For this project, there are three parameters that would be evaluated to determine the success of project implementation. The specific parameters and associated analysis are provided below.

1. **Number and size range of sea turtles reared:** To evaluate project implementation, the number of sea turtles raised to the appropriate size class would be counted and compared to the target value of 100 individuals.

2. **Number of TED designs tested for certification:** The number of TED designs tested for certification would be counted and compared to the minimum number of designs planned for testing (currently a minimum of 1 design is planned for testing).
3. **Number of TED designs subjected to fishery independent and dependent testing:** The number of TED designs subjected to fishery independent and fishery independent testing would be summed and compared to the number of TEDs certified under the small turtle testing protocol.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Performance criteria and potential corrective actions would be developed during project implementation planning and implementation, as indicated below. As the performance criteria and corrective actions are developed, this MAM plan would be updated to include them.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions, organized by restoration objective.

Monitoring Parameters	Performance Criteria	Potential Corrective Actions
Objectives #1 and #2: Develop and evaluate reduced bar spacing TEDs designed to exclude small (body depths < 4 inches) sea turtles in the shrimp otter trawl fishery; and test and certify small bar spacing TED prototypes through the NMFS small turtle testing protocol.		
Number and size range of sea turtles reared	To be determined in consultation with the NMFS Observer Program and Fishing Industry representatives.	Consider new technique concepts or test different variations of the concepts tested previously until one or more is deemed feasible and worthy of full-scale testing in a pilot program. If no alternative techniques appear to be feasible, the pilot program would be based on human observers only.
Number of TED designs tested for certification	TBD, based on the number of designs developed.	Extend the testing phase, if funding permits.
Objectives #3: Conduct independent and dependent bycatch reduction (fish/invertebrate) and target catch retention testing.		
Number of TED designs subjected to fishery independent and dependent testing:	TBD, based on the results of proof of concept testing.	Extend the testing phase, if funding permits.

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 6-1, separated by activity. Performance monitoring activities would be conducted in Years 1-4.

Table 6-1: Monitoring schedule.

Monitoring Activities	Year			
	1	2	3	4
Monitor sea turtle rearing	X	X	X	
Monitor testing for certification		X	X	
Monitor fishery independent testing			X	X
Monitor fishery dependent evaluation			X	X

7.0 Data Management

7.1 Data Description

During testing for TED certification, sea turtle escapement data would be collected by NOAA. Data collection would occur during June of the years of testing (Years 2 and 3) and be compiled within 2 months after collection. The data collection would occur at one site across a one-mile area just off Shell Island, FL, near Panama City Beach, FL. Approximately 125 samples would be collected for the minimum of four candidate TED variations and one control, in total. During the proof of concept fishery independent and dependent evaluation phases of testing, target catch retention, bycatch, sea turtle standard measurements (if turtles are captured), and other data related to each trip and tow would be collected by NOAA or NOAA trained observers. Data collection would occur at fishing locations to be determined. A minimum of 30 paired samples would be collected for each TED design and control.

To the extent practicable, all environmental and biological data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record Project-specific data, then Project-specific datasheets would be drafted prior to conducting any Project monitoring activities. Original hardcopy datasheets and notebooks and photographs would be retained by the Implementing Trustee.

Relevant project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format. All field datasheets and notebook entries would be scanned to PDF files. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created, by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents). Geospatial data would adhere to FGDC/ISO standards.

7.2 Data Review and Clearance

All collected data would undergo proper QA/QC protocols following the process outlined in Section 3 of the MAM Manual Version 1.0. In summary, the following steps would be taken. For data that have been transcribed, the electronic data sheets would be verified against the original hardcopy datasheets and/or notebooks. Any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed outside of the Implementing Trustee's agency. The Implementing Trustee would review MAM data and information and would ensure that all data is entered or converted into agreed upon/commonly used digital format and labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with Implementing Trustee agency requirements.

After identified errors have been addressed the Implementing Trustee would give the other TIG members time to review the data before making the data publicly available. Before submitting the monitoring data and information package, co-Implementing Trustees shall confirm with one another that the package is approved for submission (as applicable). The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

7.3 Data Storage and Accessibility

All data compiled and analyzed as part of this project would be stored on the Data Integration, Visualization, Exploration, and Reporting (DIVER) Restoration Portal. The data would be submitted to the DIVER Restoration Portal as soon as possible and no more than one year from when data are collected.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG trustees prior to releasing any project data that is the subject of the request (as applicable).

8.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan has been finalized and updated annually to reflect the status of the MAM activities.

A final monitoring report would be developed within one year of monitoring activities being concluded. This report would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the report would follow the outline in the MAM Manual Version 1.0.

9.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

10.0 References

NRC. 2004. Adaptive Management for Water Resources Project Planning. National Research Council. The National Academies Press, Washington, DC.

Pastorok, R.A., A. MacDonald, J.R. Sampson, P. Wilber, D.J. Yozzo, and J.P. Titre. 1997. "An ecological decision framework for environmental restoration projects." Ecological Engineering 9:89–107.

Steyer, G.D. and D.W. Llewellyn. 2000. "Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management." Ecological Engineering 15(3–4):385–395.

Thom, R.M., G. Williams, A. Borde, J. Southard, S. Sargeant, D. Woodruff, J.C. Laufle, and S. Glasoe. 2005. "Adaptively addressing uncertainty in estuarine and near coastal restoration projects." Journal of Coastal Research Special Issue No. 40. Coastal restoration: Where have we been, where are we now, and where should we be going? (Winter):94–108. Available: http://www.jstor.org/stable/25736618.

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Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Long-term Nesting Beach Habitat Protection for Sea Turtles

1.0 Introduction

Monitoring, Adaptive Management, and Administrative Oversight was identified as one of the programmatic goals in the *Deepwater Horizon* (DWH) oil spill Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS). The *Deepwater Horizon* natural resource damage assessment (NRDA) Monitoring and Adaptive Management (MAM) Framework (PDARP/PEIS - Chapter 5, Appendix E) provides a flexible, science-based approach to support the effective and efficient implementation of restoration over several decades to provide long-term benefits to the resources and services injured by the spill. This project is designed to inform and enhance restoration and as such, this project MAM plan outlines objectives of the data collection effort, data collection and analysis methods, and project schedule. It also outlines ways to evaluate progress toward meeting the overall project goal and identifies key sources of uncertainty and describes adaptive management considerations.

This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. For example, the plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design requires adjustment, or if any uncertainties are resolved or new uncertainties are identified during project implementation. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the DWH NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The goal of the project is to aid sea turtle restoration efforts through acquisition of priority nesting habitat either through fee-simple parcel acquisition or less-than-fee (perpetual) easement acquisition to provide the most flexible options. Through a willing seller approach, priority parcels would be acquired to ensure the highest density sea turtle nesting beaches are protected in perpetuity. Priorities include undeveloped parcels within the Archie Carr NWR approved acquisition boundary adjacent to already protected lands and/or where strategic acquisition would benefit perpetual sea turtle nesting opportunities. Priority parcels may also include parcels with at-risk structures (potentially subject to armoring) that help protect and/or provide the ability to create contiguous protected nesting habitat over the long term. In addition, project partners and willing seller considerations would help guide parcel acquisition priorities.

1.2 Restoration Type Goals and Project Restoration Objectives

This project would be implemented as restoration as part of the DWH oil spill NRDA. As outlined within the DWH oil spill PDARP/PEIS, this restoration project falls under the following programmatic goal, Restoration Type, restoration approach, restoration technique, TIG, and restoration plan:

- Programmatic goal: Replenish and Protect Living, Coastal, and Marine Resources.

- Restoration Type: Sea Turtles.
- Restoration approach: Enhance sea turtle hatchling productivity and restore and conserve nesting beach habitat.
- Restoration technique(s): Acquire lands for conservation of nesting beach habitat.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group DWH oil spill Restoration Plan 2/Environmental Assessment (RP/EA).

Objective: Acquisition and protection of critical beach front nesting habitat for sea turtles.

The primary objective of land acquisition is to protect sea turtle nesting habitat through fee-simple or perpetual easements of fee title acquisitions of beach front nesting habitat specifically. This activity would provide direct protection of priority nesting areas and ensure future availability of nest sites and supporting habitat. High priority nesting areas are those with high density of active nests which are currently threatened by human encroachment.

1.3 Conceptual Model, Anticipated Outcomes and Future Activities

Habitat loss and degradation in nesting areas are primary threats to nesting sea turtles. Other threats include human disturbance (particularly from beach front armoring and artificial light impacts). The purpose of these restoration activities (i.e., land acquisition, conservation easements) is to help restore resources for sea turtles by employing techniques known to minimize threats to sea turtle survival and reproduction. Acquiring targeted beach front shoreline parcels would facilitate direct protection of nesting sea turtles and would ensure future availability of nest sites and supporting habitat. Long-term habitat protection would ensure that these beaches are free from armoring and continue to support high-density nesting sea turtles. Protecting undeveloped beaches also reduces impacts caused by artificial light (USFWS 2008). Table 1-1 presents the key project activity, desired output, and anticipated long- and short-term outcomes.

Table 1-1: Project activities and anticipated outcomes for the restoration of long-term nesting beach habitat for sea turtles.

Activity	Output	Short-term outcome	Long-term outcome
Implement acquisition activities to deter development and disturbance	Protection and conservation of priority sea turtle nesting	Maintain or increase sea turtle nesting habitat	Protection of key habitats in perpetuity

1.3.1 Potential Sources of Uncertainty

The TIG aims to propose and select projects that are feasible and have a high probability of success. In some instances, projects may have restoration techniques or project components that are more innovative which may result in a higher degree of uncertainty. Sources of uncertainty, the degree of uncertainty, and the level of uncertainty associated with projects would vary. Potential uncertainties are defined as those that may affect the ability to achieve project restoration objective(s). Monitoring can be used to inform these uncertainties and inform the selection of appropriate corrective actions in the event a project is not meeting its performance criteria. Table 1-2 outlines the key uncertainties associated with the project and strategies to solve them.

Table 1-2: Key uncertainties and strategies to resolve them.

Uncertainty	Summary of Strategy to Resolve
Targeted habitats do not become available for purchase.	Funding allocated for fee-simple may be used for less-than-fee simple acquisition to implement habitat protection and long-term conservation.
Cost of parcels is higher than anticipated.	Consider waiting for more favorable or economical purchase opportunities such as following storms.

2.0 Project Monitoring

The proposed monitoring for this project, outlined below, is organized by project objective with one or more monitoring parameters for each objective. For each of the monitoring parameters, information is provided on the purpose of monitoring the parameter, data collection methods, timing, frequency, duration, sample size, and sites.

Objective: Acquisition and protection of critical beach front nesting habitat

Parameter #1: Feet of beach front acquired

- Purpose: This parameter would be used to evaluate project implementation.
- Method: This parameter would record the number and location of feet of beach front acquired through purchase of parcels with high priority nesting habitat. This information would be collected by remote sensing.
- Timing, Frequency, and Duration: Land acquisitions and/or easements would be recorded after each purchase and reported at the end of the project or at Open Ocean TIG request. Acquisition would occur over a 3-year period as parcels become available.
- Sample Size: N/A.
- Sites: Acquired parcels and/or easements.

Parameter #2: Fragmentation of protected beach front habitat

- Purpose: This parameter would be used to evaluate additional protection gained from property acquisitions due to increasing contiguity (reducing fragmentation) of protected habitat. It may be a factor in planning acquisitions.
- Method: Remote sensing data would be used to calculate an index of fragmentation of protected beach front property from pre- and post-acquisition landscapes. The specific index used would be determined during implementation planning.
- Timing, Frequency, and Duration: prior to each purchase.
- Sample Size: N/A.
- Sites: N/A.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000).

Although adaptive management is a critical component of the restoration plan, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The MAM framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (Appendix 5.E.1, PDARP/PEIS). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action. For this project, adaptive management is integrated in the prioritization of additional properties/easements that may be targeted for acquired in lieu of any property or easement for which negotiations fail.

4.0 Evaluation

Evaluation of project performance would be conducted to ensure the project meets its restoration objective to acquire and protect critical beach front nesting habitat for sea turtles. This would also inform the need for adaptive management and corrective actions. The evaluation would consist of comparing the Number of Feet of Beach Front Acquired to the minimum value required by the plan.

5.0 Project-Level Decisions: Performance Criteria and Potential Correction Actions

The adaptive management decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, the performance criteria below would be used to determine project success or the need for corrective action in accordance with 15 CFR 990.55(b)(1)(vii). However, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The information below does not include all possible options; rather, it includes a list of potential adaptive management actions for each individual parameter to be considered. The decision to implement a corrective action should holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions.

Monitoring Parameter	Final Performance Criteria used to determine Project Success	Interim Performance Criteria	Potential corrective actions or mid-course corrections*
Number of Feet of Beach Front Acquired	Protect a minimum of 1,675 linear feet (510 meters) of beach front property	N/A	Increase investment of project resources and partner involvement into 1) parcel identification, and 2) opportunities to engage landowners through outreach/workshops.

*The table provides the triggers for helping determine whether adjustments to the project are needed based on the performance criteria; potential corrective actions for unknown or unanticipated conditions should they arise would need to be determined.

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 6-1, separated by activity. Performance monitoring activities would be conducted in Year 3.

Table 6-1: Monitoring schedule.

Monitoring Activities	Year		
	1	2	3
Monitor acquisitions	X	X	X

7.0 Data Management

7.1 Data Description

The data would consist of linear measurements of beach length resulting from property surveys conducted during settlement.

To the extent practicable and where applicable, all data generated during monitoring activities would be documented using standardized field datasheets. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created, by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved. Relevant Project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into Excel spreadsheets (or similar digital format). After transcription of the data, a second person not associated with data transcription would perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks. They then would make any corrections to transcription errors, as appropriate, before data are used for any analyses or distributed outside of the agency. Implementing Trustees would verify and validate monitoring data and information and would ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.2 Data Review and Clearance

All collected data would undergo proper quality assurance (QA) and quality control (QC) protocols following the process outlined in Section 3 of the MAM Manual Version 1.0. In summary, the following steps would be taken. For data that have been transcribed, the electronic data sheets would be verified against the original hardcopy datasheets and/or notebooks. Any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed outside of the Implementing Trustee's agency. The Implementing Trustee would review MAM data and information and would ensure that all data is entered or converted into agreed upon/commonly used digital format and labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with Implementing Trustee agency requirements.

After identified errors have been addressed the Implementing Trustee would give the other TIG members time to review the data before making the data publicly available. Before submitting the monitoring data and information package, co-Implementing Trustees shall confirm with one another that the package is approved for submission (as applicable). The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

7.3 Data Storage and Accessibility

All data compiled and analyzed as part of this project would be stored on the Data Integration, Visualization, Exploration, and Reporting (DIVER) Restoration Portal. The data would be submitted to the DIVER Restoration Portal as soon as possible and no more than one year from when data are collected.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP), through the DIVER Explorer Interface within one year of when the data collection occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG trustees prior to releasing any project data that is the subject of the request (as applicable).

8.0 Reporting

Data summaries and interim analyses and interpretation would be compiled in annual monitoring reports. Reports would be made available through the DIVER Explorer Interface within a year of report development.

9.0 Roles and Responsibilities

USDOI is the lead Trustee agency for this project and would ensure that the project is completed. Work may be conducted by a contractor or cooperative agreement with a university or other entity. The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

10.0 References

NRC. 2004. Adaptive Management for Water Resources Project Planning. Washington, DC: The National Academies Press.

Pastorok, R.A., MacDonald, A., Sampson, J.R., Wilber, P., Yozzo, D.J., and Titre, J.P. 1997. “An ecological decision framework for environmental restoration projects.” Ecological Engineering, 9, 89-107.

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Marine Mammals Restoration Type Draft MAM Plans

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Reducing Impacts to Cetaceans during Disasters by Improving Response Activities

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's restoration objectives and to support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project would implement a series of actions to enhance marine mammal disaster response preparedness across the Gulf of Mexico states and open water through the assessment/identification of risks; developing protocols, tools, and techniques; and improving detection, mitigation, and prevention. By using sound science and applying best practices, enhancing marine mammal disaster response preparedness would reduce individual and population impacts and increase resilience, thereby restoring populations injured by the DWH oil spill.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Marine Mammals.
- Restoration approach: Increase marine mammal survival through better understanding of causes of illness and death as well as early detection and intervention of anthropogenic and natural threats.
- Restoration technique: Develop and increase the technical and infrastructure capabilities to respond to major strandings events or disasters.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

The project would incorporate a Gulf-wide risk assessment and gap analysis for pelagic (i.e., found over the continental shelf and in the open ocean) marine mammal species and would focus on the northern Gulf of Mexico (Florida panhandle to western Louisiana) for disasters impacting coastal and bay, sound, and estuarine bottlenose dolphins. Based on the gap analysis for all disaster scenarios, specific locations may be targeted for certain issues (e.g., Southwest Florida and the panhandle of Florida for mass strandings of pelagic species impacted by DWH) and/or specific disaster scenarios affecting pelagic species may be prioritized. NOAA would be the lead implementing trustee for this project. The NMFS Southeast Regional Office would serve as the lead, and the Office of Protected Resources (Marine Mammal Health and Stranding Response Program), Southeast Fisheries Science Center (Marine Mammal Stranding Program) and the Office of Response and Restoration would be involved in implementation.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to primarily address the Marine Mammal Restoration Type, defined in the PDARP/PEIS. The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS § 5.5.11, are to:

- Implement an integrated portfolio of restoration approaches to restore injured BSE, coastal, shelf, and oceanic marine mammals across the diverse habitats and geographic ranges they occupy.
- Identify and implement restoration activities that mitigate key stressors in order to support resilient populations.
- Collect and use monitoring information, such as population and health assessments and spatiotemporal distribution information.
- Identify and implement actions that support ecological needs of the stocks; improve resilience to natural stressors.
- Address direct human-caused threats such as bycatch in commercial fisheries, vessel collisions, noise, industrial activities, illegal feeding and harassment, and hook-and-line fishery interactions.

The specific restoration objectives for this project are to:

1. Identify area-specific disaster risks and response capacity gaps to improve planning for marine mammal disaster response and investigation.
2. Improve marine mammal disaster response and investigation through planning, protocols, development of new tools and techniques, and mass stranding specific equipment and supplies.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 CFR 990.55(b)(1)(vii). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting aids in adaptive management of the project, as well as future projects of a similar type, by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

Because of the large habitat area and cryptic nature of many cetacean species in the Gulf of Mexico, it can be difficult to assess, monitor, and restore animals/populations. One of the more direct opportunities for resource managers to benefit Gulf of Mexico cetaceans centers around disasters (natural or anthropogenic) or unusual stranding/mortality events, when larger, concentrated numbers of animals are at risk and accessible to responders, and an effective, rapid response can have positive benefits to individuals and populations.

In the years since the DWH spill, NOAA has developed guidelines, updated contingency plans and provided training for certain disaster response scenarios impacting marine mammals. These efforts have included national efforts, such as guidelines for marine mammal oil spill response (Ziccardi et al. 2015), updates to the Unusual Mortality Event (UME) Contingency Plan, and numerous drills, as well as regional efforts, such as the Gulf of Mexico Marine Mammal Disaster Response Guidelines (GoMMMDRG) and updates to the Area Contingency Plans. However, many of these efforts have been more general and not specific to situations or regional needs. In addition, there is a need for new tools and techniques to enhance our ability to respond to marine mammal disasters.

This project is designed to improve the response to and outcomes of animals threatened by anthropogenic and natural disasters. In addition, this project would use these opportunities to increase our knowledge of stressors and the health status of cetacean species subject to these disaster events. Potential factors that may affect project implementation and performance include: the level of buy-in and involvement of regional partners and the likelihood that an increase in response activities would reduce marine mammal mortality and improve outcomes.

1.3.1 Potential Sources of Uncertainty

Potential sources of uncertainty are defined as those that may affect the ability of a project to achieve its restoration objectives. Sources of uncertainty, the degree of uncertainty, and the level of uncertainty associated with projects varies.

In order to appropriately focus disaster response activities, this project would first conduct a gap analysis to identify focus areas and needs for marine mammal disaster response. Then, this project would develop and implement action plans to prepare and respond to disasters. There are a number of potential sources of uncertainty that could affect project performance and success. Potential sources of uncertainties include:

- The relative importance of disasters contributing to cetacean mortality compared to other threats.
- Changes in disaster type, occurrence, and frequency in the future (e.g., responding to changing environmental conditions, human activities).
- Changes in cetacean activity and behavior in the future (e.g., responding to changing environmental conditions, human activities).
- The ability to identify additional focus areas and needs.
- The ability to cultivate buy-in and involvement from stakeholders.
- The degree to which restoration actions would reduce cetacean mortality.
- The ability to quantify restoration benefits from implemented actions.

2.0 Project Monitoring

Performance monitoring would be conducted to evaluate project success and identify the need for potential corrective actions or adaptive management. Performance monitoring during the first three years of the project would be based on completion of the initial area specific disaster response gap analysis and risk assessment, and protocol development. This would include the development of monitoring parameters and associated performance criteria for evaluation of progress toward increasing response capacity and filling capacity gaps and for studies to improve situation response and assessment. These parameters would be added to this MAM Plan as part of the planning process.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000; Thom et al. 2005). Performance may be evaluated in terms of implementation of the project plan, expected project outputs, or the ability of the project to achieve the desired restoration outcomes.

In this project, adaptive management is incorporated in the periodic re-evaluation of response capacity gaps, risks, and data and development needs. An adaptive management approach would also be built into all levels of planning such as area and disaster specific marine mammal response plans, communication plans, and the management and operation plan for disaster planning and implementation.

4.0 Evaluation

Evaluation of project success during the first three years of its implementation would be based on completion of the initial area specific disaster response gap analysis, risk assessment, and protocol development. Progress toward increasing response capacity, filling capacity gaps, and performing studies to improve situation response and assessment would be based on evaluation of monitoring parameters and associated performance criteria developed as part of the planning process.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Performance criteria and potential corrective actions would be developed as part of the gap analysis, risk assessment, and protocol development process, and would be ongoing throughout the life of the project.

6.0 Monitoring Schedule

A monitoring schedule would be developed as part of the gap analysis, risk assessment, and protocol development process, and would be ongoing throughout the life of the project.

7.0 Data Management

7.1 Data Description

Specific data to be collected would be determined during project and study planning, and this MAM Plan would be updated accordingly upon finalization of each plan. To the extent practicable, all data generated during data and development need studies would be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record Project-specific data, then Project-specific datasheets would be drafted prior to conducting any Project monitoring activities. Original hardcopy datasheets and notebooks and photographs would be retained by the Implementing Trustee.

Relevant Project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format. All field datasheets and notebook entries would be scanned to PDF files. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format). Geospatial data would adhere to FGDC/ISO standards.

7.2 Data Review and Clearance

All newly collected data would undergo proper QA/QC protocols, following the process outlined in Section 3 of the MAM Manual Version 1.0. In summary, the following steps would be taken: 1) for data that have been transcribed, the electronic data sheets would be verified against the original hardcopy datasheets and/or notebooks. Any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed outside of the Implementing Trustee’s agency, and 2) the Implementing Trustee would review MAM data and information and ensure that all data is i) entered or converted into agreed upon/commonly used digital format, and ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with Implementing Trustee agency requirements.

For the data that would be compiled from existing data sources, it would be assumed that the datasets have been properly subjected to QA/QC. However, additional data checks may be conducted, such as:

- Checking units.

- Comparing values to expected value ranges (e.g., existing datasets, reports).
- Checking date and time.
- Performing geospatial checks (e.g., latitude and longitude coordinates).
- Ensuring data columns and rows line up properly.
- Looking for missing or irregular data entries.
- Looking for blank entries.
- Performing statistical analyses.
- Noting any data qualifiers.
- Checking for outliers.

The Implementing Trustee would verify that the dataset is labeled with metadata in accordance with Implementing Trustee agency requirements to the extent practicable, and that geospatial data follow FGDC/ISO standards.

After identified errors have been addressed, the Implementing Trustee would give the other TIG members time to review the data before making the data publicly available. The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

7.3 Data Storage and Accessibility

All data compiled and analyzed as part of this project would be stored on the Data Integration, Visualization, Exploration, and Reporting (DIVER) Restoration Portal. The data would be submitted to the DIVER Restoration Portal as soon as possible and no more than one year from when data are collected.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG Trustees prior to releasing any project data that is the subject of the request.

Some of the data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under, Magnuson–Stevens Fishery Conservation and Management Act [MSFCMA]) and therefore would not be publicly distributed.

8.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan has been finalized and updated annually to reflect the status of the MAM activities.

Interim monitoring reports would be developed annually, beginning in Year 1 of the project. The final monitoring report would be developed within one year of monitoring activities being concluded. These reports would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the interim and final monitoring reports would follow the outline in the MAM Manual Version 1.0.

9.0 Roles and Responsibilities

NOAA would be the lead implementing trustee for this project. The NMFS Southeast Regional Office would serve as the lead, and the Office of Protected Resources (Marine Mammal Health and Stranding Response Program), Southeast Fisheries Science Center (Marine Mammal Stranding Program) and the Office of Response and Restoration would be involved in implementation. Potential non-agency implementation partners include the Southeast Region Marine Mammal Stranding Network, academic institutions, Bureau of Ocean Energy Management (i.e., for passive acoustic monitoring), and partners involved in conducting response and research activities affected by the planning below.

Other related programs in the Gulf of Mexico (e.g., Gulf of Mexico Marine Assessment Program for Protected Species, Gulf Environmental Benefit Fund) are continuing to fund studies and stranding network capabilities, and it is anticipated that this project would collaborate with those programs by sharing data, leveraging and engaging partners, and leveraging funding or in-kind services/equipment with those partners. It is also expected that the other TIGs would participate in disaster response planning and implementation.

10.0 References

NRC. 2004. Adaptive Management for Water Resources Project Planning. National Research Council. The National Academies Press, Washington, DC.

Pastorok, R.A., A. MacDonald, J.R. Sampson, P. Wilber, D.J. Yozzo, and J.P. Titre. 1997. “An ecological decision framework for environmental restoration projects.” Ecological Engineering 9:89–107.

Steyer, G.D. and D.W. Llewellyn. 2000. “Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management.” Ecological Engineering 15(3–4):385–395.

Thom, R.M., G. Williams, A. Borde, J. Southard, S. Sargeant, D. Woodruff, J.C. Laufle, and S. Glasoe. 2005. “Adaptively addressing uncertainty in estuarine and near coastal restoration projects.” Journal of Coastal Research Special Issue No. 40. Coastal restoration: Where have we been, where are we now, and where should we be going? (Winter):94–108. Available: http://www.jstor.org/stable/25736618.

Williams, B.K. 2011. “Adaptive management of natural resources — framework and issues.” Journal of Environmental Management 92:1346–1353.

Ziccardi, M.H., S.M. Wilkin, T.K. Rowles, and S. Johnson. 2015. “Pinniped and Cetacean Oil Spill Response Guidelines. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.” NOAA Technical Memorandum NMFS-OPR-52, 138 p. Available: https://repository.library.noaa.gov/view/noaa/10479.

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Compilation of Environmental, Threats, and Animal Data for Cetacean Population Health Analyses (CETACEAN)

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed to evaluate progress toward meeting the project's objectives and to support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website: (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The goal of CETACEAN is to provide user-friendly access to datasets that would assist the Trustees, restoration planners, responders, and conservation managers to assess the health of cetacean stocks and the stressors that threaten them over time and space. By making these data available to decision makers in a centralized platform, the application would facilitate the development of restoration activities and would increase the speed and effectiveness of response activities to minimize the impacts of stressors and threats and therefore enhance population resiliency.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Marine Mammals.
- Restoration approach: Increase marine mammal survival through better understanding of causes of illness and death as well as early detection and intervention of anthropogenic and natural threats.
- Restoration technique: Support restoration planning and evaluation by providing data standards and compiling and serving standardized datasets related to cetacean spatiotemporal distribution, habitat, and stressors.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

This project would support Trustees in planning, implementing, and monitoring restoration projects and overall restoration goals for stocks by providing a centralized decision-making support and collaboration platform that provides access to spatiotemporal data sets on the available health, abundance, density, distribution, threats, stressors, and other ongoing monitoring and restoration projects relevant to Gulf of Mexico cetaceans. The key outcome of the project is a web-based application that provides access to the best available data about the health of Gulf of Mexico cetaceans. The data would be synthesized and displayed based on user-directed queries. In addition to aggregating various input datasets, the platform would also be designed for two-way interoperability (i.e., develop output formats to share with other established data portals [e.g., DIVER, ERMA, OBIS-SEAMAP]). Potential federal agency partners include:

- Marine Mammal Commission (MMC).
- Bureau of Ocean Energy Management (BOEM).
- Bureau of Safety and Environmental Enforcement (BSEE).
- United States Geological Service (USGS).
- United States Fish and Wildlife Service (USFWS).
- Environmental Protection Agency (EPA).
- U.S. Army Corps of Engineers (USACE).
- Office of Naval Research (ONR), possibly through the National Oceanographic Partnership Program (NOPP).

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to primarily address the Marine Mammal Restoration Type, defined in the PDARP/PEIS. The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS § 5.5.11, are to:

- Implement an integrated portfolio of restoration approaches to restore injured BSE, coastal, shelf, and oceanic marine mammals across the diverse habitats and geographic ranges they occupy.
- Identify and implement restoration activities that mitigate key stressors in order to support resilient populations.
- Collect and use monitoring information, such as population and health assessments and spatiotemporal distribution information.
- Identify and implement actions that support ecological needs of the stocks; improve resilience to natural stressors.
- Address direct human-caused threats such as bycatch in commercial fisheries, vessel collisions, noise, industrial activities, illegal feeding and harassment, and hook-and-line fishery interactions.

The specific restoration objectives for this project are to:

1. Identify key datasets, parameters, analyses, and partners necessary for DWH marine mammal restoration activities by convening a group of technical experts and potential users to guide development and management of the CETACEAN platform.
2. Develop database solutions for marine mammal-related datasets (e.g., health datasets, specific sightings, identification datasets for sperm and Bryde's whales in the Gulf) that are currently inaccessible for restoration planning and monitoring and adaptive management.
3. Create a centralized web-based application (the MAP) that provides access to these data and is interoperable with other established data repositories, or those being developed as part of other restoration efforts (e.g. sea turtle Atlas).

4. Improve and sustain the data and analysis supporting DWH restoration by developing and incentivizing the use of standardized data collection protocols, analyses, and training materials by groups working with cetaceans in the Gulf of Mexico.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 CFR 990.55(b)(1)(vii). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting aids in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

Currently, information on DWH-injured cetacean populations (e.g., abundance, distribution, health), anthropogenic threats (e.g., noise, vessel strikes, bycatch), and natural threats (e.g., harmful algal blooms, natural disasters) is collected and maintained by a variety of organizations using disparate database services (e.g., desktop files, public cloud servers, private servers). Furthermore, the field methods researchers use to collect data (e.g., photo-identification methodology, contaminant measurements, blood and biopsy analyses) may vary from one institution to another, limiting data integration and comparisons for regional assessments and restoration planning, as well as project level to resource level integration. This project would bring these data together in one web-based data platform, enabling users to synthesize and display data based on queries across multiple data sets over time and space. It would also establish a standardized set of protocols for existing field work techniques and sample analyses; develop and refine new forensic and investigative tools and techniques to evaluate health, stressors, and injuries to cetaceans; and develop and conduct data collection training opportunities.

1.3.1 Potential Sources of Uncertainty

Potential sources of uncertainty are defined as those that may affect the ability of a project to achieve its restoration objectives. Sources of uncertainty, the degree of uncertainty, and the level of uncertainty associated with projects varies.

This project would utilize existing marine mammal data and developing standardized protocols for future data collection efforts. As this project relies on existing data and stakeholder buy-in, there are a number of potential sources of uncertainty that could affect project performance and success. Potential sources of uncertainty include:

- The quality, availability, and usability of existing data.
- The degree to which stakeholders implement the recommended field methods.
- The degree to which stakeholders would use the tool to inform decisions.

2.0 Project Monitoring

Performance monitoring would be conducted to evaluate project success and identify the need for potential corrective actions or adaptive management. Progress toward each of the project objectives would initially be evaluated based on the initial soft-release of the platform over the first four years of the project. Once released, the parameters listed below would be used to evaluate project performance and inform adaptive management. These parameters would be further developed and refined, additional parameters would be developed as appropriate, and this MAM Plan would be accordingly updated, by the steering committee.

Parameter #1: Access to Key Datasets

a) Purpose: This parameter would be used to evaluate project implementation and inform adaptive management.
b) Method: TBD. Based on the datasets identified under Objective 1, the effectiveness of the steering committee in obtaining access to sufficient data to be of use in restoration and conservation management decisions would be evaluated.
c) Timing, Frequency, and Duration: Annually, at the end of each year from Year 2 to Year 4.
d) Sample size: N/A.
e) Sites: N/A.

Parameter #2: Acceptance and Use of Recommended Data Collection Practices

a) Purpose: This parameter would be used to evaluate project performance and to inform adaptive management.
b) Method: TBD. The degree of acceptance and use of the recommended data collection practices developed under Objective 4 would be evaluated (e.g., by literature review or survey to determine whether the outreach and training sessions are effective).
c) Timing, Frequency, and Duration: TBD in Years 4 to15.
d) Sample size: TBD.
e) Sites: N/A.

Parameter #3: Use of the tool (by User Group)

a) Purpose: This parameter would be used to evaluate project performance and inform adaptive management.
b) Method: TBD. Use of the tool system would be measured, potentially using several systems in tandem (e.g., web analytics, user surveys).
c) Timing, Frequency, and Duration: TBD in Years 4 to 15 (following full release).
d) Sample size: TBD.
e) Sites: N/A.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000; Thom et al. 2005). Performance may be evaluated in terms of implementation of the project plan, expected project outputs, or the ability of the project to achieve the desired restoration outcomes.

As stated in the Project Description, adaptive management would be applied through the development cycles for the database and application. In addition, evaluation of the level of access obtained to key datasets and the degree to which the recommended methodologies are adopted would provide the steering committee with the opportunity to adjust outreach methods and messaging to data providers. Similarly, feedback obtained from users of the system would provide the steering committee with potential improvements that may increase its utility and usage. More specific parameters, methods, and corrective actions would be developed and incorporated in this MAM Plan by the steering committee.

4.0 Evaluation

Evaluation of project success would initially depend on the soft-release of the platform over the first four years of the project. Further evaluation of project success would be based on performance criteria associated with each of the performance parameters listed in Section 2.0 and any additional performance parameters developed by the steering committee. Specific evaluations would be developed by the steering committee.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Performance criteria and potential corrective actions would be developed by the steering committee.

6.0 Monitoring Schedule

The monitoring schedule would be developed by the steering committee.

7.0 Data Management

7.1 Data Description

Specific data to be collected would be determined during project and study planning, and this MAM Plan would be updated accordingly upon finalization of each plan. To the extent practicable, all data generated during data and development need studies would be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record Project-specific data, then Project-specific datasheets would be drafted prior to conducting any Project monitoring activities. Original hardcopy datasheets and notebooks and photographs would be retained by the Implementing Trustee.

Relevant Project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format. All field datasheets and notebook entries would be scanned to PDF files. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format). Geospatial data would adhere to FGDC/ISO standards.

7.2 Data Review and Clearance

All newly collected data would undergo proper QA/QC protocols, following the process outlined in Section 3 of the MAM Manual Version 1.0. In summary, the following steps would be taken: 1) for data that have been transcribed, the electronic data sheets would be verified against the original hardcopy datasheets and/or notebooks. Any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed outside of the Implementing Trustee's agency, and 2) the Implementing Trustee would review MAM data and information and ensure that all data is i) entered or converted into agreed upon/commonly used digital format, and ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with Implementing Trustee agency requirements.

For the data that would be compiled from existing data sources, it would be assumed that the datasets have been properly subjected to QA/QC. However, additional data checks may be conducted, such as:

- Checking units.
- Comparing values to expected value ranges (e.g., existing datasets, reports).
- Checking date and time.
- Performing geospatial checks (e.g., latitude and longitude coordinates).
- Ensuring data columns and rows line up properly.
- Looking for missing or irregular data entries.
- Looking for blank entries.
- Performing statistical analyses.
- Noting any data qualifiers.
- Checking for outliers.

The Implementing Trustee would verify that the dataset is labeled with metadata in accordance with Implementing Trustee agency requirements to the extent practicable, and that geospatial data follow FGDC/ISO standards.

After identified errors have been addressed, the Implementing Trustee would give the other TIG members time to review the data before making the data publicly available. The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

7.3 Data Storage and Accessibility

All data compiled and analyzed as part of this project would be stored on the Data Integration, Visualization, Exploration, and Reporting (DIVER) Restoration Portal. The data would be submitted to the DIVER Restoration Portal as soon as possible and no more than one year from when data are collected.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG Trustees prior to releasing any project data that is the subject of the request.

Some of the data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under, Magnuson–Stevens Fishery Conservation and Management Act [MSFCMA]) and therefore would not be publicly distributed.

8.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan has been finalized, and updated annually to reflect the status of the MAM activities.

Interim monitoring reports would be developed as applicable. The final monitoring report would be developed within one year of monitoring activities being concluded. These reports would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the interim and final monitoring reports would follow the outline in the MAM Manual Version 1.0.

9.0 Roles and Responsibilities

NOAA would be the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

10.0 References

NRC. 2004. Adaptive Management for Water Resources Project Planning. National Research Council. The National Academies Press, Washington, DC.

Pastorok, R.A., A. MacDonald, J.R. Sampson, P. Wilber, D.J. Yozzo, and J.P. Titre. 1997. “An ecological decision framework for environmental restoration projects.” Ecological Engineering 9:89–107.

Steyer, G.D. and D.W. Llewellyn. 2000. “Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management.” Ecological Engineering 15(3–4):385–395.

Thom, R.M., G. Williams, A. Borde, J. Southard, S. Sargeant, D. Woodruff, J.C. Laufle, and S. Glasoe. 2005. “Adaptively addressing uncertainty in estuarine and near coastal restoration projects.” Journal of Coastal Research Special Issue No. 40. Coastal restoration: Where have we been, where are we now, and where should we be going? (Winter):94–108. Available: http://www.jstor.org/stable/25736618.

Williams, B.K. 2011. “Adaptive management of natural resources — framework and issues.” Journal of Environmental Management 92:1346–1353.

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Reduce Impacts of Anthropogenic Noise on Cetaceans

1.0 Introduction

This project MAM Plan identifies the monitoring and data collection needed 1) to evaluate progress toward meeting the project's restoration objectives, and 2) to support any necessary adaptive management. This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project aims to reduce the anthropogenic noise exposure to cetaceans in priority areas of the Gulf of Mexico. Cetaceans rely on sound for vital life functions, and increased noise levels may mask important sounds, disturb or displace vital behaviors, and cause direct physiological harm. First, this project would move existing noise reduction technologies and prototypes towards implementation in the Gulf. Second and simultaneously, priority areas for noise reduction would be identified by analyzing data from ongoing noise-characterization and cetacean distribution studies in the Gulf of Mexico and designing and conducting data collection efforts to address gaps in our understanding of Gulf of Mexico noise and cetacean populations. Finally, once priority areas are identified, project staff would work closely with scientists, managers, and stakeholders to develop and implement restoration actions that reduce noise. This project would help move these technologies further towards implementation and consider incentives to encourage adoption.

This project would be implemented as restoration for the DWH oil spill NRDA, consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Marine Mammals.
- Restoration approach: Measure noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals.
- Restoration technique: Reduce noise impacts on marine mammals.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

This project would start with an initial screening of approximately 10 high-risk areas within the northern Gulf of Mexico that have been identified as locations important to groups of cetaceans with varying levels of risk from noise exposure. The project would also conduct a risk assessment to identify other priority areas that may have been overlooked to date. Specific noise reduction strategies and appropriate restoration activities would be developed for each of the identified priority areas. Project activities include 1) move existing noise reduction technologies and prototypes towards implementation in the Gulf, 2) conduct a risk assessment to identify priority areas for implementing restoration actions that prevent or reduce noise impacts to cetaceans, 3) maintain the existing PAM array of high frequency acoustic recording packages (HARPs) and deploy a PAM array extension to continue and expand baseline data collection and analysis for marine mammal distribution and soundscape characterization to inform restoration and monitor noise reduction outcomes, and 4) develop and implement a specific restoration implementation plan for preventing and/or reducing noise in each high-risk area. This project is intended to restore marine mammals injured by the DWH oil spill, specifically focusing on the sperm whale, Gulf of Mexico Bryde's whale, and beaked whales. It would also consider and benefit all cetacean species whose hearing sensitivity and presence overlaps with high noise exposure from Gulf of Mexico offshore activities. The implementing agency is NOAA.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to primarily address the Marine Mammal Restoration Type, defined in the PDARP/PEIS. The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS § 5.5.11, are:

- Implement an integrated portfolio of restoration approaches to restore injured BSE, coastal, shelf, and oceanic marine mammals across the diverse habitats and geographic ranges they occupy.
- Identify and implement restoration activities that mitigate key stressors in order to support resilient populations.
- Collect and use monitoring information, such as population and health assessments and spatiotemporal distribution information.
- Identify and implement actions that support ecological needs of the stocks; improve resilience to natural stressors.
- Address direct human caused threats such as bycatch in commercial fisheries, vessel collisions, noise, industrial activities, illegal feeding and harassment, and hook-and-line fishery interactions.

The specific restoration objectives for this project are to:

1. Move existing noise reduction technologies and prototypes towards implementation in the Gulf of Mexico.
2. Conduct a risk assessment to identify priority areas for implementing restoration actions that prevent or reduce noise impacts to cetaceans.
3. Maintain existing PAM array of HARPs and deploy PAM array extension to continue and expand baseline data collection and analysis for marine mammal distribution and soundscape characterization to inform restoration and monitor noise reduction outcomes.
4. Develop and implement a specific restoration implementation plan for preventing and/or reducing noise in each key area.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 CFR 990.55(b)(1)(vii). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives.

1.3 Conceptual Setting

Cetaceans in the Gulf of Mexico inhabit a highly industrialized environment with a variety of anthropogenic acoustic inputs including shipping, oil and gas activities, and military operations. Since cetaceans rely on sound for vital life functions, increased noise levels may mask important sounds, disturb or displace vital behaviors, and cause direct harm. Despite some data gaps, there is a good base of knowledge about how to address noise impacts to marine mammals. However, to date, little has been done to identify which strategies and technologies would be the most effective in specific high-risk areas of the northern Gulf of Mexico. To address this need, this project would identify high-risk areas to focus noise reduction efforts, develop and implement restoration actions that reduce noise in those areas. This project would also help move noise-reducing technologies further towards implementation and consider incentives to encourage adoption. Key factors that may affect project implementation and performance include: 1) the ability to accurately identify high-risk areas, 2) the buy-in from stakeholders to identify and implement restoration actions, and 3) the effectiveness of noise reduction measures to benefit marine mammals.

1.3.1 Potential Sources of Uncertainty

As this project relies on existing data to inform management decisions and stakeholder buy-in, there are a number of potential sources of uncertainty that could affect project performance and success (Figure 1-1). Potential sources of uncertainties include:

- The relative importance of noise contributing to cetacean mortality and reduced reproductive success compared to other threats.
- Changes in noise producing activities in the future (e.g., responding to changing regulations, economic activity.
- Changes in cetacean spatiotemporal distribution and behavior in the future (e.g., responding to changing environmental conditions, human activities).
- The quality, availability, and usability of existing data.
- The ability to combine data from different sources.
- The ability to identify accurate locations of high priority areas.
- The ability to capture high-resolution soundscapes in high-priority areas.
- The ability to identify and implement actionable restoration actions.
- The ability to cultivate buy-in from other stakeholders.
- The likelihood that restoration actions would reduce sublethal effects to, and mortality of, cetaceans.
- The ability to quantify restoration benefits from implemented actions.

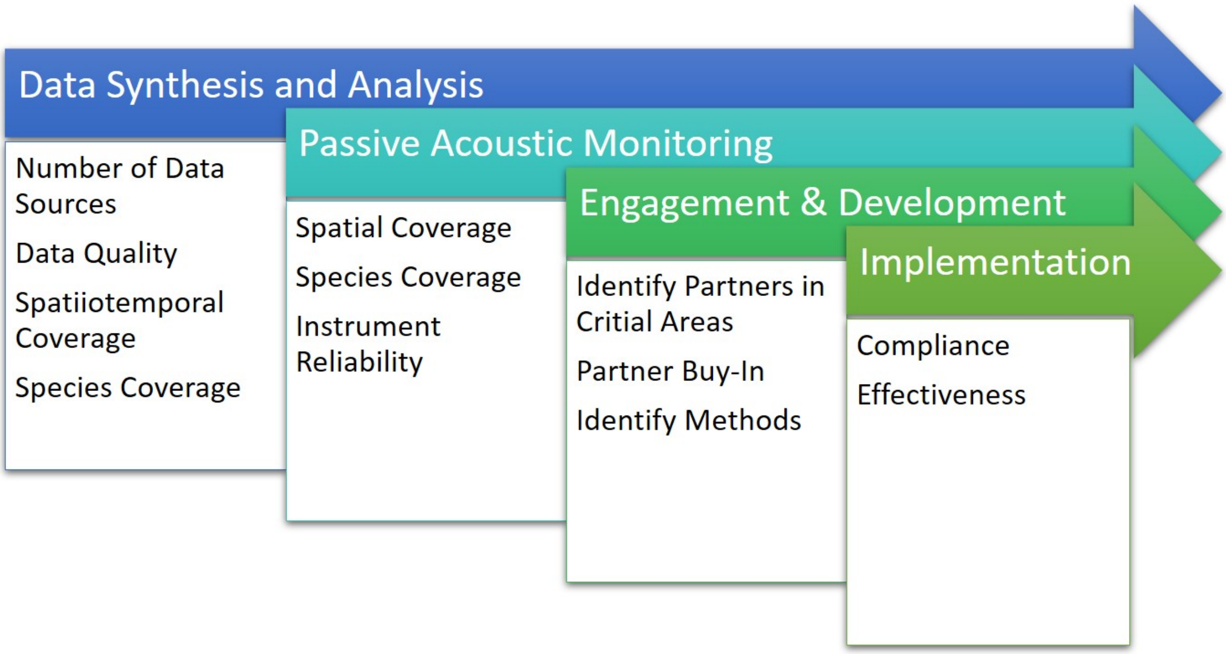

Figure 1-1: The uncertainty inherent in the project activities. This figure does not incorporate uncertainties due to biological and environmental factors. The key to planning for successful adaptive management is to identify critical processes, the factors that could lead to failure, and potential feedback and processes that could either prevent failure or provide an alternative path to the project's goals.

2.0 Project Monitoring

Performance monitoring would be conducted to evaluate project success and identify the need for potential corrective actions or adaptive management. For this project, monitoring parameters are provided by each restoration objective. Information is also provided on the intended purpose of the parameter, monitoring methods, timing and frequency, duration, sample size, and sites. The specific analyses for each parameter are described in Section 4.0 (Evaluation). Section 5.0 (Project-Level Decisions) discusses how these parameters may be tied to performance criteria and/or corrective actions.

Objective #1: Move existing noise reduction technologies and prototypes towards implementation in the Gulf of Mexico

Parameter #1: Development of a prioritized list of noise reduction technologies/prototypes to move toward implementation in the northern Gulf of Mexico

a) Purpose: Some noise reduction technologies/prototypes are close to, but not quite ready for, application in restoration implementation activities. This parameter would track the project planning progress in identifying and prioritizing appropriate technologies/prototypes for expedited development.

b) Method: A team of technical experts, resource managers, industry stakeholders, and other Gulf of Mexico stakeholders would meet and discuss/prepare a list of prioritized technologies/prototypes.
c) Timing, Frequency, and Duration: An initial list would be completed within one year of the project's initiation.
d) Sample size: N/A.
e) Sites: N/A.

Parameter #2: Development of a list of potential incentive mechanisms for expediting and implementing the measures/technologies/prototypes

a) Purpose: Although some noise reduction techniques may be technically feasible, they would not all have the same likelihood of adoption by various stakeholders. This parameter would track the project planning progress in identifying and developing potential incentive mechanisms for each technology/parameter identified in Parameter 1.
b) Method: A team of technical experts, resource managers, industry stakeholders, and other Gulf of Mexico stakeholders would meet and discuss/prepare a list of potential incentive mechanisms for the technologies/prototypes from Parameter 1.
c) Timing, Frequency, and Duration: An initial list would be completed within one year of the project's initiation, then the list would be updated on an annual basis as part of MAM activities.
d) Sample size: N/A.
e) Sites: N/A.

Parameter #3: Number of noise reduction technologies/prototypes moved toward implementation

a) Purpose: This would be used to evaluate project implementation based on the technologies/prototypes identified (Parameter 1).
b) Method: The number of noise reduction technologies/prototypes identified in Parameter 1 that are provided with support from this project would be counted.
c) Timing, Frequency, and Duration: Annually.
d) Sample size: N/A.
e) Sites: N/A.

In addition to the parameters identified above (Parameters 1 through3), parameters specific to each attempt to implement a new noise reduction technology would be developed and added to this plan. These parameters may include measures of outreach, utilization, and/or performance (i.e., performance in terms of the effect on the soundscape).

Objective #2: Conduct a risk assessment to identify high-risk areas for implementing restoration actions that prevent or reduce noise impacts to cetaceans

Parameter #4: Compilation of density and distribution data on a seasonal basis for each cetacean species found in the northern Gulf of Mexico, including identification of sensitive/important habitats as available and appropriate

a) Purpose: An accurate spatiotemporal understanding of animal populations and habitat is critical to conduct the risk assessment. The completion of this compilation would be used to evaluate the performance of the project. The data compiled would be used to inform project planning.
b) Method: Collate the best available density and distribution data for each species and generate spatiotemporal datasets. Track the number of key species for which the project generates datasets.
c) Timing, Frequency, and Duration: First set of spatiotemporal datasets completed as part of Activity 2, by the end of year 2. Then revisit as part of adaptive management every other year.
d) Sample size: N/A.
e) Sites: N/A.

Parameter #5: Compilation of a spatially and temporally explicit inventory of noise producing human activities throughout the Gulf of Mexico

a) Purpose: An accurate spatiotemporal understanding of noise producing human activities is critical to conduct the risk assessment.
b) Method: Collate the best available data on noise generating human activities and generate spatiotemporal datasets.
c) Timing, Frequency, and Duration: First set of spatiotemporal datasets completed as part of Activity 2, by the end of year 2. Then revisit as part of adaptive management every other year.
d) Sample size: N/A.
e) Sites: N/A.

Parameter #6: Adaptation/improvement of existing predictive soundscape modeling based on noise producing human activities to best plan northern Gulf of Mexico restoration activities

a) Purpose: Understanding and predicting how noise producing activities generate a soundscape, and how that soundscape may impact various species of marine mammals is a critical component of the risk assessment.
b) Method: Use the information from Parameter 5 to adapt and improve the modeling from CetSound[1] to generate information to specifically plan restoration activities in the northern Gulf of Mexico.
c) Timing, Frequency, and Duration: First set of modeling improvements completed as part of Activity 2, by the end of year 2. Then revisit as part of adaptive management every other year.
d) Sample size: N/A.
e) Sites: N/A.

Parameter #7: Spatiotemporal distribution of high-risk areas

a) Purpose: The distribution of high-risk areas would be used to inform restoration planning. Completion of the risk analysis to identify these areas would be used to evaluate project implementation.

b) Method: This would be accomplished by overlaying predictive soundscape maps (model results) and cetacean density/distribution maps (Parameter 4), and identifying locations and times with co-occurrence of high noise levels and high cetacean density or critical habitat.
c) Timing, Frequency, and Duration: First list of high-risk areas completed as part of Activity 2, by the end of Year 2. Then revisit as part of adaptive management every other year.
d) Sample size: N/A.
e) Sites: N/A.

Parameter #8: Development of a prioritized list of noise sources within high-risk areas

a) Purpose: The prioritized list would be used to inform restoration planning. Completion of development of the list would be used to evaluate project implementation.
b) Method: Collate and synthesize the information on noise sources specific to each high-risk area identified in Parameter 7.
c) Timing, Frequency, and Duration: First completed as part of Activity 2, by the end of year 2. Then revisit as part of adaptive management every other year.
d) Sample size: N/A.
e) Sites: N/A.

Objective #3: Maintain existing PAM array of HARPs and deploy PAM array extension to continue and expand baseline data collection and analysis for marine mammal distribution and soundscape characterization to inform restoration and monitor noise reduction outcomes

Parameter #9: Maintenance of existing HARPs and deployment of moveable low frequency acoustic recording packages (LARPs)

a) Purpose: This parameter would be used to evaluate project implementation.
b) Method: A team of technical experts and resource managers would identify areas without existing PAM array coverage, develop a deployment plan, and deploy moveable LARPs in those areas. The existing, permanently installed HARPs would be maintained according to schedule. Deployment and maintenance logs would be kept per standard operating procedures.
c) Timing, Frequency, and Duration: TBD based on review of existing data.
d) Sample size: N/A.
e) Sites: TBD, based on review of existing data.

Parameter #10: Passive acoustic monitoring data

a) Purpose: The goals of PAM data collection include 1) providing data on changes in ambient noise conditions at sites in important marine mammal habitat that are expected to be impacted by early noise mitigation implementation plans for monitoring effectiveness of those plans, and 2) providing data on the occurrence, distribution, and density of marine mammals at long-term DWH damage assessment sites and early noise mitigation sites to evaluate the resource level effects of noise mitigation restoration efforts. The second PAM goal also provides data that is useful for Monitoring and Adaptive Management across marine mammal restoration plans and may additionally provide resource-level MAM data that is useful across other taxa, such as acoustically-active fish species that are incidentally recorded during this work.

b) Method: Collect and analyze data from the PAM array.
c) Timing, Frequency, and Duration: Continuous before, during, and after implementation of restoration actions (Years 1 to 5).
d) Sample size: N/A.
e) Sites: The existing PAM array would be used (fixed sites). Additional, temporary sites would be added based on planning done to support deployment of LARPs.

Objective #4: Develop and implement a specific restoration implementation plan for preventing and/or reducing noise in each key area

Parameter #11: Development of a restoration implementation plan

a) Purpose: With the list of potential noise-reduction techniques, risk assessment, and PAM array data, develop restoration implementation activities specific to each high-risk area.
b) Method: Develop implementation plans for each restoration measure and vet with Gulf of Mexico stakeholders.
c) Timing, Frequency, and Duration: Once, at the end of Activity 4 (Year 3).
d) Sample size: N/A.
e) Sites: TBD, based on the locations of identified high-risk areas.

Additional parameters for Objective 4 would depend on the specific restoration activities selected for implementation at each priority area. Therefore, additional parameters to gauge stakeholder involvement and performance of each restoration activity would be selected as part of an update to this MAM plan during development of the restoration implementation plan.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). An adaptive management approach would be applied to all aspects of the project but would be most robust during the implementation of the restoration actions. All planning activities would be initially conducted to inform the first implementation activities, but these efforts would be revisited so that implementation is carried out with the best available information as the project progresses. Whenever possible, activities would be carried out as soon as there is strong technical information to support implementation. For example, if existing noise reduction techniques can effectively reduce the threat to animals in one of the already identified 10 high-risk areas, implementation can occur prior to additional risk-assessment activities.

4.0 Evaluation

Project monitoring would require carefully planned evaluation of the parameters in Section 2.0. By thoughtfully designing evaluation methods for both the implementation of project restoration activities and the outcomes of the activities, the project team would assess if the project is meeting the restoration objectives and/or determine the need for adaptive management.

4.1 Evaluation of Project Implementation

To track progress and determine success of project implementation, the project team would evaluate the following parameters:

1. Development of a prioritized list of noise reduction technologies/prototypes to move toward implementation in the northern Gulf of Mexico.
2. Development of a list of potential incentive mechanisms for expediting and implementing the measures/technologies/prototypes.
3. Number of noise reduction technologies/prototypes moved toward implementation.
4. Compilation of density and distribution data on a seasonal basis for cetaceans found in the northern Gulf of Mexico, including identification of sensitive/critical habitats as available and appropriate.
5. Compilation of a spatially and temporally explicit inventory of noise producing human activities throughout the Gulf of Mexico.
6. Adaptation/improvement of existing predictive soundscape modeling based on noise producing human activities to best plan northern Gulf of Mexico restoration activities.
7. Spatiotemporal distribution of high-risk areas.
8. Development of a prioritized list of noise sources within high-risk areas.
9. Maintenance of existing HARPs and deployment of moveable LARPs.
11. Development of a restoration implementation plan.

Parameters 1 and 2 would be evaluated by the project team, subject experts, and regional stakeholders during project calls, webinars, and meetings. The activities would include searching the literature, previous workshop recommendations, seeking out presentations on pilot study data analyses, and conducting a risk assessment. The project team would monitor the progress of these activities and make a yes/no determination of whether/when each of the activities are complete.

Once the information for Parameters 1 and 2 is developed, the project team would decide which of the technologies to support. This would define the targeted number of technologies to move toward implementation. The actual number of technologies supported by the project (Parameter 3) would be compared to the target to determine the successfulness of this part of the project.

Parameters 4 through 9 would be evaluated by the project team, subject experts, and regional stakeholders during project calls, webinars, and meetings. The activities would include GIS spatio-temporal analyses and modeling exercises similar to the work done for the CetSound project. The project team would monitor the progress of these activities and make a yes/no determination of whether/when each of the activities are complete.

For Parameter 11, the project team would coordinate and participate in collaborative discussions with relevant experts and stakeholders in the northern Gulf of Mexico to develop restoration implementation plans for each high-risk area. The project team would monitor the progress of this activity and make a yes/no determination of whether/when the activity is complete.

4.2 Evaluation of Project Outcomes

Products from PAM data collection (Parameter 10) would include 1) seasonal patterns of occurrence of detectable marine mammals at a given site, 2) characterization of monthly and annual sound levels across frequencies, 3) characterization of occurrence patterns for shipping and seismic survey noise sources, and additional sources as determined, and 4) characterization of noise levels during presence and absence of anthropogenic noise sources. Additional comparisons would be made, evaluating changes in these metrics over time as mitigation measures are implemented. Temporal changes in density of marine mammals would be evaluated across multiple sites and compared with historical data and with changes in noise levels from noise mitigation activities. If animal dive behavior is collected using tags or PAM instruments like 3D HARPs, it may be possible to further develop the risk assessments of Activity 2 to incorporate modeled animal movements through sound fields which would be useful for estimating sound exposure under different mitigation scenarios.

For this project, evaluations of other outcomes would be determined for the implementation actions during Activity 3 based on the specific plans developed for each high-risk area. They would be added to this plan and used to track and evaluate project performance and inform adaptive management.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

In this section, we describe how knowledge gained from the evaluation of monitoring data would be used at the project-level 1) to determine whether the project, once implemented, is considered successful, and/or 2) to inform the need for potential corrective actions. Project success would be determined by comparing monitoring data to project-specific performance criteria for key parameters related to the project's restoration objectives. The monitoring parameters and project-specific performance criteria are presented in Table 5-1, as well as potential corrective actions that can be taken if performance criteria are not met. This table may not include all possible options for corrective actions; rather, it includes a list of potential actions for each individual parameter to be considered if the project has not met its performance criteria. Other corrective actions may be identified post-implementation, as appropriate.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions, organized by restoration objective.

Monitoring Parameters	Performance Criteria	Potential Corrective Actions
Objective #1: Move existing noise reduction technologies and prototypes towards implementation in the Gulf of Mexico		
Development of a prioritized list of noise reduction technologies/prototypes to move toward implementation in the northern Gulf of Mexico.	Completion by the end of Year 1.	No corrective actions identified.
Development of a list of potential incentive mechanisms for expediting and implementing the measures/ technologies/prototypes.	Completion of an initial list by the end of Year 1. Completion of an annual update by the end of each additional year of project implementation.	No corrective actions identified.
Number of noise reduction technologies/prototypes moved toward implementation.	TBD, based on the number of noise reduction technologies and/or prototypes identified.	TBD, based on the nature of the failure to move a sufficient number toward implementation.

Monitoring Parameters	Performance Criteria	Potential Corrective Actions
Objective #2: Conduct a risk assessment to identify high-risk areas for implementing restoration actions that prevent or reduce noise impacts to cetaceans		
Compilation of density and distribution data on a seasonal basis for each cetacean species found in the Gulf of Mexico, including identification of sensitive/critical habitats as available and appropriate.	Completion of initial compilation by the end of Year 2.	TBD, based on the nature of the failure.
Compilation of a spatially and temporally explicit inventory of noise producing human activities throughout the Gulf of Mexico.	Completion by the end of Year 2.	TBD, based on the nature of the failure.
Adaptation/improvement of existing predictive soundscape modeling based on noise producing human activities to best plan northern Gulf of Mexico restoration activities.	TBD, based on the current level of uncertainty in the model.	Identify additional data sources/experts with soundscape modeling expertise to supplement the project team.
Spatiotemporal distribution of high-risk areas	Completion by the end of Year 2.	No corrective actions identified.
Development of a prioritized list of noise sources within high-risk areas.	Completion by the end of Year 2.	No corrective actions identified.
Objective #3: Monitor and maintain a PAM array to capture soundscape data before, during, and after the project		
Maintenance of existing HARPs and deployment of moveable LARPs	TBD during implementation planning and deployment planning.	TBD based on the nature of the failure to maintain or deploy instruments.
Passive acoustic monitoring data	Sufficient spatial and temporal coverage to detect potential changes in the soundscape due to implementation of noise mitigation measures.	Move LARPs to better cover areas in which changes are expected, deploy different instrument packages, or seek funding for additional LARPs, based on the nature of the problem.
Objective #4: Develop and implement a specific restoration implementation plan for preventing and/or reducing noise in each key area		
Development of a restoration implementation plan.	Completion by the end of Year 3.	Identify additional stakeholder groups and/or subject matter experts to assist the project team. Schedule additional meetings and/or working sessions.

6.0 Monitoring Schedule

The schedule for project monitoring is shown in Table 6-1, separated by activity.

Table 6-1: Monitoring schedule.

Monitoring Activities	Year				
	1	2	3	4	5
Document the identification of priority areas		X			
Document the development and implementation of implementation plans			X	X	
PAM monitoring	X	X	X	X	X
Track stakeholder participation				X	X

7.0 Data Management

7.1 Data Description

Data would be compiled from existing data sources, including ongoing marine mammal surveys and Gulf of Mexico stakeholders, to support this project. As much as possible, the Noise Reduction project team would work closely with the Marine Mammal Atlas project team to coordinate data management.

In addition, acoustic data would be collected from the PAM arrays that would be deployed for this project. Data collection would occur from Years 1 to 5 and be integrated into the overall project data set and the Marine Mammal Atlas.

To the extent practicable, all data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record Project-specific data, then Project-specific datasheets would be drafted prior to conducting any Project monitoring activities. Original hardcopy datasheets and notebooks and photographs would be retained by the Implementing Trustee.

Relevant Project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format. All field datasheets and notebook entries would be scanned to PDF files. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents). Geospatial data would adhere to FGDC/ISO standards.

7.2 Data Review and Clearance

All newly collected data would undergo proper QA/QC protocols, following the process outlined in Section 3 of the MAM Manual Version 1.0. In summary, the following steps would be taken: 1) For data that have been transcribed, the electronic data sheets would be verified against the original hardcopy datasheets and/or notebooks. Any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed outside of the Implementing Trustee's agency, and 2) the Implementing Trustee would review MAM data and information and ensure that all data is i) entered or converted into agreed upon/commonly used digital format, and ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with Implementing Trustee agency requirements.

For the data that would be compiled from existing data sources, it would be assumed that the datasets have been properly cleared. However, additional data checks may be conducted, such as:

- Checking units.
- Comparing values to expected value ranges (e.g., existing datasets, reports).
- Checking date and time.
- Performing geospatial checks (e.g., latitude and longitude coordinates).
- Ensuring data columns and rows line up properly.
- Looking for missing or irregular data entries.
- Looking for blank entries.
- Performing statistical analyses.
- Noting any data qualifiers.
- Checking for outliers.

The Implementing Trustee would verify that the dataset is labeled with metadata in accordance with Implementing Trustee agency requirements to the extent practicable, and that geospatial data follow FGDC/ISO standards.

After identified errors have been addressed, the Implementing Trustee would give the other TIG members time to review the data before making the data publicly available. Before submitting the monitoring data and information package, co-Implementing Trustees shall confirm with one another that the package is approved for submission. The Cross-TIG MAM workgroup would then conduct a cursory review of the data before it is published on a public site.

7.3 Data Storage and Accessibility

All metadata compiled and analyzed as part of this project would be stored on the Marine Mammal Atlas framework and/or the Data Integration, Visualization, Exploration, and Reporting (DIVER) Restoration Portal. Raw acoustic data would be archived with NOAA's National Center for Environmental Information. Challenges associated with data-processing, hosting, and providing such large quantities of PAM data may preclude submission within one-year of data collection. Therefore, these data would be submitted to the portals as soon as practicable.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy, through the Marine Mammal Atlas framework, the DIVER Explorer Interface, and/or NCEI. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG Trustees prior to releasing any project data that is the subject of the request.

Some of the data collected may be protected from public disclosure (e.g., personally identifiable information under the Privacy Act or observer information collected under, Magnuson–Stevens Fishery Conservation and Management Act) and therefore would not be publicly distributed.

8.0 Reporting

MAM activities would be reported in the DIVER Restoration Portal once the MAM Plan has been finalized and updated annually to reflect the status of the MAM activities.

Interim monitoring reports would be developed annually. The final monitoring report would be developed within one year of monitoring activities being concluded. These reports would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the interim and final monitoring reports would follow the outline in the MAM Manual Version 1.0.

9.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

10.0 References

Pastorok, R.A., A. MacDonald, J.R. Sampson, P. Wilber, D.J. Yozzo, and J.P. Titre. 1997. “An ecological decision framework for environmental restoration projects.” Ecological Engineering 9:89–107.

Williams, B.K. 2011. “Adaptive management of natural resources – framework and issues.” Journal of Environmental Management 92:1346–1353.

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Reduce and Mitigate Vessel Strike Mortality of Cetaceans

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring and data collection needed 1) to evaluate progress toward meeting the project's restoration objectives, and 2) to support any necessary adaptive management. This plan was developed in accordance to the MAM Plan template provided in the MAM Manual Version 1.0 and was adapted to fit the needs of this project. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the DWH natural resource damage assessment (NRDA) Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project aims to reduce and mitigate vessel strike mortality of cetaceans in the Gulf of Mexico. In order to implement efficient reduction activities, this project would first conduct planning analyses to establish vessel activity in the Gulf and determine where these areas co-occur with whales and other offshore cetaceans. Once the project establishes and prioritizes a catalog of the most prevalent cetacean vessel strike "hot spots" or high-risk areas, scientists and managers would identify, develop, cultivate buy-in from other stakeholders, and implement the most effective and efficient restoration actions for each high-risk area.

This project would be implemented as restoration for the DWH oil spill NRDA, consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Marine Mammals.
- Restoration approach: Reduce injury and mortality of marine mammals from vessel collisions.
- Restoration technique: Reduce vessel collisions with marine mammals.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

This restoration project would initially be a Gulf-wide risk assessment, but the project team would identify a set of specific locations for further actions by the end of Activity 1. Project activities include 1) conducting analyses to establish vessel activity in the Gulf and where these areas co-occur with whales and other offshore cetaceans, 2) identifying cetacean vessel strike hot spots and working with stakeholders to develop restoration actions, and 3) implementing the most effective and efficient restoration actions for each high-risk area. This project is intended to restore marine mammals injured by the DWH oil spill, prioritizing large whales but also considering other offshore cetacean species. The implementing agency is NOAA.

1.2 Restoration Type Goals and Project Restoration Objectives

This project is designed to primarily address the marine mammal Restoration Type, defined in the PDARP/PEIS. The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS § 5.5.11, are:

- Implement an integrated portfolio of restoration approaches to restore injured bay, sound, and estuary, coastal, shelf, and oceanic marine mammals across the diverse habitats and geographic ranges they occupy.
- Identify and implement restoration activities that mitigate key stressors in order to support resilient populations.
- Collect and use monitoring information, such as population and health assessments and spatiotemporal distribution information.
- Identify and implement actions that support ecological needs of the stocks; improve resilience to natural stressors.
- Address direct human-caused threats such as bycatch in commercial fisheries, vessel collisions, noise, industrial activities, illegal feeding and harassment, and hook-and-line fishery interactions.

The specific restoration objectives for this project are to:

1. Identify high-risk areas in the northern Gulf of Mexico where restoration activities could be most effective in reducing the risk of vessel strikes to whale species.
2. For each high-risk area, identify the restoration activities that would sustainably and most effectively restore large whale and, to the extent possible, other offshore cetacean populations through collaborative partnerships of Gulf of Mexico stakeholders.
3. Implement restoration activities that reduce the risk of vessel strikes to whales and other oceanic species in the northern Gulf of Mexico.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 CFR 990.55(b)(1)(vii). Specific, measurable performance criteria are defined for monitoring parameters associated with each of the restoration objectives.

1.3 Conceptual Setting

While there is a suite of potential actions to reduce whale-vessel interactions (e.g., changing vessel routes and speeds), it is currently impossible to 1) implement one set of measures uniformly across the Gulf of Mexico, and 2) know what measures would be the most effective in each area of the Gulf of Mexico for the species that were injured by the DWH oil spill and at risk from vessel strikes. Many factors influence the risk of occurrence and severity of vessel collisions, including the overlap between whale spatial distribution and shipping lanes, the levels of shipping traffic, the size and speed of vessels, species behavior, and other unknown variables (Figure 1-1). Other key factors that may affect project implementation and performance include the level of buy-in of shipping sectors for each recommended measure, which may be influenced by logistical constraints, cost constraints, or perception.

Sperm whales and Bryde’s whales are long-lived protected species with relatively small populations. Therefore, the DWH restoration activities to support these resources need to be well coordinated and multifaceted—one project must be considered in the context of the whole restoration portfolio. When evaluating and monitoring project success, it would be important to look across the set of projects also attempting to benefit these resources, whether by providing complimentary management activities or by addressing other threats.

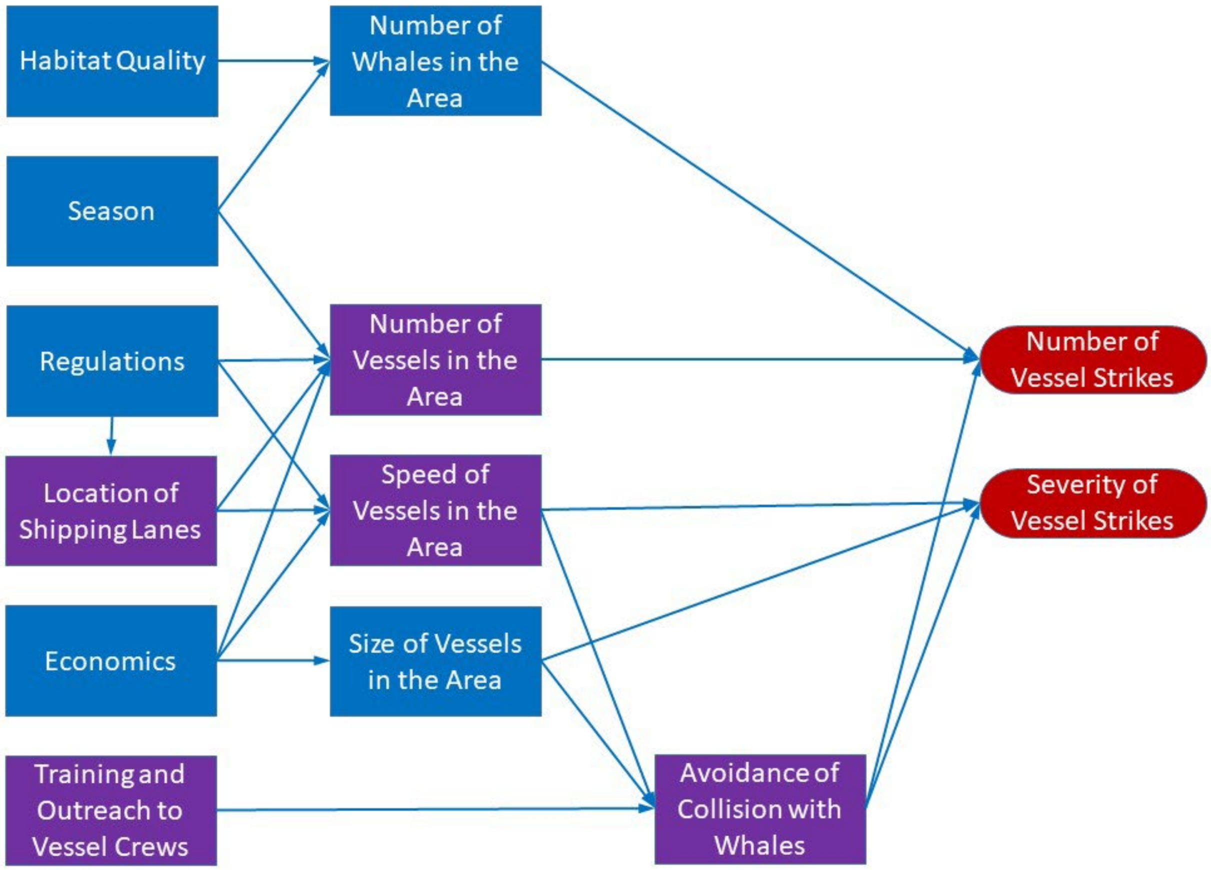

Figure 1-1. Diagram showing factors that affect the number and severity of ship collisions with whales in any given area of the Gulf of Mexico. Arrows indicate the directionality of influence of a given factor on another. Factors that might be affected by the project are shown in purple. There are other external forces acting on the system that are not depicted, and the feedback between the number and severity of vessel strikes and the number of whales is not depicted. Every component of the system is a potential source of uncertainty. For example, active avoidance of collisions by vessel crews can reduce the number and severity of vessel strikes. The effectiveness of the avoidance behavior can be improved by training the crew to be alert and responsive. In addition, vessel size and speed affect the ship's maneuverability; thus, can alter the effectiveness of the avoidance behavior. The degree to which each of these factors contribute to changes in number and severity of vessel strikes varies and may be affected by other factors (e.g., whether or not the ship is in an established shipping lane, regulatory speed limits, whether or not the ship is on schedule).

1.3.1 Potential Sources of Uncertainty

As this project relies on existing data to inform management decisions and stakeholder buy-in, there are a number of potential sources of uncertainty that could affect project performance and success. Potential sources of uncertainties include:

- The relative importance of vessel strikes contributing to cetacean mortality compared to other threats.
- Changes in vessel activity (spatially, temporally, size, speed) in the future (e.g., responding to changing regulations, economic activity).

- Changes in cetacean activity and behavior in the future (e.g., responding to changing environmental conditions, human activities).
- Changes in crew responsiveness and behavior.
- The quality, availability, and usability of existing data.
- The ability to identify accurate locations of high-risk areas.
- The ability to identify and implement actionable restoration actions.
- The ability to cultivate buy-in from stakeholders.
- The likelihood that restoration actions would reduce cetacean mortality.
- The ability to quantify restoration benefits from implemented actions (e.g., carcasses of offshore cetaceans rarely drift to shore).

2.0 Project Monitoring

Performance monitoring would be conducted to evaluate project success and to identify the need for potential corrective actions or adaptive management. Progress toward each of the project objectives would be primarily evaluated based on the achievement of the outcomes and delivery of the products within the timeframes stated in the Project Description. In addition, the parameters for Objective 3 would depend on the specific restoration activities selected for implementation at each site. Therefore, parameters would be identified as part of an update to this MAM plan during development of Objective 2. Potential monitoring parameters may include the spatiotemporal distribution of vessel traffic and cetacean distribution and density in each succeeding year.

3.0 Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). For this project, an adaptive management approach would be taken to ensure that high-priority restoration activities are identified and effectively and efficiently implemented in high-risk areas to decrease the relative risk of vessel collisions with offshore cetacean species. The project team would use an iterative process to plan, evaluate, implement, and monitor activities so that the project can address the uncertainties inherent in ecological restoration of protected species.

The objectives are specifically designed to use the best available information to identify the highest priority areas for the team's initial implementation focus. During Phase I, adaptive management would focus on the sufficiency of the available data to identify high-risk areas. During Phase II, it would be important to ensure engagement and cooperation of the stakeholders in developing the options to be implemented during Phase III. Therefore, the level of engagement of the stakeholders, would be monitored to determine whether additional outreach is needed. During Phases II and III, the team would make initial plans for the best approaches for implementation (and appropriate monitoring parameters) specific to each high-risk area. As development of techniques and implementation progresses, the project team would continue to evaluate the implementation success at each site and adjust the implementation approaches to make use of the best available information (e.g., from the Population Consequences of Multiple Stressors project) and conditions in the field. Additionally, in the post-execution period, the team would continue to monitor the northern Gulf of Mexico for other hotspots that may become a priority as additional data (from this project or any other ecological activities in the Gulf of Mexico) become available.

4.0 Evaluation

Specific evaluation methods would be developed as part of Phase II of the project, and this MAM plan would be updated accordingly.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

Performance criteria and potential corrective actions would be developed as part of Phase II of the project, and this MAM plan would be updated accordingly.

6.0 Monitoring Schedule

A monitoring schedule would be developed as part of Phase II of the project, and this MAM plan would be updated accordingly.

7.0 Data Management

7.1 Data Description

During Activity 1, the Vessel Strikes project team would work with the Marine Mammal Atlas project team to compile existing datasets that support the identification of high-risk areas. Data would consist of georeferenced heat maps, i.e., raster representations of normalized data ranges for vessel traffic and cetacean activity, and georeferenced polygon layers depicting high-risk areas. During Activity 3, additional data would be compiled to support the evaluation of restoration activities. The data would include vessel traffic data (e.g., AIS and VMS) and cetacean stranding data in the northern Gulf of Mexico, and additional data, depending on the restoration implementation plans developed during Activity 2.

All data would have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., information about how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format). The Vessel Strikes project team would work closely with the Marine Mammal Atlas team to ensure that all data are integrated into the Atlas framework appropriately.

7.2 Data Review and Clearance

Data Review and Clearance would be conducted as recommended in the Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0.

7.3 Data Storage and Accessibility

All data compiled and analyzed as part of this project would be stored in the Marine Mammal Atlas framework and/or on the Data Integration, Visualization, Exploration, and Reporting (DIVER)

Restoration Portal. The data would be submitted to these platforms as soon as possible and no more than one year from when data are collected.

7.4 Data Sharing

Data would be made publicly available, in accordance with the Federal Open Data Policy, through the Marine Mammal Atlas framework and/or the DIVER Explorer Interface within one year of when the data collection occurred. In the event of a public records request related to data and information on a project that is not already publicly available, the Trustee to whom the request is addressed would provide notice to the other TIG Trustees prior to releasing any project data that is the subject of the request.

Some of the data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under, Magnuson–Stevens Fishery Conservation and Management Act [MSFCMA]) and therefore would not be publicly distributed.

8.0 Reporting

MAM activities would be reported in the Marine Mammal Atlas framework and/or the DIVER Restoration Portal once the MAM Plan has been finalized and updated annually to reflect the status of the MAM activities.

The final monitoring report would be developed within one year of monitoring activities being concluded. This report would be made publicly available through the DIVER Restoration Portal. To the extent practicable, the final monitoring report would follow the outline in the MAM Manual Version 1.0.

9.0 Roles and Responsibilities

NOAA is the Implementing Trustee for this project and would be responsible for the management of all activities related to project monitoring and adaptive management.

10.0 References

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Mesophotic and Deep Benthic Communities Restoration Type

Draft MAM Plans

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Mapping, Ground-Truthing, and Predictive Habitat Modeling

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support any necessary adaptive management of the restoration project. Where applicable, it identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. It also establishes a decision-making process for making adjustments where needed.

This MAM Plan is a "living" document and may be updated as needed to reflect changing conditions and/or new information. For example, the plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design requires adjustment, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

There are extensive areas of hard substrates across the continental shelf, slope, and abyssal plain in the northern Gulf of Mexico (Jenkins 2011, ONMS 2016). The full extent is unclear, however, of areas that possess biological, physical, and chemical conditions conducive to the recruitment, growth, and reproduction of the mesophotic or deep water coral species and associated communities that are the targets for restoration under the trustees' programmatic restoration plan. The activities undertaken through this mapping, ground-truthing, and predictive habitat modeling project would characterize the biological, chemical, and geophysical conditions of a significant proportion of the potential hard substrates in the northern Gulf of Mexico, dramatically improving current knowledge of the extent and distribution of target communities. Such documentation alone substantially informs and augments ongoing or potential activities to manage, protect, and restore these communities. Furthermore, the data obtained from this work would increase our ability to predict the distribution of deep water corals in the northern Gulf of Mexico using models.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and Protect Living Coastal and Marine Resources.
- Restoration Type: Mesophotic and Deep Benthic Communities (MDBC).
- Restoration approach: Improve understanding of MDBC to inform better management and ensure resiliency.
- Restoration technique: Resource-level monitoring and adaptive management to address critical uncertainties.
- TIG: Open Ocean.

- Restoration Plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

This restoration project is being implemented within MDBC of the northern Gulf of Mexico. This project is intended to accomplish data collection to improve understanding of MDBC to inform better management and ensure resiliency.

NOAA is the implementing agency for this project; NOAA would coordinate with DOI during project implementation.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, is:

- Improve understanding of MDBC to inform better management and ensure resiliency.

The project restoration objectives are:

- Document the abundance and distribution of MDBC.
- Provide fundamental information to prioritize and support protection and management activities and to target locations for direct restoration.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii).

1.3 Conceptual Setting

The objectives of this project are to document the abundance and distribution of MDBC (e.g., biology and substrates) and to refine predictive models to improve the effectiveness and cost efficiency of future mapping efforts. Identification of coral communities through this mapping effort may trigger protection and management activities by the DWH trustees or under other existing programs, as well as identify potential locations for active restoration.

1.3.1 Potential Sources of Uncertainty

Several factors may influence the chances of the project meeting its objectives. First, the total area we would map is currently undetermined, subject to a variety of factors including the rapidly evolving technologies to be employed, and would be evaluated further during implementation planning. The oil spill's spatial scale and the distribution of MDBC in the northern Gulf of Mexico are sufficiently large that scientists cannot survey or sample all areas that may have been injured or that may present opportunities for management, protection, or direct restoration. The total area surveyed would depend on factors such as the specific mapping technologies employed, depths surveyed, weather, visibility, and equipment reliability. The accuracy with which the models developed through this project would predict the location of coral communities is currently unknown. Similarly, the sufficiency of data to be generated by the project for determining appropriate target sites for direct restoration is currently unknown. Finally, implementation of management processes and regulatory frameworks designed to benefit and protect MDBC resources are led by non-trustee offices or agencies and are subject to substantial and lengthy public engagement. Thus, this DWH MDBC alternative to provide information on MDBC abundance and distribution would not solely or specifically determine the ultimate outcomes of whether or how such management efforts or protective frameworks are implemented.

2.0 Project Monitoring

This project would map and ground-truth mesophotic and deep benthic habitats by collecting high resolution bathymetry, backscatter (albedo), and rugosity measurements, as well as high-resolution imagery. Additionally, the project would measure spatial extent and distribution of benthic habitats, population metrics (age and length distributions, ontogenetic changes, density/abundance, and biomass), community metrics (species composition, diversity, species richness, and percent cover), and interactions (predator/prey relationships, habitat utilization). Existing standards and protocols for such data collections (e.g., Brooks et al. 2016; Coggan et al. 2007a; Coggan et al. 2007b; Edwards et al. 2017; Freiwald and Roberts, eds, 2005) would be applied to the extent possible, with the development of new protocols as needed given the unprecedented scale of this project.

Objective #1. Document the abundance and distribution of MDBC

Parameter #1: Area of bottom mapped

a) Purpose: This parameter measures how much bottom area was mapped at a resolution sufficient to identify coral communities and the corresponding resolution. The more area (km^2) mapped, the greater the chance of locating coral communities for management and protection.
b) Method: High resolution bathymetry, backscatter (albedo), high-resolution imagery, side-scan sonar, multibeam sonar, synthetic aperture sonar.
c) Timing, Frequency and Duration: Implemented approximately annually over 5 years.
d) Sample Size: TBD during implementation planning.
e) Sites: Priority sites are areas currently designated or under consideration for designation to protect and manage known MDBC sites as HAPCs or NMS, with additional less-known or currently unknown sites to be determined based on other available information such as existing, lower-resolution maps of known mesophotic community sites on the continental shelf (e.g., USGS maps of the Pinnacles and northwest banks areas) and BOEM’s seismic anomalies dataset and deepwater bathymetry grid for the northern Gulf of Mexico.

Parameter #2: Predictive habitat model development

a) Purpose: This parameter describes whether or not predictive habitat models were developed, including building on existing modeling efforts.
b) Method: TBD during implementation planning.
c) Timing, Frequency, and Duration: Models would be developed and refined throughout the course of the project.
d) Sample Size: TBD.
e) Sites: All sites mapped during the project.

Parameter #3: Predictive habitat model performance

a) Purpose: To determine how well models predict habitat occurrence.
b) Method: Compare model predictions with ground-truthing data.
c) Timing, Frequency, and Duration: Models would be developed, tested, and refined throughout the 5 years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD.

Objective #2. Provide fundamental information to prioritize and support protection and management activities and to target locations for direct restoration

Parameter #1: Sampling sufficiency for population metrics

a) Purpose: To determine if age and size distributions, biomass, density and abundance, were measured and ontogenetic changes observed for select species.
b) Method: Determine confidence in the values calculated for each population level metric.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: All sites mapped during the project.

Parameter #2: Sampling sufficiency for community metrics

a) Purpose: To determine if species composition, diversity, species richness, and percent cover were measured or calculated.
b) Method: Count the number of sites for which community level metrics were calculated.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: All sites mapped during the project.

Parameter #3: Species and habitat interactions elucidated

a) Purpose: To determine if species and habitat interactions (e.g., feeding/predation, mutualism, reproduction, use of structure or substrate, water column, etc.) were elucidated.
b) Method: Count the number of sites for which species and habitat interactions were elucidated.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: All sites mapped during the project.

Parameter #4: Usefulness of data to managers

a) Purpose: To determine if information is useful for planning active restoration activities or for providing actionable information to managers to support prioritization and support protection, management, and direct restoration.
b) Method: Survey of managers receiving information.
c) Timing, Frequency, and Duration: TBD during implementation planning.
d) Sample Size: TBD
e) Sites: TBD during implementation planning.

3.0 Adaptive Management

This project's focus on data collection reflects the need for information to inform or augment ongoing efforts to protect, manage, and restore MDBC. Restoration for MDBC resources would include staged implementation to allow for data collection to address critical uncertainties and inform adaptive decision-making. The data generated by this project would be critical to the adaptive management feedback loop, informing active management and protection of MDBCs and substrate placement and coral propagation activities undertaken to benefit MDBCs. The information this project generates would iteratively advance restoration planning by supporting implementation of initial restoration actions, monitoring the success of these actions, and using the information obtained to refine future projects. The MDBC project management structure would provide milestones and mechanisms to evaluate progress in meeting well-defined restoration outcomes, project objectives, and long-term Restoration Type goals, and redirect the portfolio and/or project activities as necessary to ensure we meet the goals defined in the PDARP/PEIS. This structure would support adaptive management of the overall portfolio of projects based on MDBC vision and restoration outcomes established by the steering committee.

4.0 Evaluation

As a data collection project, this work would be evaluated on the collection and analyses of data as planned; the quality of data to improve understanding of the distribution, abundance, and community composition of MDBC; and the usefulness of the data to inform management and support habitat conservation and restoration strategies.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

In this section, we describe how knowledge gained from the evaluation of monitoring data would be used at the project-level to determine whether the project, once implemented, is considered successful or whether corrective actions are needed during project implementation. A project may not be achieving its intended objectives because of previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

Table 5-1 provides the list of performance criteria for monitoring parameters and potential corrective actions that can be taken if performance criteria are not met. This table may not include all possible options; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions, organized by restoration objective.

Monitoring Parameter	Performance Criteria	Potential Corrective Actions
Objective #1. Document the abundance and distribution of MDBC		
Area of bottom mapped	TBD during implementation planning.	Equipment would be chosen to give the best cost/benefit for the area being mapped. If equipment fails, it would be repaired or replaced. Targets for total area mapped and mapping resolution may be modified based on the results of implementation each year.
Predictive habitat model development	Development of the model	No corrective actions identified.
Predictive habitat model performance	TBD during implementation planning.	If the model does not accurately predict habitat and/or coral occurrence, a different modeling approach may be tried, or more data may be used or gathered (i.e., through additional ground-truthing) to parameterize the model.
Objective #2. Provide fundamental information to prioritize and support protection and management activities and to target locations for direct restoration		
Sampling Sufficiency for Population metrics	TBD during implementation planning.	If population metrics are difficult to measure or calculate due to low numbers, aggregate by species across sites, realizing that site-specific data may be lost. Consider cost/benefit of additional sampling/analysis.
Sampling Sufficiency for Community metrics	TBD during implementation planning.	If community metrics are difficult to measure or calculate due to low numbers, aggregate by species across sites, realizing that site-specific data may be lost. Consider cost/benefit of additional sampling/analysis.

Monitoring Parameter	Performance Criteria	Potential Corrective Actions
Species and habitat interactions elucidated	TBD during implementation planning.	If species and habitat interactions are difficult to measure or calculate due to low numbers, aggregate by species across sites, realizing that site-specific data may be lost. Consider cost/benefit of additional sampling/analysis. Consider cost/benefit of additional sampling/analysis.
Usefulness of data to managers	TBD during implementation planning.	Redirect effort to more relevant areas or apply techniques to determine most cost-effective alternatives for management decisions.

6.0 Monitoring Schedule

The first 1-2 years of the project would focus on implementation planning, followed by 5 years of field- and lab-based project implementation. The final year of the project would be dedicated to project close-out and reporting. Data would be presented to resource managers throughout the project period, for use in protecting and restoring MDBC.

Table 6-1: Monitoring schedule.

Monitoring Parameter	Year							
	1	2	3	4	5	6	7	8
Area of bottom mapped	X	X	X	X	X	X	X	X
Predictive habitat model development	X	X	X	X	X	X	X	X
Predictive habitat model performance	X	X	X	X	X	X	X	X
Sampling sufficiency for population metrics			X	X	X	X	X	X
Sampling sufficiency for community metrics			X	X	X	X	X	X
Species and habitat interactions elucidated			X	X	X	X	X	X
Usefulness of data to managers			X	X	X	X	X	X

7.0 Data Management

7.1 Data Description

Data collection would occur throughout this project and be would compiled in a manner consistent with the requirements of NOAA's National Centers for Environmental Information, Coral Reef Conservation Program, and/or Deep-Sea Coral Research and Technology Program, and of the Trustees' existing data repositories (e.g., DIVER). Data compilation would be completed on an ongoing basis and would be finalized in the year following the 5th year of field and lab implementation effort. Data collection would occur at MDBC sites throughout the northern Gulf of Mexico and analyses would be performed in shore-side laboratory settings. This project is expected to generate a large volume of data, requiring substantial support for data management and standardization, to be overseen and coordinated by the steering committee and project management structure described above.

To the extent practicable, all environmental and biological data generated during monitoring activities would be documented using standardized field datasheets, software, or file types (see e.g. https://www.coris.noaa.gov/, https://www.mbari.org/products/research-software/mb-system/, and https://deepseacoraldata.noaa.gov/internal-documents/program-guidance/science-team-guidance-for-data-management/dscrtp-database-records-submission-template.xlsx/view).

If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original datasheets and source datasets (i.e., imagery, sensor) would be retained by the Implementing Trustee.

Relevant project data would be collected and entered in standardized digital formats. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

Data generated by this project would be integrated across sampling methods, record types, and institutions, and standardized to facilitate data discovery, access and application, as described in the "Guiding Principles" section of NOAA's *Introduction to NOAA's National Database for Deep-Sea Corals and Sponges* (Hourigan et al. 2015). All data would have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents).

Data for measuring success of this project (i.e. the parameters mentioned above) would be uploaded to the DIVER portal within a year of collection, QA/QC, and analysis.

7.2 Data Sharing

This project would distill data and information from many sources and at the same time generate new data, becoming a source for future analyses and products. The intent is that both project managers and the public would be able to discover and access this full range of related data and information, from input data to analyzed products. Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. Some of the data collected may be protected from public disclosure under federal and state law and therefore would not be publicly distributed.

8.0 Reporting

Project reports would be generated on an annual basis to inform annual project field- and lab-work planning efforts. Final project report and analyses would be generated in the final year of the project, following the 5th year of project implementation through field and lab effort.

9.0 Roles and Responsibilities

NOAA is the implementing agency for this project; NOAA would coordinate with DOI during project implementation.

10.0 References

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Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Habitat Assessment and Evaluation

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support any necessary adaptive management of the restoration project. Where applicable, it identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. It also establishes a decision-making process for making adjustments where needed.

This MAM Plan is a "living" document and may be updated as needed to reflect changing conditions and/or new information. For example, the plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design requires adjustment, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The two main approaches to restoration of damaged mesophotic and deep-sea coral populations currently under consideration are 1) direct restoration of communities through deployments of living coral fragments and/or substrates for coral growth, and 2) protecting and managing specific areas that host diverse and abundant coral communities. To effectively plan and implement either of these approaches, it is important that we understand the distribution of mesophotic and deep coral and the character of their habitats in the northern Gulf of Mexico, including the genetic diversity within metapopulations of target species, and the connectivity among metapopulations of various species. This project would support and inform restoration planning and implementation for mesophotic and deep benthic communities (MDBC) through strategically designed field surveys, with subsequent laboratory-based analyses of MDBC components and interactions. The surveys would yield the types of samples that support determinations of ages and growth rates 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 methods. The 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) following the DWH spill.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and Protect Living Coastal and Marine Resources.
- Restoration Type: Mesophotic and Deep Benthic Communities.
- Restoration approach: Improve understanding of MDBC to inform better management and ensure resiliency.

- Restoration technique: Resource-level monitoring and adaptive management to address critical uncertainties.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

This restoration project is being implemented within MDBC of the northern Gulf of Mexico. This project is intended to survey and sample these communities, in order to accomplish data collection necessary to improving scientific understanding of MDBC to inform better management and ensure resiliency.

NOAA is the implementing agency for this project; NOAA would coordinate with DOI during project implementation.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, is:

- Improve understanding of MDBC to inform better management and ensure resiliency.

The project restoration objectives are:

- Fill critical data gaps (e.g., on the biology and ecology of species) and evaluate sites for potential direct restoration and protection activities, at both injured and reference sites.
- Identify ongoing impacts and assess natural and anthropogenic threats to MDBC (e.g., oil spill related impacts, invasive species, water quality anomalies, vessel anchoring, fishing impacts, marine debris, contaminant releases, marine heatwaves, and climate change).
- Provide the background data needed to detect and quantify trends affecting MDBC habitats for inference of potential future impacts (e.g., for prioritizing sites for protection and management) and to assess success of restoration efforts with respect to recovery, natural mortality and growth rates.
- Establish a baseline for health and condition to guide direct restoration and protection.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii).

1.3 Conceptual Setting

The objectives of this project are to fill critical data gaps in the characterization of MDBC habitats to inform potential direct restoration and protection activities. Characterization of MDBC habitats through this assessment and evaluation effort may inform protection and management activities by the DWH Trustees or under other existing programs, identifying ongoing impacts and threats to MDBC, providing background data to detect and quantify trends affecting MDBC and to assess success of restoration efforts, and establish a baseline for health and condition to guide direct restoration and protection.

1.3.1 Potential Sources of Uncertainty

Several factors may influence the chances of the project meeting its objectives. First, the number of sites and total area we would assess and evaluate is currently undetermined and would be evaluated further during implementation planning. The oil spill's spatial scale and the distribution of MDBC in the northern Gulf of Mexico are sufficiently large that scientists cannot survey or sample all areas that may have been injured or that may present opportunities for management, protection, or direct restoration. The total area surveyed would depend on factors such as the specific technologies employed, depths surveyed, weather, visibility, and equipment reliability. The sufficiency of data to be generated by the project for determining appropriate targets for direct restoration is currently unknown. Finally, implementation of management processes and regulatory frameworks designed to benefit and protect MDBC resources are led by non-trustee offices or agencies and are subject to substantial and lengthy public engagement. Thus, this DWH MDBC alternative to characterize MDBC habitats would not solely or specifically determine the ultimate outcomes of whether or how such management efforts or protective frameworks are implemented.

2.0 Project Monitoring

This project would assess and evaluate MDBC using parameters such as spatial distribution of benthic habitats; coral community metrics (condition, species composition, and size distribution); benthic community metrics and species composition; and fish habitat use, community metrics, and species composition, among others. Precise details of the methods, timing, frequency, duration, sample sizes, and sites to be sampled under this project would be determined during the initial 1-2 year implementation planning period of the project. Overall, monitoring efforts would apply tested and accepted methods for determination of mesophotic and deep-sea sediment and coral community condition (e.g.; high resolution imaging, video surveys, sediment sampling; Brooks et al. 2016; Freiwald and Roberts eds, 2005), but would also potentially apply new and emerging techniques as needed and as they become available.

Objective #1. Fill critical data gaps (e.g., biological, ecological) and evaluate sites for potential direct restoration and protection activities, at both injured and reference sites

Parameter #1: Sampling sufficiency for population metrics

a) Purpose: To determine if age and size distributions, biomass, density and abundance were measured and if ontogenetic changes were observed for select species.
b) Method: Determine confidence in the values calculated for each population level metric.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

Parameter #2: Sampling sufficiency for community metrics

a) Purpose: To determine if species composition, diversity, species richness, and percent cover were measured or calculated.
b) Method: Count the number of sites for which community level metrics were calculated

c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

Parameter #3: Species and habitat interactions elucidated

a) Purpose: To determine if species and habitat interactions (e.g., feeding/predation, mutualism, reproduction, use of structure or substrate, water column, etc.) were elucidated.
b) Method: Count the number of sites for which species and habitat interactions were elucidated.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

Parameter #4: Metapopulation dynamics and genetic diversity elucidated

a) Purpose: To determine if population structure, genetic diversity, source/sink population demographics, relative rate and directionality of genetic exchange were elucidated.
b) Method: Count the number of sites and species for which population structure, genetic diversity, and exchange rates were elucidated.
c) Timing, Frequency, and Duration: Annually during the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

Parameter #5: Coral larvae dispersal model development

a) Purpose: This parameter describes whether or not coral larvae dispersal models were developed, including building on existing modeling efforts.
b) Method: Determine whether a functioning model is developed (i.e., meaningful output is obtainable).
c) Timing, Frequency, and Duration: Models would be developed and refined throughout the course of the project.
d) Sample Size: TBD
e) Sites: TBD during implementation planning.

Parameter #6: Coral larvae dispersal model performance

a) Purpose: To determine whether the model accurately predicts dispersal of coral larvae.
b) Method: Compare predicted dispersal to independent field data (i.e., data not used for model development or parameterization).
c) Timing, Frequency, and Duration: Models would be developed and refined throughout the course of the project.
d) Sample Size: TBD.

e) Sites: TBD during implementation planning.

Parameter #7: Usefulness of population ecology data to managers

a) Purpose: To determine if information is useful for planning active restoration activities or for providing actionable information to managers to support prioritization and support protection, management, and direct restoration.
b) Method: Survey of managers receiving information.
c) Timing, Frequency, and Duration: Annually during the five years of field- and lab-based project implementation.
d) Sample Size: TBD
e) Sites: TBD during implementation planning.

Objective #2. Identify ongoing impacts and assess natural and anthropogenic threats to MDBC (e.g., oil spill related impacts, invasive species, water quality anomalies, vessel anchoring, fishing impacts, marine debris, contaminant releases, marine heatwaves, and climate change)

Parameter #1: Natural and anthropogenic threats and impacts to MDBC documented

a) Purpose: To determine if impacts and threats to target species were documented.
b) Method: Count the number of individuals/colonies, species, and sites for which threats and impacts were observed.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

Parameter #2: Usefulness of threat data to managers

a) Purpose: This parameter measures whether natural and anthropogenic threats and impacts are characterized with sufficient confidence to inform management actions, such as planning active restoration activities or providing actionable information to managers to support prioritization and support protection, management, and direct restoration.
b) Method: Survey of managers receiving information.
c) Timing, Frequency, and Duration: Annually during the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

Objective #3. Provide the background data needed to detect and quantify trends affecting MDBC habitats for inference of potential future impacts (e.g., for prioritizing sites for protection and management) and to assess success of restoration efforts with respect to recovery, natural mortality and growth rates

Parameter #1: Sufficiency of data to establish recovery trajectories and restoration targets.

a) Purpose: To determine if age and size distributions, biomass, density and abundance were measured reliably and ontogenetic changes observed for select species.

b) Method: Count the number of species and sites for which recovery, mortality, and growth rate metrics were calculated.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

Parameter #2: Number of sediment community recovery trajectories calculated

a) Purpose: To determine if sediment community recovery trajectories were established.
b) Method: Count the number of sites for which sediment community recovery trajectories were calculated.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

Parameter #3: Usefulness of environmental trends analyses to managers

a) Purpose: This parameter measures whether environmental baseline conditions and changes over time around impacted and healthy deep-sea and mesophotic environments are established with sufficient confidence to support management, infer future impacts, and assess restoration success (usefulness of data for planning active restoration activities or for providing actionable information to managers to support prioritization and support protection, management, and direct restoration).
b) Method: Survey of managers receiving information.
c) Timing, Frequency, and Duration: Annually during the five years of field- and lab-based project implementation.
d) Sample Size: NA.
e) Sites: TBD during implementation planning.

Objective #4. Determine a baseline for health and condition to guide direct restoration and protection

Parameter #1: Community structure and function elucidated

a) Purpose: To determine if the observations were sufficient to elucidate community structure and function for injured and reference MDBCs over time. Any changes in reference communities could be compared to those in injured communities to determine their similarity/differences.
b) Method: Document community structure and function.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

Parameter #2: Usefulness of data related to baseline conditions and changes over time to managers

a) Purpose: This parameter measures whether baseline conditions and changes over time are characterized with sufficient confidence for planning active restoration activities or for providing actionable information to managers to support prioritization and support protection, management, and direct restoration.
b) Method: Survey of managers receiving information.
c) Timing, Frequency, and Duration: Annually during the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

3.0 Adaptive Management

The project's focus on data collection reflects the need for information to inform or augment ongoing efforts to protect, manage, and restore MDBC. Restoration for MDBC resources would include phased implementation to allow for data collection to address critical uncertainties and inform adaptive decision-making. The data generated by this project would be critical to the adaptive management feedback loop, informing active management and protection of MDBCs and substrate placement and coral propagation activities undertaken to benefit MDBCs. The information this project generates would iteratively advance restoration planning by supporting implementation of initial restoration actions, monitoring the success of these actions, and using the information obtained to refine future projects. The MDBC project management structure would provide milestones and mechanisms to evaluate progress in meeting well-defined restoration outcomes, project objectives, and long-term Restoration Type goals, and redirect the portfolio and/or project activities as necessary to ensure we meet the goals defined in the PDARP/PEIS. This structure would support adaptive management of the overall portfolio of projects based on MDBC vision and restoration outcomes established by the steering committee.

4.0 Evaluation

As a data collection project, this work would be evaluated on the collection and analyses of data as planned; the quality of data to characterize mesophotic and deep-sea communities; and the usefulness of the data to inform management and support habitat conservation and restoration strategies.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

In this section, we describe how knowledge gained from the evaluation of monitoring data would be used at the project-level to determine whether the project, once implemented, is considered successful or whether corrective actions are needed during project implementation. A project may not be achieving its intended objectives because of previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

Table 5-1 provides the list of performance criteria for monitoring parameters and potential corrective actions that can be taken if performance criteria are not met. This table may not include all possible options; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions, organized by restoration objective.

Monitoring Parameter	Performance Criteria	Potential Corrective Actions
Objective #1. Fill critical data gaps (e.g., biological, ecological) and evaluate sites for potential direct restoration and protection activities, at both injured and reference sites.		
Sampling sufficiency for population metrics	TBD during implementation planning.	If population metrics are difficult to measure or calculate due to low numbers, aggregate by species across sites, realizing that site-specific data may be lost. Consider cost/benefit of additional sampling/analysis.
Sampling sufficiency for community metrics	TBD during implementation planning.	If community metrics are difficult to measure or calculate due to low numbers, aggregate by species across sites, realizing that site-specific data may be lost. Consider cost/benefit of additional sampling/analysis.
Species and habitat interactions elucidated	TBD during implementation planning.	If species and habitat interactions are difficult to measure or calculate due to low numbers, aggregate by species across sites, realizing that site-specific data may be lost. Consider cost/benefit of additional sampling/analysis.
Metapopulation dynamics and genetic diversity elucidated	TBD during implementation planning.	Consider design and cost/benefit of additional sampling/analysis.
Coral larvae dispersal model development	Development of model	No corrective actions identified.
Coral larvae dispersal model performance	TBD during implementation planning.	If the model does not accurately predict larval dispersal, a different modeling approach may be tried or additional data and/or more factors/variables may need to be examined to improve the existing model.

Monitoring Parameter	Performance Criteria	Potential Corrective Actions
Usefulness of population ecology data to managers	TBD, depending on the survey methodology developed during implementation planning.	If habitat assessment data do not provide actionable information to managers to support prioritization and support protection, management, and direct restoration, redirect effort for that purpose.
Objective #2. Identify ongoing impacts and assess natural and anthropogenic threats to MDBC (e.g., oil spill related impacts, invasive species, water quality anomalies, vessel anchoring, fishing impacts, marine debris, contaminant releases, marine heatwaves, and climate change).		
Natural and anthropogenic threats and impacts to MDBC documented	TBD during implementation planning.	If threats and impacts are difficult to quantify due to low numbers, aggregate across sites, realizing that site-specific data may be lost. Consider cost/benefit of additional sampling/analysis.
Usefulness of threat data to managers	TBD, based on the survey design methodology developed during implementation planning.	If data related to natural and anthropogenic threats to MDBCs do not provide actionable information to managers to support prioritization and support protection, management, and direct restoration, redirect effort for that purpose.
Objective #3. Provide the background data needed to detect and quantify trends affecting MDBC habitats for inference of potential future impacts (e.g., for prioritizing sites for protection and management) and to assess success of restoration efforts with respect to recovery, natural mortality and growth rates.		
Sufficiency of data to establish recovery trajectories and restoration targets	Data are sufficient for establishment of recovery trajectories and restoration targets. Specific values would depend on the statistical models that are most appropriate to data analysis.	Consider cost/benefit of additional sampling/analysis.
Number of sediment recovery trajectories calculated	TBD, depending on the number of sediment communities identified.	If recovery trajectories are difficult to measure or calculate, aggregate across sites, realizing that site-specific data may be lost. Consider cost/benefit of additional sampling/analysis.
Usefulness of environmental trends analyses to managers	TBD, based on the survey design methodology developed during implementation planning.	If data related to trends affecting MDBCs do not provide actionable information to managers to support prioritization and support protection, management, and direct restoration, redirect effort for that purpose.
Objective #4. Determine a baseline for health and condition to guide direct restoration and protection.		

Monitoring Parameter	Performance Criteria	Potential Corrective Actions
Community structure and function elucidated	TBD during implementation planning.	If changes over time to injured and reference MDBC structure and function are difficult to quantify due to low numbers, aggregate by species across sites, realizing that site-specific data may be lost. Consider cost/benefit of additional sampling/analysis.
Usefulness of data related to baseline conditions and changes over time to managers	TBD during implementation planning.	If data related to baseline conditions and changes over time do not provide actionable information to managers to support prioritization and support protection, management, and direct restoration, redirect effort for that purpose.

6.0 Monitoring Schedule

The first 1-2 years of the project would focus on implementation planning, followed by five years of field- and lab-based project implementation. The final year of the project would be dedicated to project close-out and reporting. Data would be presented to resource managers throughout the project period, for use in protecting and restoring MDBC.

Table 6-1: Monitoring schedule.

Monitoring Parameter	Year							
	1	2	3	4	5	6	7	8
Sampling sufficiency for population metrics			X	X	X	X	X	X
Sampling sufficiency for community metrics			X	X	X	X	X	X
Species and habitat interactions elucidated			X	X	X	X	X	X
Metapopulation dynamics and genetic diversity elucidated			X	X	X	X	X	X
Coral larvae dispersal model development	X	X	X	X	X	X	X	X
Coral larvae dispersal model performance			X	X	X	X	X	X
Usefulness of population ecology data to managers	X	X	X	X	X	X	X	X
Natural and anthropogenic threats and impacts to MDBC documented			X	X	X	X	X	X
Usefulness of threat data to managers			X	X	X	X	X	X
Sufficiency of data to establish recovery trajectories and restoration targets			X	X	X	X	X	X
Number of sediment recovery trajectories calculated			X	X	X	X	X	X

Monitoring Parameter	Year							
	1	2	3	4	5	6	7	8
Usefulness of environmental trends analyses to managers	X	X	X	X	X	X	X	X
Community structure and function elucidated			X	X	X	X	X	X
Usefulness of data related to baseline conditions and changes over time to managers			X	X	X	X	X	X

7.0 Data Management

7.1 Data Description

Data collection would occur throughout this project and be would compiled in a manner consistent with the requirements of NOAA's National Centers for Environmental Information, Coral Reef Conservation Program, and/or Deep-Sea Coral Research and Technology Program, and of the Trustees' existing data repositories (e.g., DIVER). Data compilation would be completed on an ongoing basis and would be finalized in the year following the 5th year of field and lab implementation effort. Data collection would occur at MDBC sites throughout the northern Gulf of Mexico in shore-side laboratory settings. This project is expected to generate a large volume of data, requiring substantial support for data management and standardization, to be overseen and coordinated by the steering committee and project management structure described above.

To the extent practicable, all environmental and biological data generated during monitoring activities would be documented using standardized field datasheets, software, or file types (see e.g. https://www.coris.noaa.gov/, https://www.mbari.org/products/research-software/mb-system/, and https://deepseacoraldata.noaa.gov/internal-documents/program-guidance/science-team-guidance-for-data-management/dscrtp-database-records-submission-template.xlsx/view). If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original datasheets and source datasets (i.e., imagery, sensor) would be retained by the Implementing Trustee.

Relevant project data would be collected and entered in standardized digital formats. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Geospatial data would adhere to FGDC/ISO standards.

Data generated by this project would be integrated across sampling methods, record types, and institutions and standardized to facilitate data discovery, access and application, as described in the "Guiding Principles" section of NOAA's *Introduction to NOAA's National Database for Deep-Sea Corals* *and Sponges* (Hourigan et al. 2015). All data would have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents).

Data for measuring success of this project (i.e. the parameters mentioned above) would be uploaded to the DIVER portal within a year of collection, QA/QC, and analysis.

7.2 Data Review and Clearance

Data generated by this project would be quality-controlled by NOAA with internal procedures to 'flag' and correct problems as described in the "Guiding Principles" section of NOAA's *Introduction to NOAA's National Database for Deep-Sea Corals and Sponges* (Hourigan et al. 2015).

Relevant project data would be collected and entered in standardized digital formats. Data entries would be verified against source datasets (i.e., imagery, sensor), and any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed. Project managers would verify and validate MAM data and information and would ensure that all data are: i) entered or converted into agreed upon/commonly used digital format, ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with NOAA requirements.

7.3 Data Storage and Accessibility

Once all data have been subjected to QA/QC procedures, the metadata would be submitted to the Restoration Portal, and data collected for this project would be stored in existing data repositories established for the type of data in question (e.g., NOAA's National Database for Deep-Sea Corals and Sponges, https://deepseacoraldata.noaa.gov/, NCEI's Multibeam Bathymetry Database, https://www.ngdc.noaa.gov/mgg/bathymetry/multibeam.html, NOAA's Coral Reef Conservation Program's information portal CoRIS, https://www.coris.noaa.gov/, and NCEI's oceanographic data archives, https://www.nodc.noaa.gov/submit/index.html). These repositories would be mapped/linked/integrated into the DIVER platform, as appropriate. Trustees would provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected, subjected to QA/QC, and analyzed.

7.4 Data Sharing

This project would distill data and information from many sources and at the same time would generate new data, becoming a source for future analyses and products. The intent is that both project managers and the public would be able to discover and access this full range of related data and information, from input data to analyzed products. Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. Some of the data collected may be protected from public disclosure under federal and state law and therefore would not be publicly distributed.

8.0 Reporting

Project reports would be generated on an annual basis to inform annual project field- and lab-work planning efforts. Final project report and analyses would be generated in the final year of the project, following the 5th year of project implementation through field and lab effort.

9.0 Roles and Responsibilities

NOAA is the implementing agency for this project; NOAA would coordinate with DOI during project implementation.

10.0 References

Brooks, J.M., Fisher, C., Roberts, H., Cordes, E., Baums, I., Bernard, B., Church, R., Etnoyer, P., German, C., Goehring, E., McDonald, I., Shank, T., Warren, D., Welsh, S., and Wolff, G. In Review. 2016. “Exploration and research of northern Gulf of Mexico deepwater natural and artificial hard-bottom habitats with emphasis on coral communities: Reefs, rigs, and wrecks - “Lophelia II” Final report.” BOEM Contract M08PC20028. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA

Freiwald, A. and Roberts, J. M. (eds) 2005. “Cold-Water Corals and Ecosystems.” Erlangen Earth Conference Series. xxxii + 1243 pp. Berlin, Heidelberg, New York: Springer-Verlag. ISBN 3 540 24136 1.

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Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Coral Propagation Technique Development

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support any necessary adaptive management of the restoration project. Where applicable, it identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. It also establishes a decision-making process for making adjustments where needed.

This MAM Plan is a "living" document and may be updated as needed to reflect changing conditions and/or new information. For example, the plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design requires adjustment, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

Perhaps the most direct approach to restoring deep-water coral communities damaged by the DWH spill is to facilitate the growth of new corals of the same species as those damaged – primarily gorgonian octocorals and black corals. Deployment of coral fragments is a well-developed technique to restore shallow water coral populations. Settlement structures have also been used to catalyze or restore shallow water coral populations in cases where the original substrate was damaged or limited. While coral restoration has not yet been conducted in deep water, pilot studies of coral transplantation have been carried out with *Oculina varicosa* off eastern Florida, *Lophelia pertusa* in the Gulf of Mexico, and more recently with octocorals at Sur Ridge and Davidson Seamount in the Monterey Bay NMS. This coral propagation technique development project would replicate these types of studies using relevant endemic taxa. The techniques to be tested would include laboratory husbandry and in-situ placement of artificial substrate to enhance growth and recruitment of coral larvae. The project would rate performance based on growth of coral transplants and recruitment to placed substrate at relevant sites across the northern Gulf of Mexico. The research design would include sites inside and outside of areas with documented or potential injury from the DWH spill. The project would also be designed to "scale up" to a meaningful level, consistent with the scope and context of DWH-related injury to mesophotic and deep benthic communities. The techniques and approaches that would best achieve these purposes with Gulf of Mexico species are unknown, so this project would first be implemented at a pilot scale in the lab and in the field, with robust monitoring and adaptive management. Further, because of the generally very slow growth rates of the deeper living species, and their unknown natural settlement and colonization rates, this project would begin testing this approach as soon as possible. It may take as long as 5-10 years for a robust, preliminary determination of the efficacy of different methods.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Mesophotic and Deep Benthic Communities (MDBC).
- Restoration approach: Restore mesophotic and deep benthic invertebrate and fish abundance and biomass for injured species.
- Restoration technique: Place hard ground substrate and transplant coral.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/ Environmental Assessment.

This restoration project is being implemented within MDBCs of the northern Gulf of Mexico. This project is intended to pilot test coral propagation methods to directly restore lost biomass of mesophotic and deep-sea coral species injured by the DWH oil spill.

NOAA is the implementing agency for this project; NOAA would coordinate with DOI during project implementation.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, is:

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

The project restoration objectives are:

- Develop methods and techniques for effective enhancement of coral recruitment and growth and recommend successful methods to be implemented at a large scale for restoration.
- Directly compensate the loss of MDBC corals and associated benthic and water column communities injured by the DWH oil spill.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 C.F.R. 990.55(b)(1)(vii).

1.3 Conceptual Setting

The objective of this project is to develop techniques to directly restore MDBCs through enhanced recruitment and growth of healthy coral colonies. As described in the PDARP/PEIS, considering the slow natural growth rate, low recruitment, and long life of mesophotic and deep benthic corals, creation of interim habitat and active transplantation of corals would be helpful to accelerate an otherwise protracted natural recovery. The approach would propagate and raise live corals, and strategically place hard substrate in suitable locations with conditions conducive to coral colonization and coral transplant survival. Siting of experiments may be informed by oceanographic conditions (currents, depths, temperatures, water quality parameters), permitted areas, habitat suitability models and/or available information on source/sink dynamics of the coral populations from genetic studies and dispersal models. Coral fragments would be attached to the hard substrate. The hard substrate is envisioned as large three-dimensional structures that would serve as interim habitat and protection for small, planktivorous reef fish that were injured during the spill.

1.3.1 Potential Sources of Uncertainty

Several factors may influence the chances of the project meeting its objectives. First, substrate placement and coral propagation/transplantation techniques have not yet been implemented in deep water. It is not known how well transplants would grow nor how long it takes for the substratum to be colonized. It is also unknown whether methods and techniques for MDBC restoration can be developed in a way that is scalable to a level meaningful in the scope and context of DWH injury. Further, the generally very slow growth rates of the deeper living species, and their unknown natural settlement and colonization rates, suggest that project results may not be discernable for as long as 5-10 years. The number of sites at which propagation methods would be tested is not yet determined (should be a minimum of three), and the environmental variability across those sites is unknown at this time and must be documented. Existing and newly generated data on life histories of target taxa and the distribution and connectivity among populations would provide critical context to inform implementation of substrate placement and coral propagation efforts.

2.0 Project Monitoring

The pilot effort represented by this project was developed to evaluate different methods and techniques for effective enhancement of coral recruitment and growth and to consider the application of successful methods at a large scale for restoration. This project would apply a variety of techniques to enhance the recruitment and growth of corals to MDBCs. The monitoring approaches applied to the various techniques would assess similar performance metrics and parameters. The metrics include: number and size of coral colonies, areal coverage and spatial extent of benthic habitats, coral community structure (percent cover, species composition), coral condition (coral tissue percent cover, fecundity), coral fragment survival (or mortality), characterization of other benthic macrobiota (presence/absence, percent cover, density, species identification), density, diversity, and size of associated fish, structural integrity of 3-D structures. Existing methods and information from peer-reviewed literature and project reports on biological and environmental parameters controlling recruitment, growth, health, and reproduction would be applied to the extent possible, with the development of new protocols as needed given the unprecedented scale of this project.

Objective #1. Develop methods and techniques for effective enhancement of coral recruitment and growth and the application of successful methods at a large scale for restoration

Parameter #1: Number of coral growth enhancement and recruitment enhancement techniques tested

a) Purpose: This parameter would be used to evaluate project implementation based on the implementation plan.
b) Method: Count the number of techniques of each type that are sufficiently tested to determine their effectiveness.
c) Timing, Frequency, and Duration: Findings would be summarized annually as part of the annual reporting process.

d) Sample Size: N/A.
e) Sites: N/A.

Parameter #2: Effectiveness of techniques to enhance coral recruitment and growth in situ and in laboratory husbandry settings

a) Purpose: To determine if pilot tested techniques for substrate placement and coral propagation effectively enhance recruitment and growth of target species.
b) Method: Measure recruitment and growth rate performance of propagated coral target species, number and size of colonies, locations of colonies, health and condition, growth, feeding, fecundity, fragmentation rate, size class distribution over time, water column larval count.
c) Timing, Frequency, and Duration: Minimum of twice annually throughout the five years of field- and lab-based project implementation, with intensive sampling during specific periods (e.g., based on lunar cycles) of up to several weeks at a time. Specific timing and frequency to be determined during implementation planning.
d) Sample Size: TBD.
e) Sites: All locations selected for methods testing.

Objective #2. Directly compensate the loss of MDBC corals and associated benthic and water column communities injured by the DWH oil spill

Parameter #1: Area of project footprint

a) Purpose: This parameter would be used to evaluate project implementation.
b) Method: The area of substrate deployed would be measured using established mapping techniques.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: All *in situ* locations selected for methods testing.

Parameter #2: Area effectively restored

a) Purpose: This parameter would be used to evaluate the effectiveness of the restoration methods.
b) Method: The area of substrate deployments that achieve structural/functional similarity to reference sites and are successfully colonized would be measured using established mapping and habitat assessment techniques, and summed.
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: All *in situ* locations selected for methods testing.

Parameter #3: Potential for successful methods of enhancing coral recruitment and growth to compensate documented injuries

a) Purpose: This parameter measures whether successful substrate placement and coral propagation techniques can be implemented at large scale for meaningful restoration relative to injury.
b) Method: Cost/benefit analysis (e.g., cost per number of colonies propagated or transplanted, cost per recruit to placed substrate or per area of substrate placed, cost relative to effectiveness at achieving structural/functional similarity to reference sites).
c) Timing, Frequency, and Duration: Throughout the five years of field- and lab-based project implementation.
d) Sample Size: TBD.
e) Sites: All locations selected for methods testing.

3.0 Adaptive Management

The inherent focus of this project on pilot-scale coral propagation technique development reflects the need for additional information about these communities to inform or augment ongoing efforts to actively restore them. Restoration for MDBC resources would include phased implementation to allow for data collection to address critical uncertainties and inform adaptive decision-making. The MDBC steering committee would provide planning resources and longer-term planning to define specific activities and objectives. The data generated by this project would be critical to the adaptive management feedback loop, informing active management and protection of MDBCs and substrate placement and coral propagation activities undertaken to benefit MDBCs. The information this project generates would iteratively advance restoration planning by supporting implementation of initial restoration actions, monitoring the success of these actions, and using the information obtained to refine future projects. The MDBC project management structure would provide milestones and mechanisms to evaluate progress in meeting well-defined restoration outcomes, project objectives, and long-term Restoration Type goals, and redirect the portfolio and/or project activities as necessary to ensure we meet the goals defined in the PDARP/PEIS. This structure would support adaptive management of the overall portfolio of projects based on MDBC vision and restoration outcomes established by the steering committee.

4.0 Evaluation

This pilot project would be evaluated based on the advances it achieves toward development of techniques for mesophotic and deepwater coral substrate placement and coral transplantation/propagation, the degree to which those advances are applied toward future substrate placement and coral transplantation/propagation efforts, and the extent to which they support habitat restoration strategies and decision-making for MDBCs. The nature and quality of the data generated by the project would be critical to determining the extent to which it achieves the project goal to identify viable methods for large-scale implementation. Evaluation of these outcomes would continue for a minimum of one year beyond the duration of the field- and lab-based implementation work described here, and the benefits of this project may be enhanced by subsequent follow-on visits to pilot test sites. This potential may be further evaluated in a future restoration plan.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

In this section, we describe how knowledge gained from the evaluation of monitoring data would be used at the project-level to determine whether the project, once implemented, is considered successful or whether corrective actions are needed during project implementation. A project may not be achieving its intended objectives because of previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

Table 5-1 provides the list of performance criteria for monitoring parameters and potential corrective actions that can be taken if performance criteria are not met. This table may not include all possible options; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions, organized by restoration objective.

Monitoring Parameter	Performance Criteria	Potential Corrective Actions
Objective #1. Develop methods and techniques for effective enhancement of coral recruitment and growth and the application of successful methods at a large scale for restoration		
Number of coral growth enhancement and recruitment enhancement techniques tested	TBD during implementation planning.	TBD, depending on the nature of the failure to conduct testing as planned.
Objective #2. Directly compensate the loss of MDBC corals and associated benthic and water column communities injured by the DWH oil spill		
Area of project footprint	TBD during implementation planning.	TBD, depending on the nature of the failure to conduct deployment as planned.
Area effectively restored	TBD during implementation planning.	Additional testing of deployment methods may be considered.

6.0 Monitoring Schedule

The first 1-2 years of the project would focus on implementation planning, followed by five years of field- and lab-based project implementation. The final year of the project would be dedicated to project close-out and reporting. Data would be presented to resource managers throughout the project period, for use in protecting and restoring MDBCs.

Table 6-1: Monitoring schedule.

Monitoring Activity	Year							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Testing Technique Effectiveness	X	X	X	X	X	X	X	X
Evaluating the potential for large-scale implementation			X	X	X	X	X	X

7.0 Data Management

7.1 Data Description

Data collection would occur throughout this project and be would compiled in a manner consistent with the requirements of NOAA's National Centers for Environmental Information, Coral Reef Conservation Program, and/or Deep-Sea Coral Research and Technology Program, and of the Trustees' existing data repositories (e.g., DIVER). Data compilation would be completed on an ongoing basis and would be finalized in the year following the 5th year of field and lab implementation effort. Data collection would occur in shore-side coral propagation/nursery facilities and at MDBC sites throughout the northern Gulf of Mexico. This project is expected to generate a large volume of data, requiring substantial support for data management and standardization, to be overseen and coordinated by the steering committee and project management structure described above.

To the extent practicable, all environmental and biological data generated during monitoring activities would be documented using standardized field datasheets, software, and/or file types (see e.g. https://www.coris.noaa.gov/, https://www.mbari.org/products/research-software/mb-system/, and https://deepseacoraldata.noaa.gov/internal-documents/program-guidance/science-team-guidance-for-data-management/dscrtp-database-records-submission-template.xlsx/view). If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original datasheets and source datasets (i.e., imagery, sensor) would be retained by the Implementing Trustee.

Relevant project data would be collected and entered in standardized digital formats. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents). Geospatial data would adhere to FGDC/ISO standards. Data generated by this project would be integrated across sampling methods, record types, and institutions and standardized to facilitate data discovery, access and application, as described in the "Guiding Principles" section of NOAA's *Introduction to NOAA's National Database for Deep-Sea Corals and Sponges* (Hourigan et al. 2015). All data would have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents).

Data for measuring success of this project (i.e. the parameters mentioned above) would be uploaded to the DIVER portal within a year of collection, QA/QC, and analysis.

7.2 Data Review and Clearance

Data generated by this project would be quality-controlled by NOAA with internal procedures to 'flag' and correct problems as described in the "Guiding Principles" section of NOAA's *Introduction to NOAA's National Database for Deep-Sea Corals and Sponges* (Hourigan et al. 2015).

Relevant project data would be collected and entered in standardized digital formats. Data entries would be verified against source datasets (i.e., imagery, sensor), and any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed. Project managers would verify and validate MAM data and information and would ensure that all data are: i) entered or converted into agreed upon/commonly used digital format, and ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with NOAA requirements.

7.3 Data Storage and Accessibility

Once all data have been subjected to QA/QC procedures, the metadata would be submitted to the Restoration Portal and data collected for this project would be stored in existing data repositories established for the type of data in question (e.g., NOAA's National Database for Deep-Sea Corals and Sponges, https://deepseacoraldata.noaa.gov/, NCEI's Multibeam Bathymetry Database, https://www.ngdc.noaa.gov/mgg/bathymetry/multibeam.html, NOAA's Coral Reef Conservation Program's information portal CoRIS, https://www.coris.noaa.gov/, and NCEI's oceanographic data archives, https://www.nodc.noaa.gov/submit/index.html). These repositories would be mapped/linked/integrated into the DIVER platform as appropriate. Trustees would provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected, subjected to QAQC, and analyzed.

7.4 Data Sharing

This project would distill data and information from many sources and at the same time would generate new data, becoming a source for future analyses and products. The intent is that both project managers and the public would be able to discover and access this full range of related data and information, from input data to analyzed products. Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. Some of the data collected may be protected from public disclosure under federal and state law and therefore would not be publicly distributed.

8.0 Reporting

Project reports would be generated on an annual basis to inform annual project field- and lab-work planning efforts. Final project report and analyses would be generated in the final year of the project, following the 5th year of project implementation through field and lab effort.

9.0 Roles and Responsibilities

NOAA is the implementing agency for this project; NOAA would coordinate with DOI during project implementation.

10.0 References

Hourigan, T. F., P. J. Etnoyer, R. P. McGuinn, C. Whitmire, D.S. Dorfman, M. Dornback, S. Cross, D. Sallis. 2015. An Introduction to NOAA's National Database for Deep-Sea Corals and Sponges. NOAA Technical Memorandum NOS NCCOS 191. 27 pp. Silver Spring, MD.

Monitoring and Adaptive Management Plan for *Deepwater Horizon* NRDA Project: Active Management and Protection

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support any necessary adaptive management of the restoration project. Where applicable, it identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. It also establishes a decision-making process for making adjustments where needed.

This MAM Plan is a "living" document and may be updated as needed to reflect changing conditions and/or new information. For example, the plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design requires adjustment, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any future revisions to this document would be made publicly available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the *Deepwater Horizon* NRDA Trustees website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project is intended to actively manage valuable mesophotic and deep-sea communities to protect against multiple threats and provide a framework for monitoring, education, and outreach. The project would consist of a suite of restoration activities to manage and protect MDBCs in the northern Gulf of Mexico and would support activities in existing protected area management plans to achieve DWH restoration goals identified in the PDARP/PEIS. Project activities would include education and outreach targeting MDBC resource users and the general public; engagement of stakeholders; development of socioeconomic analyses to evaluate potential impacts of management or protection actions; and directly addressing threats to MDBCs through management activities including installing mooring buoys, documenting and removing marine debris and derelict fishing gear, removing invasive species, assessing and remediating risks associated with leaking and abandoned oil and gas infrastructure, reducing user conflict, and enhancing protection capacity.

This project is being implemented as restoration for the *Deepwater Horizon* oil spill natural resource damage assessment (NRDA), consistent with the PDARP/PEIS.

- Programmatic goal: Replenish and protect living coastal and marine resources.
- Restoration Type: Mesophotic and Deep Benthic Communities (MDBC).
- Restoration approach: Protect and manage MDBC.
- Restoration technique: Active management and protection.
- TIG: Open Ocean.
- Restoration plan: Open Ocean Trustee Implementation Group Restoration Plan 2/Environmental Assessment.

NOAA is the implementing agency for this project; NOAA would coordinate with DOI during project implementation.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, is:

- Actively manage valuable MDBC to protect against multiple threats and provide a framework for monitoring, education, and outreach.

The project restoration objective is to:

- Manage and protect MDBCs from known threats to achieve restoration goals identified in the DWH PDARP/PEIS, help maintain ecological integrity, and increase ecosystem resilience.

1.3 Conceptual Setting

As described in the PDARP/PEIS, MDBC include hard and soft ground habitats and are integral parts the northern Gulf of Mexico ecosystem. Despite the depth of these resources, human activities and environmental perturbations threaten the health and resilience of these communities. These potential threats include oil and gas industry activity; fishing (e.g., harvest pressure, damage from bottom-tending gear, impacts from anchoring or lost gear); recreational activities, such as diving and boating; marine debris; invasive species; and climate change. Identifying management actions to address these threats can help prevent future injury to MDBC. The PDARP/PEIS also describes how restoration that prevents future injuries to natural resources from known threats can often have more certain outcomes and be more cost-effective than projects that create new resources, and how spatially based management provides a framework for addressing threats to MDBC. Depending on the mechanism, management can reduce threats to MDBC to help maintain ecological integrity and potentially increase ecosystem resilience by restricting oil and gas industry activities, limiting the use of specific fishing gears, restricting anchoring, providing education and outreach targeted to both resource users and to the public generally, and monitoring resources and activities. To implement these types of management actions, the Trustees need to coordinate across the agencies involved in implementing protections and with multiple stakeholders through the advisory group and public review processes that are a part of establishing protections.

1.3.1 Potential Sources of Uncertainty

Several uncertainties may affect the performance of this project. These include:

- The effectiveness of outreach, education, and engagement efforts.
- Rates of compliance with/adoption of measures to reduce bottom impacts from anchoring and use of bottom tending gear or to reduce user conflicts.
- Identification of opportunities to perform marine debris removal activities that achieve a net benefit to MDBC habitats.
- The potential for and effectiveness of remediating leaking or abandoned oil and gas infrastructure.
- The potential to reduce invasive species abundances to levels that benefit native species.

- Identification of community/ecosystem traits that provide resilience to stressors.

2.0 Project Monitoring

This project would apply a variety of techniques to actively manage and protect MDBCs. Effectiveness monitoring of education activities would apply attitudinal and behavioral survey and assessment techniques common to the environmental education field and would assess numbers of individuals reached by programming. The performance of this activity would also be evaluated relative to national standards, including targets and success criteria, for environmental education, environmental literacy, and ocean literacy established by EPA, NOAA, and North American Association for Environmental Education (NAAEE). The monitoring approach applied to each technique to assess and mitigate threats to MDBC would vary. Techniques intended to reduce bottom impacts from anchoring, fishing, or marine debris would be assessed by the scale of the threat they eliminate and their capacity to reduce bottom impacts over time, as well as against actual documented reductions in such impacts over time. Invasive species removal would be assessed against metrics such as abundance or density of invasive species as well as community composition of native species assemblage. Protection capacity enhancements would be assessed against metrics such as numbers of enforcement actions taken and compliance rates.

Objective #1: Manage and protect MDBCs from known threats to achieve restoration goals identified in the DWH PDARP/PEIS, help maintain ecological integrity, and increase ecosystem resilience

Parameter #1: Performance of outreach, education, and engagement activities

a) Purpose: To determine the level of effort and reach of outreach, education, and engagement activities conducted.
b) Method: Counts and types of events conducted (i.e., telepresence cruises), exhibits mounted, materials distributed, participants reached, demographics, locations.
c) Timing, Frequency and Duration: Annually and at end of project.
d) Sample Size: TBD.
e) Sites: All locations where outreach, education, and engagement events are conducted.

Parameter #2: Effectiveness of outreach, education, and engagement activities

a) Purpose: To gauge the degree to which outreach, education, and engagement activities increase public awareness and support for conservation and restoration of MDBC habitats.
b) Method: Attitudinal/behavioral survey and assessment techniques used in environmental education.
c) Timing, Frequency and Duration: Before and after education and outreach efforts.
d) Sample Size: TBD during implementation planning.
e) Sites: A subset of locations where education and outreach activities are performed.

Parameter #3: Completion of socioeconomic analyses

a) Purpose: To confirm whether or not socioeconomic analyses were performed.

b) Method: Consultation with those performing analyses.
c) Timing, Frequency and Duration: Annually for first three years of 5-year implementation period.
d) Sample Size: Number of analyses planned.
e) Sites: N/A.

Parameter #4: Usefulness of socioeconomic analyses to managers.

a) Purpose: To determine if the socioeconomic analyses provide useful input for planning active restoration activities or for providing actionable information to managers to support prioritization and support protection, management, and direct restoration (maybe under management project).
b) Method: Consultation with managers.
c) Timing, Frequency and Duration: Upon completion of each round of analyses.
d) Sample Size: TBD.
e) Sites: TBD during implementation planning.

Parameter #5: Threat reduction effort

a) Purpose: To document performance of threat reduction activities targeting sources of bottom impacts from anchoring, bottom tending gear, and marine debris.
b) Method: Count mooring buoys deployed, count bottom tending gear use modifications achieved, count mass/volume/number of marine debris items removed.
c) Timing, Frequency and Duration: Annually and at the end of the project.
d) Sample Size: TBD during implementation planning.
e) Sites: All sites where threat reduction activities targeting bottom impacts are conducted.
f) Performance criteria: TBD during implementation planning.
g) Corrective actions: If bottom impact threat reduction activities do not meet annual targets, consider alternative implementation mechanisms, incentives for compliance/adoption, etc.

Parameter #6: Reduction in bottom impacts

a) Purpose: To determine effectiveness of threat reduction activities targeting sources of bottom impacts.
b) Method: Quantify area over which mooring buoys are deployed and usage of buoys relative to historic and new rates of anchoring in that area, quantify area in which bottom tending gear use is modified and reduction in related impacts relative to historic rates, quantify area in which marine debris removal is conducted and reduction in related impacts relative to historic rates.
c) Timing, Frequency and Duration: Annually and at the end of the project.
d) Sample Size: TBD implementation planning.
e) Sites: All sites where threat reduction activities targeting bottom impacts are conducted.

Parameter #7: Invasive species removed

a) Purpose: To determine the number and biomass of invasive species removed.

b) Method: Count the number of individuals of each invasive species removed; weigh the invasive species removed (kg).
c) Timing, Frequency and Duration: At each invasive species removal event.
d) Sample Size: Number of invasive species removal events.
e) Sites: All locations where invasive species are killed or removed.

Parameter #8: Invasive species presence/absence

a) Purpose: To determine if invasive species are present.
b) Method: Species identity presence/absence, percent cover, abundance/biomass.
c) Timing, Frequency and Duration: Annually during implementation period.
d) Sample Size: Number of sites.
e) Sites: All locations where invasive species are killed or removed.

Parameter #9: Documentation of abandoned/leaking oil and gas infrastructure causing impacts that could be mitigated

a) Purpose: To determine the potential for mitigating impacts of abandoned and/or leaking oil and gas infrastructure.
b) Method: Count the number sites deemed viable candidates for impact mitigation activities by risk assessment.
c) Timing, Frequency and Duration: Annually.
d) Sample Size: TBD during implementation planning.
e) Sites: Any deemed viable candidates for impact mitigation activities.

Parameter #10: Mitigation of impacts from abandoned/leaking oil and gas infrastructure

a) Purpose: This parameter would be used to evaluate the effectiveness of efforts to mitigate impacts of abandoned and/or leaking oil and gas infrastructure.
b) Method: Count the number of sites and determine area benefitted by successful impact mitigation activities.
c) Timing, Frequency and Duration: Annually.
d) Sample Size: TBD during implementation planning.
e) Sites: All locations where impact mitigation activities are successfully implemented.

Parameter #11: Number/scope of enhancements to protection capacities

a) Purpose: To evaluate the effectiveness of enhancement effort for resource protection capacities.
b) Method: Count of interagency trainings offered, joint enforcement agreements entered or expanded, surveillance capabilities installed, etc., to characterize enhancements to resource protection capacities.
c) Timing, Frequency and Duration: Annually.
d) Sample Size: TBD during implementation planning.
e) Sites: All sites affected by enhancements to resource protection capacity.

Parameter #12: Rate of compliance with regulations

a) Purpose: To gauge compliance with regulations protecting MDBCs to inform planning for identification of options for increasing compliance.
b) Method: Ask enforcement agencies for information on the number and percentage of citations issued relative to the number of vessels stopped.
c) Timing, Frequency and Duration: monthly.
d) Sample Size: Total number of patrols conducted.
e) Sites: All sites that are patrolled.

3.0 Adaptive Management

Implementation of active management and protection efforts would be informed by the experience of existing management and protection regimes benefiting MDBC in the northern Gulf of Mexico. Notable among these are the regulatory frameworks of the National Marine Sanctuary system and the Gulf of Mexico Fishery Management Council's Habitat Areas of Particular Concern (HAPCs). These frameworks would provide critical context for monitoring parameters assessing the performance of active management and protection efforts and/or identify the need for corrective actions. Implementation of protection and management activities to benefit MDBC resources would allow for data collection to address critical uncertainties and inform adaptive decision-making. The MDBC steering committee would provide planning resources and longer-term planning to define specific activities and objectives. The data generated by this project would be critical to the adaptive management feedback loop, yielding data on the performance of active management and protection of MDBCs. The information this project generates would iteratively advance restoration planning by supporting implementation of initial restoration actions, monitoring the success of these actions, and using the information obtained to refine future projects. The MDBC project management structure would provide milestones and mechanisms to evaluate progress in meeting well-defined restoration outcomes, project objectives, and long-term Restoration Type goals, and redirect the portfolio and/or project activities as necessary to ensure we meet the goals defined in the PDARP/PEIS. This structure would support adaptive management of the overall portfolio of projects based on MDBC vision and restoration outcomes established by the steering committee.

4.0 Evaluation

This project would be assessed and evaluated based on the effectiveness of the project activities described above, relative to their stated goals and objectives (i.e., outcomes relative to targets) for the active management of valuable MDBC to protect against multiple threats and provide a framework for monitoring, education, and outreach, help maintain ecological integrity, and increase ecosystem resilience. Evaluation of these outcomes would continue for a minimum of one year beyond the duration of the field- desktop-based implementation work described here.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

In this section, we describe how knowledge gained from the evaluation of monitoring data would be used at the project-level to determine whether the project, once implemented, is considered successful or whether corrective actions are needed during project implementation. A project may not be achieving its intended objectives because of previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

Table 5-1 provides the list of performance criteria for monitoring parameters and potential corrective actions that can be taken if performance criteria are not met. This table may not include all possible options; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

Table 5-1: Summary of monitoring parameters, performance criteria, and potential corrective actions, organized by restoration objective.

Monitoring Parameter	Performance Criteria	Potential Corrective Actions
Objective #1: Manage and protect MDBCs from known threats to achieve restoration goals identified in the DWH PDARP/PEIS, help maintain ecological integrity, and increase ecosystem resilience		
Performance of outreach, education, and engagement activities	TBD during implementation planning.	Increase outreach effort for under-represented groups.
Effectiveness of outreach, education, and engagement activities	TBD during implementation planning.	Develop and use different outreach methods.
Completion of socioeconomic analyses	Completion of the analyses annually in the first 3 years of implementation	TBD, depending on the nature of the failure to perform.
Usefulness of socioeconomic analyses to managers	General consensus among those consulted that the information is useful.	Identify ways of revising the analyses to provide useful information.
Threat reduction effort	TBD during implementation planning.	Develop and employ alternative implementation mechanisms, incentives for compliance/adoption, etc.
Reduction in bottom impacts	Impacts are reduced relative to historic impacts.	Develop and employ alternative implementation mechanisms, incentives for compliance/adoption, etc.
Invasive species removed	TBD during implementation planning for each removal event.	Increase effort or change location or technique as necessary.
Invasive species presence/absence	TBD during implementation planning.	If invasive species remain, increase effort or change technique as necessary.
Documentation of abandoned/leaking oil and gas infrastructure causing impacts that could be mitigated	TBD during implementation planning.	If no sites are viable for potential mitigation activities, discontinue.
Mitigation of impacts from abandoned/leaking oil and gas infrastructure	Identification of at least one site that benefitted from the mitigation efforts.	Terminate this activity.
Number/scope of enhancements to protection capacities	TBD during implementation planning.	TBD, depending on the nature of the failure to increase protection effort.

Monitoring Parameter	Performance Criteria	Potential Corrective Actions
Rate of compliance with regulations	TBD during implementation planning.	If people are not complying with regulations, explore options to increase compliance, including education.

6.0 Monitoring Schedule

The first 1-2 years of the project would focus on implementation planning, followed by 5 years of field- and desktop-based project implementation. The final year of the project would be dedicated to project close-out and reporting. Data would be presented to resource managers throughout the project period, for use in protecting and restoring MDBC.

Table 6-1: Monitoring schedule.

Monitoring Parameter	Year							
	1	2	3	4	5	6	7	8
Performance of outreach, education, and engagement activities	X	X	X	X	X	X	X	X
Effectiveness of outreach, education, and engagement activities			X	X	X	X	X	X
Completion of socioeconomic analyses			X	X	X			
Usefulness of socioeconomic analyses to managers			X	X	X	X	X	X
Threat reduction effort			X	X	X	X	X	X
Reduction in bottom impacts			X	X	X	X	X	X
Invasive species removed			X	X	X	X	X	X
Invasive species presence/absence			X	X	X	X	X	X
Documentation of abandoned/leaking oil and gas infrastructure causing impacts that could be mitigated	X	X	X	X	X	X	X	X
Mitigation of impacts from abandoned/leaking oil and gas infrastructure			X	X	X	X	X	X
Number/scope of enhancements to protection capacities			X	X	X	X	X	X
Rate of compliance with regulations	X	X	X	X	X	X	X	X

7.0 Data Management

7.1 Data Description

Data collection would occur throughout this project and be would compiled in a manner consistent with the requirements of NOAA's National Centers for Environmental Information, Coral Reef Conservation Program, and/or Deep-Sea Coral Research and Technology Program, of any relevant protected area management framework (e.g., FGBNMS, GMFMC), and of the Trustees' existing data repositories (e.g., DIVER). Data compilation would be completed on an ongoing basis and would be finalized in the year following the 5th year of field and lab implementation effort. Data collection would occur at MDBC sites throughout the northern Gulf of Mexico. This project is expected to generate a large volume of data, requiring substantial support for data management and standardization, to be overseen and coordinated by the steering committee and project management structure.

To the extent practicable, all environmental and biological data generated during monitoring activities would be documented using standardized field datasheets, software, and/or file types (see e.g. https://www.coris.noaa.gov/, https://www.mbari.org/products/research-software/mb-system/, and https://deepseacoraldata.noaa.gov/internal-documents/program-guidance/science-team-guidance-for-data-management/dscrtp-database-records-submission-template.xlsx/view). If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original datasheets and source datasets would be retained by the Implementing Trustee.

Relevant project data would be collected and entered in standardized digital formats. Electronic data files would be named with the date on which the file was created and would include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy would be made and the original preserved.

All data would have properly documented metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance [QA] and quality control [QC] procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents). Geospatial data would adhere to FGDC/ISO standards.

Data generated by this project would be integrated across sampling methods, record types, and institutions and standardized to facilitate data discovery, access and application, as described in the "Guiding Principles" section of NOAA's *Introduction to NOAA's National Database for Deep-Sea Corals and Sponges* (Hourigan et al. 2015). All data would have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format — can reference different documents).

Data for measuring success of this project (i.e. the parameters mentioned above) would be uploaded to the DIVER portal within a year of collection, QA/QC, and analysis.

7.2 Data Review and Clearance

Data generated by this project would be quality-controlled by NOAA with internal procedures to 'flag' and correct problems as described in the "Guiding Principles" section of NOAA's *Introduction to NOAA's National Database for Deep-Sea Corals and Sponges* (Hourigan et al. 2015).

Relevant project data would be collected and entered in standardized digital formats. Data entries would be verified against source datasets (i.e., imagery, sensor), and any corrections to transcription errors would be made as appropriate before data are used for any analyses or distributed. Project managers would verify and validate MAM data and information and would ensure that all data is i) entered or converted into agreed upon/commonly used digital format, and ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with NOAA requirements.

7.3 Data Storage and Accessibility

Once all data have been subjected to QA/QC procedures, the metadata would be submitted to the Restoration Portal and data collected for this project would be stored in existing data repositories established for the type of data in question (e.g., NOAA's National Database for Deep-Sea Corals and Sponges, https://deepseacoraldata.noaa.gov/, NCEI's Multibeam Bathymetry Database, https://www.ngdc.noaa.gov/mgg/bathymetry/multibeam.html, NOAA's Coral Reef Conservation Program's information portal CoRIS, https://www.coris.noaa.gov/, and NCEI's oceanographic data archives, https://www.nodc.noaa.gov/submit/index.html). These repositories would be mapped/linked/integrated into the DIVER platform, as appropriate. Trustees would provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected, subjected to QA/QC procedures, and analyzed.

7.4 Data Sharing

This project would distill data and information from many sources and at the same time would generate new data, becoming a source for future analyses and products. The intent is that both project managers and the public would be able to discover and access this full range of related data and information, from input data to analyzed products. Data would be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. Some of the data collected may be protected from public disclosure under federal and state law and therefore would not be publicly distributed.

8.0 Reporting

Project reports would be generated on an annual basis to inform annual project field- and desktop--work planning efforts. Final project report and analyses would be generated in the final year of the project, following the 5th year of project implementation through field and lab effort.

9.0 Roles and Responsibilities

NOAA is the implementing agency for this project; NOAA would coordinate with DOI during project implementation.

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Appendix C: Impact Thresholds

Impact thresholds used for the analysis of environmental consequences, as presented in the PDARP/PEIS.

Resource	Impact Duration	Minor Intensity	Moderate Intensity	Major Intensity
Physical Resources				
Geology and Substrates	Short-term: During construction period. Long-term: Over the life of the project or longer.	Disturbance to geologic features or soils could be detectable, but could be small and localized. There could be no changes to local geologic features or soil characteristics. Erosion and/or compaction could occur in localized areas.	Disturbance could occur over local and immediately adjacent areas. Impacts to geology or soils could be readily apparent and result in changes to the soil character or local geologic characteristics. Erosion and compaction impacts could occur over local and immediately adjacent areas.	Disturbance could occur over a widespread area. Impacts to geology or soils could be readily apparent and could result in changes to the character of the geology or soils over a widespread area. Erosion and compaction could occur over a widespread area. Disruptions to substrates or soils may be permanent.
Hydrology and Water Quality	Short-term: During construction period. Long-term: Over the life of the project or longer.	Hydrology: The effect on hydrology could be measurable, but it could be small and localized. The effect could only temporarily alter the area's hydrology, including surface and ground water flows. Water quality: Impacts could result in a detectable change to water quality, but the change could be expected to be small and localized. Impacts could quickly become undetectable. State water quality standards as required by the Clean Water Act could not be exceeded. Floodplains: Impacts may result in a detectable change to natural and beneficial floodplain values,	Hydrology: The effect on hydrology could be measurable, but small and limited to local and adjacent areas. The effect could permanently alter the area's hydrology, including surface and ground water flows. Water quality: Effects to water quality could be observable over a relatively large area. Impacts could result in a change to water quality that could be readily detectable and limited to local and adjacent areas. Change in water quality could persist; however, it could likely not exceed state water quality standards as required by the Clean Water Act. Floodplains: Impacts could result in	Hydrology: The effect on hydrology could be measurable and widespread. The effect could permanently alter hydrologic patterns including surface and ground water flows. Water quality: Impacts could likely result in a change to water quality that could be readily detectable and widespread. Impacts could likely result in exceedance of state water quality standards and/or could impair designated uses of a water body. Floodplains: Impacts could result in a change to natural and beneficial floodplain values that could have substantial consequences over a widespread area. Location of operations could increase risk of flood loss, including impacts on human safety, health, and welfare.

		but the change could be expected to be small, and localized. There could be no appreciable increased risk of flood loss including impacts on human safety, health, and welfare. Wetlands: The effect on wetlands could be measurable but small in terms of area and the nature of the impact. A small impact on the size, integrity, or connectivity could occur; however, wetland function could not be affected and natural restoration could occur if left alone.	a change to natural and beneficial floodplain values and could be readily detectable, but limited to local and adjacent areas. Location of operations in floodplains could increase risk of flood loss, including impacts on human safety, health, and welfare. Wetlands: The action could cause a measurable effect on wetlands indicators (size, integrity, or connectivity) or could result in a permanent loss of wetland acreage across local and adjacent areas. However, wetland functions could only be permanently altered in limited areas.	Wetlands: The action could cause a permanent loss of wetlands across a widespread area. The character of the wetlands could be changed so that the functions typically provided by the wetland could be permanently lost.
Air Quality	Short-term: During construction period. Long-term: Over the life of the project or longer.	The impact on air quality may be measurable, but could be localized and temporary, such that the emissions do not exceed the Environmental Protection Agency's (EPA's) de minimis criteria for a general conformity determination under the Clean Air Act (40 CFR § 93.153).	The impact on air quality could be measurable and limited to local and adjacent areas. Emissions of criteria pollutants could be at EPA's de minimis criteria levels for general conformity determination.	The impact on air quality could be measurable over a widespread area. Emissions are high, such that they could exceed EPA's de minimis criteria for a general conformity determination.
Noise	Short-term: During construction period. Long-term: Over the life of the project or longer.	Disturbance to geologic features or soils could be detectable, but could be small and localized. There could be no changes to local geologic features or soil characteristics. Erosion and/or compaction could occur in localized areas.	Disturbance could occur over local and immediately adjacent areas. Impacts to geology or soils could be readily apparent and result in changes to the soil character or local geologic characteristics. Erosion and compaction impacts could occur over local and immediately adjacent areas.	Disturbance could occur over a widespread area. Impacts to geology or soils could be readily apparent and could result in changes to the character of the geology or soils over a widespread area. Erosion and compaction could occur over a widespread area. Disruptions to substrates or soils may be permanent.

Biological Resources				
Habitats	<u>Short-term:</u> Lasting less than two growing seasons. <u>Long-term:</u> Lasting longer than two growing seasons.	Impacts on native vegetation may be detectable, but could not alter natural conditions and could be limited to localized areas. Infrequent disturbance to individual plants could be expected, but would not affect local or range-wide population stability. Infrequent or insignificant one-time disturbance to locally suitable habitat could occur, but sufficient habitat could remain functional at both the local and regional scales to maintain the viability of the species. Opportunity for increased spread of non-native species could be detectable but temporary and localized and could not displace native species populations and distributions.	Impacts on native vegetation could be measureable but limited to local and adjacent areas. Occasional disturbance to individual plants could be expected. These disturbances could affect local populations negatively but could not be expected to affect regional population stability. Some impacts might occur in key habitats, but sufficient local habitat could retain function to maintain the viability of the species both locally and throughout its range. Opportunity for increased spread of non-native species could be detectable and limited to local and adjacent areas, but could only result in temporary changes to native species population and distributions.	Impacts on native vegetation could be measurable and widespread. Frequent disturbances of individual plants could be expected, with negative impacts to both local and regional population levels. These disturbances could negatively affect range-wide population stability. Some impacts might occur in key habitats, and habitat impacts could negatively affect the viability of the species both locally and throughout its range. Actions could result in the widespread increase of non-native species, resulting in broad and permanent changes to native species populations and distributions.
Wildlife Species (Including Birds)	<u>Short-term:</u> Lasting up to two breeding seasons, depending on length of breeding season. <u>Long-term:</u> Lasting more than two	Impacts to native species, their habitats, or the natural processes sustaining them could be detectable, but localized, and could not measurably alter natural conditions. Infrequent responses to disturbance by some individuals could be expected, but without interference to feeding, reproduction, resting, migrating, or other factors affecting population levels. Small changes to local population	Impacts on native species, their habitats, or the natural processes sustaining them could be measureable but limited to local and adjacent areas. Occasional responses to disturbance by some individuals could be expected, with some negative impacts to feeding, reproduction, resting, migrating, or other factors affecting local population levels. Some impacts might occur in key habitats. However, sufficient population	Impacts on native species, their habitats, or the natural processes sustaining them could be detectable and widespread. Frequent responses to disturbance by some individuals could be expected, with negative impacts to feeding, reproduction, migrating, or other factors resulting in a decrease in both local and range-wide population levels and habitat type. Impacts could occur during critical periods of reproduction or in key habitats and could result in direct mortality or loss of habitat that might affect the viability of a species.

	breeding seasons.	numbers, population structure, and other demographic factors could occur. Sufficient habitat could remain functional at both the local and range-wide scales to maintain the viability of the species. Opportunity for increased spread of non-native species could be detectable but temporary and localized, and these species could not displace native species populations and distributions.	numbers or habitat could retain function to maintain the viability of the species both locally and throughout its range. Opportunity for increased spread of non-native species could be detectable and limited to local and adjacent areas, but could only result in temporary changes to native species population and distributions.	Local population numbers, population structure, and other demographic factors might experience large changes or declines. Actions could result in the widespread increase of non-native species resulting in broad and permanent changes to native species populations and distributions.
Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms)	<u>Short-term:</u> Lasting up to two spawning seasons, depending on length of season. <u>Long-term:</u> Lasting more than two spawning seasons.	Impacts could be detectable and localized but small. Disturbance of individual species could occur; however, there could be no change in the diversity or local populations of marine and estuarine species. Any disturbance could not interfere with key behaviors such as feeding and spawning. There could be no restriction of movements daily or seasonally. Opportunity for increased spread of non-native species could be detectable but temporary and localized and could not displace native species populations and distributions.	Impacts could be readily apparent and result in a change in marine and estuarine species populations in local and adjacent areas. Areas being disturbed may display a change in species diversity; however, overall populations could not be altered. Some key behaviors could be affected but not to the extent that species viability is affected. Some movements could be restricted seasonally. Opportunity for increased spread of non-native species could be detectable and limited to local and adjacent areas, but could only result in temporary changes to native species population and distributions.	Impacts could be readily apparent and could substantially change marine and estuarine species populations over a wide-scale area, possibly river-basin-wide. Disturbances could result in a decrease in fish species diversity and populations. The viability of some species could be affected. Species movements could be seasonally constrained or eliminated. Actions could result in the widespread increase of non-native species resulting in broad and permanent changes to native species populations and distributions.
Protected Species	<u>Short-term:</u> Lasting up to one breeding/ growing	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable, but small and	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable and some alteration in	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable, widespread, and permanent. Substantial

	season. <u>Long-term:</u> Lasting more than one breeding/growing season.	localized, and could not measurably alter natural conditions. Impacts could likely result in a "may affect, not likely to adversely affect" determination for at least one listed species.	the numbers of protected species or occasional responses to disturbance by some individuals could be expected, with some negative impacts to feeding, reproduction, resting, migrating, or other factors affecting local and adjacent population levels. Impacts could occur in key habitats, but sufficient population numbers or habitat could remain functional to maintain the viability of the species both locally and throughout their range. Some disturbance to individuals or impacts to potential or designated critical habitat could occur. Impacts could likely result in a "may affect, likely to adversely affect" determination for at least one listed species. No adverse modification of critical habitat could be expected.	impacts to the population numbers of protected species, or interference with their survival, growth, or reproduction could be expected. There could be impacts to key habitat, resulting in substantial reductions in species numbers. Results in an "is likely to jeopardize proposed or listed species/adversely modify proposed or designated critical habitat (impairment)" determination for at least one listed species.
Socioeconomic Resources				
Socioeconomics and Environmental Justice (Evaluation of potential environmental justice issues would be fully address in future tiered documents).	<u>Short-term:</u> During construction period. <u>Long-term:</u> Over the life of the project or longer.	A few individuals, groups, businesses, properties, or institutions could be affected. Impacts could be small and localized. These impacts are not expected to substantively alter social and/or economic conditions. Actions could not disproportionately affect minority and low-income populations.	Many individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily apparent and detectable in local and adjacent areas and could have a noticeable effect on social and/or economic conditions. Actions could disproportionately affect minority and low-income populations. However, the impact could be temporary and localized.	A large number of individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily detectable and observed, extend over a widespread area, and have a substantial influence on social and/or economic conditions. Actions could disproportionately affect minority and low-income populations, and this impact could be permanent and widespread.

Cultural Resources	Short-term: During construction period. Long-term: Over the life of the project or longer.	The disturbance of a site(s), building, structure, or object could be confined to a small area with little, if any, loss of important cultural information potential.	Disturbance of a site(s), building, structure, or object not expected to result in a substantial loss of important cultural information.	Disturbance of a site(s), building, structure, or object could be substantial and may result in the loss of most or all its potential to yield important cultural information.
Infrastructure	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could affect public services or utilities, but the impact could be localized and within operational capacities. There could be negligible increases in local daily traffic volumes resulting in perceived inconvenience to drivers but no actual disruptions to traffic.	The action could affect public services or utilities in local and adjacent areas and the impact could require the acquisition of additional service providers or capacity. Detectable increase in daily traffic volumes (with slightly reduced speed of travel), resulting in slowed traffic and delays, but no change in level of service (LOS). Short service interruptions (temporary closure for a few hours) to roadway and railroad traffic could occur.	The action could affect public services or utilities over a widespread area resulting in the loss of certain services or necessary utilities. Extensive increase in daily traffic volumes (with reduced speed of travel) resulting in an adverse change in LOS to worsened conditions. Extensive service disruptions (temporary closure of one day or more) to roadways or railroad traffic could occur.
Land and Marine Management	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could require a variance or zoning change or an amendment to a land use, area comprehensive, or management plan, but could not affect overall use and management beyond the local area.	The action could require a variance or zoning change or an amendment to a land use, area comprehensive, or management plan, and could affect overall land use and management in local and adjacent areas.	The action could cause permanent changes to and conflict with land uses or management plans over a widespread area.
Tourism and Recreational Use	Short-term: During construction period.	There could be partial developed recreational site closures to protect public safety. The same site capacity and visitor experience could remain	There could be complete site closures to protect public safety. However, the sites could be reopened after activities occur. There could be slightly reduced site	All developed site capacity could be eliminated because developed facilities could be closed and removed. Visitors could be displaced to facilities over a widespread area and visitor experiences

	Long-term: Over the life of the project or longer.	unchanged after construction. The impact could be detectable and/or could only affect some recreationists. Users could likely be aware of the action but changes in use could be slight. There could be partial closures to protect public safety. Impacts could be local. There could be a change in local recreational opportunities; however, it could affect relatively few visitors or could not affect any related recreational activities.	capacity. The visitor experience could be slightly changed but still available. The impact could be readily apparent and/or could affect many recreationists locally and in adjacent areas. Users could be aware of the action. There could be complete closures to protect public safety. However, the areas could be reopened after activities occur. Some users could choose to pursue activities in other available local or regional areas.	could no longer be available in many locations. The impact could affect most recreationists over a widespread area. Users could be highly aware of the action. Users could choose to pursue activities in other available regional areas.
Fisheries and Aquaculture	Short-term: During construction period. Long-term: Over the life of the project or longer.	A few individuals, groups, businesses, properties, or institutions could be affected. Impacts could be small and localized. These impacts are not expected to substantively alter social and/or economic conditions.	Many individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily apparent and detectable in local and adjacent areas and could have a noticeable effect on social and/or economic conditions.	A large number of individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily detectable and observed, extend over a widespread area, and could have a substantial influence on social and/or economic conditions.
Marine Transportation	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could affect public services or utilities, but the impact could be localized and within operational capacities. There could be negligible increases in local daily marine traffic volumes, resulting in perceived inconvenience to operators but no actual disruptions to transportation.	The action could affect public services or utilities in local and adjacent areas, and the impact could require the acquisition of additional service providers or capacity. Detectable increase in daily marine traffic volumes could occur (with slightly reduced speed of travel), resulting in slowed traffic and delays. Short service interruptions	The action could affect public services utilities over a widespread area resulting in the loss of certain services or necessary utilities. Extensive increase in daily marine traffic volumes could occur (with reduced speed of travel), resulting in extensive service disruptions (temporary closure of one day or more).

			could occur (temporary delays for a few hours).	
Aesthetics and Visual Resources	Short-term: During construction period. Long-term: Over the life of the project or longer.	There could be a change in the view shed that was readily apparent but could not attract attention, dominate the view, or detract from current user activities or experiences.	There could be a change in the view shed that was readily apparent and attracts attention. Changes could not dominate the viewscape, although they could detract from the current user activities or experiences.	Changes to the characteristic views could dominate and detract from current user activities or experiences.
Public Health and Safety, Including Flood and Shoreline Protection	Short-term: During construction period. Long-term: Over the life of the project or longer.	Actions could not result in 1) soil, ground water, and/or surface water contamination, 2) exposure of contaminated media to construction workers or transmission line operations personnel, and/or 3) mobilization and migration of contaminants currently in the soil, ground water, or surface water at levels that could harm the workers or general public. Increased risk of potential hazards (e.g., increased likelihood of storm surge) to visitors, residents, and workers from decreased shoreline integrity could be temporary and localized.	Project construction and operation could result in 1) exposure, mobilization and/or migration of existing contaminated soil, ground water, or surface water to an extent that requires mitigation, and/or 2) could introduce detectable levels of contaminants to soil, ground water, and/or surface water in localized areas within the project boundaries such that mitigation/remediation is required to restore the affected area to the preconstruction conditions. Increased risk of potential hazards to visitors, residents, and workers from decreased shoreline integrity could be sufficient to cause a permanent change in use patterns and area avoidance in local and adjacent areas.	Actions could result in 1) soil, ground water, and/or surface water contamination at levels exceeding federal, state, or local hazardous waste criteria, including those established by 40 CFR § 261, 2) mobilization of contaminants currently in the soil, ground water, or surface water, resulting in exposure of humans or other sensitive receptors such as plants and wildlife to contaminant levels that could result in health effects, and 3) the presence of contaminated soil, ground water, or surface water within the project area, exposing workers and/or the public to contaminated or hazardous materials at levels exceeding those permitted by the federal Occupational Safety and Health Administration (OSHA) in 29 CFR § 1910. Increased risk of potential hazards to visitors, residents, and workers from decreased shoreline integrity could be substantial and could cause permanent changes in use patterns and area avoidance over a widespread area.

Appendix D: Life Stages of Species with Essential Fish Habitat in the Northern Gulf of Mexico

Species Name	Eggs and Larvae	Juvenile	Adult	Spawning/Reproduction
HARDBOTTOM SPECIES				
Jacks (*Carangidae*)				
Greater amberjack (*Seriola dumerili*)	Pelagic, associated with floating plants and debris	Pelagic, associated with floating plants and debris	Pelagic and epibenthic, occurring over reefs, wrecks, and around buoys; to water depths of 400 m (1,312 ft)	Little information; spawn in the Gulf of Mexico from May to July
Lesser amberjack (*Seriola fasciata*)	Pelagic, associated with floating plants and debris	Occur offshore in late summer and fall in the Gulf of Mexico. Associated with *Sargassum* and flotsam	Offshore year round in the Gulf of Mexico; associated with oil and gas platforms and irregular bottom features	Spawn offshore September to December and February to March; likely near oil and gas platforms and irregular bottom features
Almaco jack (*Seriola rivoliana*)	Unknown	Associated with *Sargassum* in open waters and off barrier islands	Offshore, associated with oil and gas platforms in the Gulf of Mexico	Spawning thought to occur from spring through fall
Banded rudderfish (*Seriola zonata*)	Pelagic, associated with floating plants and debris	Offshore, associate with jellyfish and floating plants	Pelagic or epibenthic, coastal waters over continental shelf	Spawn offshore in the eastern Gulf of Mexico, Yucatan Channel, and Straits of Florida
Wrasses (*Labridae*)				
Hogfish (*Lachnolaimus maximus*)	N/A	Shallow seagrass beds of Florida bay	Moderate-high-relief hard bottom structure in shelf waters, coral reefs and rocky flats	N/A
Snappers (*Lutjanidae*)				
Queen snapper (*Etelis oculatus*)	Pelagic, offshore	N/A	Deepwater species in the southern Gulf of Mexico; associate with rocky bottoms and ledges between 135-450 m (443-1,476 ft) water depth	N/A
Mutton snapper (*Lutjanus analis*)	Shallow continental shelf waters	Shallow seagrass beds in tidal creeks and bights surrounded by mangroves; protected bays	Offshore reef areas, deep barrier reefs	Spawn on steep drop offs near reef areas
Schoolmaster (*Lutjanus apodus*)	Pelagic	Shallow and offshore habitats, seagrass beds, mangrove	Coastal waters out to 90 m (295 ft) water depth; occur	Offshore reefs

Species Name	Eggs and Larvae	Juvenile	Adult	Spawning/Reproduction
		habitats, congregate around jetties, inshore and offshore rocky and coral reefs	over rock, vegetated sand, inshore and offshore reefs, and mud	
Blackfin snapper (*Lutjanus buccanella*)	Present year-round in shelf edge waters over spawning areas	Shallow hard bottom areas from 12-4 0m (39-131 ft) water depth	Throughout Gulf of Mexico; shelf edge habitats from 40-300 m (131-984 ft) water depth	Year round with spring and fall peaks, presumably near shelf edge habitats
Red snapper (*Lutjanus campechanus*)	Offshore in summer and fall in shelf waters from 17-183 m (56-600 ft) water depth	Associated with structure, also abundant over sand and mud bottom; from 20-46 m (66-151 ft) water depth	Throughout Gulf of Mexico; occur in submarine gullies and depressions, over coral reefs, rock outcroppings, and gravel bottom; 7-146 m (23-479 ft) water depth	Offshore from May to October in 18-37 m (59-121 ft) water depth over fine sand bottom away from reefs
Cubera snapper (*Lutjanus cyanopterus*)	Presumed in June and July as a result of spawning aggregations, open water near reefs and wrecks	Streams, canals, seagrass beds, mangrove areas, and lagoons	Most common off southwestern Florida; shallow and deep reefs and wrecks; mangroves; up to 85 m (279 ft) water depth	Spawn in June and July near wrecks and deep reefs in 67-85 m (220-279 ft) water depth
Gray snapper (*Lutjanus griseus*)	Occur June through August in offshore shelf waters and near coral reefs; move to estuarine habitats and seagrass beds	Marine, estuarine, and riverine dwellers, prefer *Thalassia* sp. grass beds, marl bottoms, seagrass meadows, and mangrove roots	Estuaries and shelf waters 180 m (591 ft) water depth; demersal and mid-water dwellers; marine, estuarine, and riverine dwellers	Spawn offshore around reefs and shoals from June to August
Dog snapper (*Lutjanus jocu*)	Pelagic	Shallow water seagrass beds; coastal waters, estuaries, or rivers; mangrove roots, jetties, and pilings	From shallow vegetated areas to deep reefs to 150 m (492 ft) water depth; coral reefs	Spawning aggregations near reefs from 15-30 m (49-98 ft) water depth
Mahogany snapper (*Lutjanus mahogoni*)	Pelagic	N/A	Throughout Gulf of Mexico; shallow water down to 30 m (98 ft) water depth; rocky bottoms and reefs	Multiple spawnings, spring and fall
Lane snapper (*Lutjanus synagris*)	Offshore, on shelf	Mangrove and grassy estuarine areas; shallow areas with sandy and muddy bottoms; grass flats,	Offshore from 4-132 m (13-433 ft) water depth; occur on sand bottom, natural	Offshore from March through September

Species Name	Eggs and Larvae	Juvenile	Adult	Spawning/Reproduction
		reefs, and soft bottom to 20 m (60 ft) water depth	channels, banks, and artificial reefs and structures	
Silk snapper (Lutj*anus vivanus*)	N/A	Shallow water	Throughout Gulf of Mexico; near the edge of continental and island shelves, common between 90-and 200 m (295- and 656 ft) water depth	Throughout the year with peak spawning from July to August
Yellowtail snapper (*Ocyurus chrysurus*)		Nearshore areas over vegetated sandy substrate, muddy shallow bays, *Thalassia* sp. beds and mangrove roots, shallow reef areas	Throughout shelf area of Gulf of Mexico, shallow water to 183 m (600 ft) water depth; semi-pelagic wanderers over reef habitat, irregular bottom, coral reefs, banks, and shelves	February through October in offshore areas
Wenchman (*Pristipomoides aquilonaris*)	Presumed in warmer months along mid to outer shelf water	N/A	Throughout Gulf of Mexico; hard bottom habitats of mid to outer shelf; 19-378 m water depth	Presumed warmer months along deep slopes between 80 and 200 m water depth
Vermilion snapper (*Rhomboplites aurorubens*)	N/A	Reefs, underwater structures and hard bottom habitats 20-200 m (66-656 ft) water depth	Throughout shelf area of the Gulf of Mexico, demersal, over reefs and rocky bottom from 20-200 m (66-656 ft) water depth	April to September in offshore areas
Tilefishes (*Malacanthidae*)				
Goldface tilefish (*Caulolatilus chrysops*)	N/A	N/A	N/A	N/A
Blackline tilefish (*Caulolatilus cyanops*)	N/A	N/A	N/A	N/A
Anchor tilefish (*Caulolatilus intermedius*)	N/A	N/A	Common in the northern and western Gulf of Mexico; irregular bottom, troughs, terraces, sand, mud and rubble, shell hash	N/A
Blueline tilefish (*Caulolatilus microps*)	Pelagic, offshore	N/A	Eastern and southeastern Gulf of Mexico; epibenthic browsers	N/A

Species Name	Eggs and Larvae	Juvenile	Adult	Spawning/Reproduction
Golden tilefish (*Lopholatilus chamaeleonticeps*)	Pelagic	Pelagic to benthic; burrow and occupy shafts in the substrate	Throughout the Gulf of Mexico; demersal from 80-450 m (262-1,476 ft) water depth; rough bottom, steep slopes; burrow	From March to November throughout range
Groupers (*Epinephelidae*)				
Rock hind (*Epinephelus adscensionis*)	Pelagic, offshore	Early juveniles in shallow waters	Shallow hard bottom, coral and rock reefs, rock piles, oil and gas platforms, steep crevices and ledges; 2-100 m (7-328 ft) water depth	January to June in Florida middle grounds in spawning aggregations
Speckled hind (*Epinephelus drummondhayi*)	Pelagic, offshore	Found in shallow end of depth range	North and eastern Gulf of Mexico on offshore hard bottom habitats, rocky bottom, high and low profile bottom; 25-183 m (82-600 ft) water depth	Deeper portion of depth range, greater than 146 m (479 ft) depth along shelf edge, April to May, July to September
Yellowedge grouper (*Hyporthodus flavolimbatus*)	Pelagic, offshore	Inhabit burrows	Throughout deep waters of the Gulf of Mexico; high-relief hard bottom, rocky out croppings, inhabit burrows; 35-370 m (115-1,214 ft) water depth	Form spawning aggregations, peaks May to September
Red hind (*Epinephelus guttatus*)	Pelagic, settle and develop in shallow inshore areas	Patch reefs, coral, and limestone rock	Occupy reefs, stony coral, holes, and crevices, sandy bottoms with coral patches; 18-to 110 m (59-361 ft) water depth	Late spring and summer on Florida Middle Grounds along seaward side of submerged ridges
Goliath grouper (*Epinephelus itajara*)	Offshore, late summer, early fall	Bays and estuaries, inshore grassbeds, canals, mangroves, ledges, reefs, and holes	Shallow waters of Gulf of Mexico to 95 m (312 ft) water depth; inshore around docks, bridges, jetties, reef crevices, offshore ledges, and wrecks	June to December around offshore structures, wrecks, and patch reefs
Red grouper (*Epinephelus morio*)	Pelagic as larvae, become benthic by 2 mm (0.8 in) standard length	Inshore hard bottom around 50 m (164 ft) water depth,	Demersal throughout the Gulf of Mexico from 3-200 m (10-656 ft) water depth; rocky	Spawn on Florida banks during April and May, do not aggregate,

Species Name	Eggs and Larvae	Juvenile	Adult	Spawning/Reproduction
		crevices, grass bets, rock formations, shallow reefs	outcrops, wrecks, reefs, ledges, crevices and caverns of rock bottom, and live bottom	near low-relief habitats often near solution holes
Misty grouper (*Hyporthodus mystacinus*)	N/A	Shallower water than adults	Offshore throughout the Gulf of Mexico; hard bottom slope and shelf substrates, high-relief rocky ledges and pinnacles, 100-400 m (328-1,312 ft) water depth	April through July
Warsaw grouper (*Hyporthodus nigritus*)	Pelagic, offshore	Shallow nearshore habitats, bays	Throughout Gulf of Mexico; hard bottom, rocky, high profile, steep cliffs, rocky ledges, from 40-525 m (131-1,722 ft) water depth	Likely late summer
Snowy grouper (*Epinephelus niveatus*)	Pelagic, offshore	Shallow, nearshore reefs	Deep water, rocky bottom, offshore around boulders and ridges	April to July off of Florida keys; May to August west Florida
Nassau grouper (*Epinephelus striatus*)	December to February, nearshore, 0.8-16 km (0.5-10 mi) from shore	Inshore seagrass beds, macroalgal mats, tilefish mounds, and small coral clumps	Reefs and crevice caves down to 100 m (328 ft) water depth; primarily along the Florida Keys' reef tract	Spawning offshore reefs and hard bottom outside of the Gulf of Mexico
Marbled grouper (*Epinephelus inermis*)	N/A	N/A	Nearshore and offshore reefs, 3-213 m (10-699 ft)	N/A
Black grouper (*Mycteroperca banaci*)	Pelagic, offshore	Shallow water reefs, rocky bottom, patch reefs, muddy bottom, mangrove lagoons, and estuaries	Found along eastern Gulf of Mexico, rare in western Gulf of Mexico, demersal from shore to 150 m (492 ft) water depth; wrecks, rocky coral reefs, irregular bottom, ledges	Late winter through spring and summer, aggregations observed in Florida keys at 18-28 m (59-92 ft) water depth
Yellowmouth grouper (*Mycteroperca interstitialis*)	Pelagic, offshore	Mangrove-lined lagoons	Campeche banks, west coast of Florida, Texas Flower Garden Banks, rocky bottoms, and coral reefs	Spring and summer
Gag grouper (*Mycteroperca microlepis*)	Pelagic, greatest offshore abundance on west	Move through inlets into coastal lagoons, high salinity estuaries in April and May,	Demersal; hard bottom substrates, offshore reefs and	Aggregate in 50-120 m (164-394 ft) water depth along shelf edge

Species Name	Eggs and Larvae	Juvenile	Adult	Spawning/Reproduction
	Florida shelf December through April	become benthic and settle into grass flats and oyster beds; later juveniles move to shallow reef habitats from 1-50 m (3-164 ft) water depth	wrecks, coral and live bottom, depressions, and ledges	breaks from December to April on the west Florida shelf
Scamp (*Mycteroperca phenax*)	Pelagic; occur in spring	Inshore hard bottom and reefs, 12-33 m (39-108 ft) water depth	Demersal, throughout shelf areas of Gulf of Mexico, ledges, high relief hard bottom in water depth from 12 to 189 m (39 to 620 ft)	Late February to early June in aggregations, shelf edge, often spawn on Oculina formations
Yellowfin (*Mycteroperca venosa*)	N/A	Shallow seagrass beds, move to deeper rocky bottoms with age	Uncommon in the Gulf of Mexico, primarily southern Gulf of Mexico, reef ridge and high-relief spur and groove reefs	March to August in the eastern Gulf of Mexico
Triggerfishes (*Balistidae*)				
Gray triggerfish (*Balistes capriscus*)	Pelagic, occur in upper water column, associated with *Sargassum* and flotsam	Associated with *Sargassum*, flotsam, or found in mangrove estuaries	Offshore in water depths greater than 10 m (33 ft); associated with natural and artificial reefs	Spawn around natural and artificial reefs in water depths greater than 10 m (33 ft); late spring and summer
SOFT BOTTOM SPECIES				
Red drum (*Sciaenops ocellatus*)	N/A	N/A	Red drum is a demersal species that occur throughout the Gulf in a variety of habitats, ranging from depths of about 230 ft offshore to very shallow estuarine waters	N/A
Brown shrimp (*Farfantepenaeus aztecus*)	N/A	N/A	Adult brown shrimp move seasonally with changes to water temperatures.	Brown -spawn at depths greater than 25 ft.
Pink shrimp (*Farfantepenaeus duorarum*)	N/A	Deeper waters	Off-shore waters at depths between 30-144 feet. Adult pink shrimp prefer calcareous	Spawn at depths of 13-157 ft and sometimes deeper water

Species Name	Eggs and Larvae	Juvenile	Adult	Spawning/Reproduction
			sediments and also use hard sand substrate.	
White shrimp (*Litopenaeus setiferus*)	Larvae, plantonic and move into estuaries	N/A	Less than 100 ft deep. shallow muddy-bottom substrate	Spawn at depths of 26-102 ft
HIGHLY MIGRATORY SPECIES				
Coastal Migratory Pelagic Species				
King Mackerel (*Scomberomorus cavalla*)	Pelagic eggs offshore over areas of 35-180 m (115-591 ft) water depth, middle and outer continental shelf	Inshore to the middle shelf	Throughout the Gulf of Mexico, over reefs and coastal waters, generally in less than 80 m (262 ft) water depth	Over the outer continental shelf from May to October
Spanish Mackerel (*Scomberomorus maculatus*)	Pelagic eggs over the inner continental shelf at water depths less than 50 m (164 ft) in spring and summer	Estuarine and coastal waters	Throughout the Gulf of Mexico, inshore coastal waters, may enter estuaries, to water depths of 75 m (246 ft)	Over inner continental shelf from May to September
Cobia Rachycentron canadum)	Eggs drift in the top meter of the water column, larvae are found in offshore waters	Coastal and offshore waters	Coastal and offshore waters from bays and inlets to the continental shelf; 1-70 m (3-230 ft) water depth	In coastal waters from April through September
Epipelgaic Species				
Albacore Tuna (*Thunnus alalunga*)	N/A	N/A	Epipelagic, oceanic, generally found in surface waters, often associated with *Sargassum* communities and debris	N/A
Bigeye Tuna (*Thunnus obesus*)	N/A	School near sea surface with other tuna species, associated with *Sargassum* communities and floating debris	N/A	N/A
Bluefin Tuna (*Thunnus thynnus*)	Over continental shelf	Over continental shelf during summer, farther offshore in winter	Epipelagic, oceanic, generally found in surface waters, often associated with *Sargassum* communities and debris	Annual spawn May to June in Gulf of Mexico

Species Name	Eggs and Larvae	Juvenile	Adult	Spawning/Reproduction
Skipjack Tuna (*Katsuwonus pelamis*)	N/A	N/A	Epipelagic, oceanic, as deep as 260 m (853 ft) during the day, associate with drifting objects, whales, sharks, and other tuna species	Opportunistic spawning throughout year, most spawning from April to May
Yellowfin Tuna (*Thunnus albacares*)	Limited to water temperature greater than 24°C (75°F) and salinity greater than 33 ppt	Nearer to shore than adults	Epipelagic, oceanic, mix with skipjack and bigeye tuna species, occur beyond 500-fathom isobath in the upper 100 m (328 ft) of the water column	Spawning throughout year with peaks in the summer
Swordfish (*Xiphias gladius*)	Present year round in the eastern Gulf of Mexico, also present in the western Gulf of Mexico from March to May and September to November	N/A	Epipelagic to mesopelagic, diurnal vertical migration	N/A
Blue Marlin (*Mokaira nigricans*)	Some larvae present in the Gulf of Mexico	N/A	Epipelagic and oceanic	N/A
White Marlin (*Tetrapturus albidus*)	N/A	Off west coast of Florida between the 200-2,000 m (656-6,562 ft) isobaths; off coast of Texas to 50 m (164 ft) isobath	Epipelagic and oceanic, usually occur above thermocline in deep ≥100 m [328 ft]) water with surface temp ≥22°C (72°F) and salinities of 35-37; usually in upper 30 m (98 ft) of the water column	N/A
Roundscale Spearfish (*Tetrapturus georgii*)	N/A	N/A	Epipelagic and oceanic	N/A
Sailfish (*Istiophorus platypterus*)	Larvae found in offshore waters from March to October	In all waters of the Gulf of Mexico from the 200-2,000 m (656-6,562 ft) isobath or EEZ boundary	Epipelagic, coastal, and oceanic; usually found above thermocline at a temperature range of 21°C to 28°C (70°F to 83°F); often move to inshore waters and over the shelf edge	Occurs in shallow waters around Florida beyond the 100 m (328 ft) isobath, from April to September

Species Name	Eggs and Larvae	Juvenile	Adult	Spawning/Reproduction
Longbill Spearfish (*Tetrapturus pfluegeri*)	N/A	N/A	Relatively rare in the Gulf of Mexico; epipelagic, oceanic species inhabiting waters above the thermocline; generally found in offshore waters	N/A
*Dolphinfish (*Coryphaena hippurus*)	Larvae abundant in *Sargassum* communities, prominent near the Mississippi River delta	Closely associated with *Sargassum* communities and floating debris	Oceanic pelagic; both offshore and coastal inshore; out to 1,800 m (5,906 ft) water depth, common between 40-200 m (131-656 ft) water depth, closely associated with *Sargassum* communities	Multiple spawning events throughout year; spring and early fall in the Gulf of Mexico; offshore, continental shelf, and upper slope waters
*Wahoo (*Acanthocybium solandri*)	Oceanic and shelf waters	Oceanic and shelf waters, associated with *Sargassum* communities and flotsam	Oceanic and shelf waters, associated with *Sargassum* communities and flotsam	N/A
Small Sharks Coastal				
Angel shark (*Squatina dumeril*)	Shallow coastal waters		Shallow coastal waters	Up to 16 pup litters
Bonnethead shark (*Sphyrna tiburo*)	N/A		Shallow coastal waters, sandy and muddy bottoms	Annual reproductive cycle, 8-2 pup litters
Atlantic sharpnose shark (*Rhizoprionodon terraenovae*)	Shallow coastal waters		Shallow coastal waters	Late June, 4-7 pup litters
Blacknose shark (*Carcharhinus acronotus*)	Shallow coastal waters		Shallow coastal waters	3-6 pup litters
Finetooth shark (*Carcharhinus isodon*)	Shallow coastal waters, muddy bottom		Shallow coastal waters	Biennial reproductive cycle, 2-6 pup litters
Large Sharks Coastal				
Great hammerhead shark (*Sphyrna mokarran*)	Shallow coastal waters		Open ocean and shallow coastal waters	Biennial reproductive cycle, 20-40 pup litters

Species Name	Eggs and Larvae Juvenile	Adult	Spawning/Reproduction
Scalloped hammerhead shark (*Sphyrna lewini*)	Shallow coastal waters	Schooling, open ocean and shallow coastal waters	Annual reproductive cycle, 15-31 pup litters
White shark (*Carcharodon carcharias*)	N/A	N/A	N/A
Nurse shark (*Ginglymostoma cirratum*)	Shallow *Thalassia* beds and shallow coral reefs, mangrove islands	Littoral waters, congregates in shallow water	June to July in the shallow waters of the Florida Keys, 20-30 pup litters
Bignose shark (*Carcharhinus altimus*)	N/A	Deepwater species, continental shelf	N/A
Blacktip shark (*Carcharhinus limbatus*)	Year-round in shallow coastal waters, seagrass beds, and muddy bottoms	Shallow coastal waters and offshore surface waters of continental shelf, throughout the Gulf of Mexico	1-8 pup litters
Bull shark (*Carcharhinus leucas*)	Low salinity estuaries of the Gulf Coast	Shallow coastal waters and often fresh water	Likely biennial reproductive cycle
Caribbean reef shark (*Carcharhinus perezi*)	N/A	Shallow coastal waters, bottom-dwelling, near coral reefs	Biennial reproductive cycle, 4-6 pup litters
Dusky shark (*Carcharhinus obscurus*)	Shallow coastal waters, inlets, and estuaries	Migratory, inshore and outer continental shelf waters	6-14 pup litters
Lemon shark (*Negaprion brevirostris*)	Shallow coastal water, near mangrove islands	Shallow coastal waters, around coral reefs	Biennial reproductive cycle, 5-17 pup litters
Night shark (*Carcharhinus signatus*)	N/A	Depths >275-366 m (902-1,201 ft) during the day and 183 m (600 ft) at night	N/A
Sandbar shark (Carcharhinus *plumbeus*)	Shallow coastal waters	Shallow coastal waters	Biennial reproductive cycle, March to July, 1 14 pup litters
Silky shark (*Carcharhinus falciformis*)	Offshore and shallow coastal waters	Offshore, epipelagic	10-14 pup litters

Species Name	Eggs and Larvae	Juvenile	Adult	Spawning/Reproduction
Spinner shark (*Carcharhinus brevipinna*)	Shallow coastal waters, muddy bottom less than 5 m (16 ft) water depth, seagrass beds		Migratory, coastal-pelagic	Biennial reproductive cycle, 6-12 pup litters
Tiger shark (*Galeocerdo cuvier*)	N/A		Shallow coastal waters and deep oceanic waters	35-55 pup litters
Whale shark (*Rhincodon typus*)	N/A		Pelagic waters	N/A
Pelagic Sharks				
Longfin mako shark (*Isurus paucus*)	N/A		Deepwater species	2-8 pup litters
Porbeagle shark (*Lamna nasus*)	N/A		Deepwater species	N/A
Shortfin mako shark (*Isurus oxyrinchus*)	N/A		Oceanic waters	Biennial reproductive cycle, 12-20 pup litters
Oceanic whitetip shark (*Carcharhinus longimanus*)	Likely offshore over continental shelf		Oceanic waters	Likely biennial, 2-10 pup litters
Bigeye thresher shark (*Alopias superciliosus*)	N/A		Deep water	2 pup litters
Common thresher shark (*Alopias vulpinus*)	N/A		Coastal and oceanic waters	Birth annually from March to June, 4-6 pup litters
Smooth dogfish (*Mustelus canis*)	N/A		Continental and insular shelves from shallow inshore waters to a maximum water depth of 579 m (1,900 ft)	4-20 pup litters

°C = degrees Celsius; °F = degrees Fahrenheit; EEZ = Exclusive Economic Zone; ft = feet; m = meters; N/A = not available; ppt = parts per thousand.
* Species not managed in the Gulf of Mexico by the U.S. Dept. of Commerce, National Marine Fisheries Service.

Appendix E: Marine Mammals Occurring in the Northern Gulf of Mexico

Species	MMPA Stock[1]	Distribution[1]	Hearing Frequency (Hz-hertz; kHz – kilohertz)[2]	Abundance (SAR)[3]	Occurrence in Gulf of Mexico[4]	Habitat[5]	Status (ESA / MMPA Stock)
ORDER CETACEA							
Suborder Mysticeti (Baleen Whales)							
Bryde's Whale (*Balaenoptera edeni*)	northern Gulf of Mexico	Worldwide in tropical and subtropical waters of the world in coastal and pelagic waters, and often in shelf break waters or near topographic features.	0.007 to 35 kHz	33	Uncommon	Shelf Edge and Upper Slope within DeSoto Canyon or Florida Escarpment	Endangered / Strategic
Suborder Odontoceti (Toothed Whales, Dolphins, and Porpoises)							
Family Delphinidae							
Pygmy Killer Whale (*Feresa attenuata*)	northern Gulf of Mexico	Worldwide in tropical to subtropical oceanic waters.	--	152	Uncommon	Oceanic	--
Short-Finned Pilot Whale (*Globicephala macrorhynchus*)	northern Gulf of Mexico	Worldwide in tropical to subtropical waters, generally on the continental shelf break and in deep oceanic waters.	--	2,415	Common	Oceanic	--
Risso's Dolphin (*Grampus griseus*)	northern Gulf of Mexico	Worldwide in tropical to warm temperate waters.	0.15 to 160 kHz	2,442	Common	Oceanic	--
Fraser's Dolphin (*Lagenodelphis hosei*)	northern Gulf of Mexico	Worldwide in warm temperate, subtropical, and tropical pelagic waters.	--	Unknown	Uncommon	Oceanic	--

[1] Waring et al. 2016
[2] DWH NRDA Trustees 2017b
[3] Stock assessment report (SAR) - Best population estimate (within associated stock) "NBest" from Table 1 of the Hayes et al. 2017.
[4] Common – abundant wherever it occurs in the region; Uncommon – May or may not be widely distributed but does not occur in large numbers; Rare – Present in such small numbers throughout the region that it is seldom seen (Würsig et al. 2000).
[5] Waring et al. 2016; Hayes et al. 2017.

Species	MMPA Stock[1]	Distribution[1]	Hearing Frequency (Hz-hertz; kHz – kilohertz)[2]	Abundance (SAR)[3]	Occurrence in Gulf of Mexico[4]	Habitat[5]	Status (ESA / MMPA Stock)
Killer Whale (*Orcinus orca*)	northern Gulf of Mexico	Mostly in polar waters, but can be found in temperate waters. Can be found in lower densities in tropical, subtropical, and offshore waters.	--	28	Uncommon	Oceanic	--
Melon-Headed Whale (*Peponocephala electra*)	northern Gulf of Mexico	Worldwide in tropical and subtropical waters.	--	2,235	Common	Oceanic	--
False Killer Whale (*Pseudorca crassidens*)	northern Gulf of Mexico	Worldwide in warm temperate and tropical oceans in relatively deep offshore waters.	--	Unknown	Uncommon	Shelf-Oceanic	--
Pantropical Spotted Dolphin (*Stenella a. attenuata*)	northern Gulf of Mexico	Offshore tropical waters.	--	50,880	Common	Oceanic	--
Clymene Dolphin (*Stenella clymene*)	northern Gulf of Mexico	Deep tropical, subtropical, and warm temperate waters.	--	129	Common	Oceanic	--
Striped Dolphin (*Stenella coeruleoalba*)	northern Gulf of Mexico	Tropical to cool temperate waters.	--	1,849	Common	Oceanic	--
Atlantic Spotted Dolphin (*Stenella frontalis*)	northern Gulf of Mexico	Tropical to warm temperate waters.	0.15 to 160 kHz	Unknown	Common	Shelf-Shelf Edge	--
Spinner Dolphin (*Stenella l. longirostris*)	northern Gulf of Mexico	Tropical to temperate oceanic waters.	--	11,441	Common	Oceanic	--
Rough-Toothed Dolphin (*Steno bredanensis*)	northern Gulf of Mexico	Deep tropical and subtropical waters.	--	624	Common	Shelf Edge - Oceanic	--
Common Bottlenose Dolphin (*Tursiops t. truncatus*)	northern Gulf of Mexico, Oceanic	Worldwide in temperate and tropical waters.	0.15 to 160 kHz	5,806	Common	Oceanic	--
	northern Gulf of Mexico,	Worldwide in temperate and tropical waters.	0.15 to 160 kHz	51,192	Common	Shelf and Shelf Edge	--

Species	MMPA Stock[1]	Distribution[1]	Hearing Frequency (Hz-hertz; kHz – kilohertz)[2]	Abundance (SAR)[3]	Occurrence in Gulf of Mexico[4]	Habitat[5]	Status (ESA / MMPA Stock)
	Continental Shelf						
	Gulf of Mexico, Eastern Coastal	Worldwide in temperate and tropical waters.	0.15 to 160 kHz	12,388	Common	Coastal and Inner Shelf	-- --
	Gulf of Mexico, northern Coastal	Worldwide in temperate and tropical waters.	0.15 to 160 kHz	7,185	Common	Coastal and Inner Shelf	--/Strategic
	Gulf of Mexico, Western Coastal	Worldwide in temperate and tropical waters.	0.15 to 160 kHz	20,161	Common	Coastal and Inner Shelf	--/Strategic
	northern Gulf of Mexico, Bay, Sound, and Estuary Stock Block (31 stocks)	Inshore from Texas to Florida	0.15 to 160 kHz	14,040	Common (Localized)	Coastal	--/Strategic
Family Physeteridae							
Sperm Whale (*Physeter microcephalus*)	northern Gulf of Mexico	Worldwide in temperate and tropical waters.	Low frequency	763	Common	Oceanic	Endangered / Strategic
Family Kogiidae							
Pygmy Sperm Whale (*Kogia breviceps*)	northern Gulf of Mexico	Worldwide in temperate to tropical oceanic waters.	--	186	Uncommon	Oceanic	--
Dwarf Sperm Whale (*Kogia sima*)	northern Gulf of Mexico	Worldwide in temperate to tropical oceanic waters.	--		Uncommon	Oceanic	--
Family Ziphiidae							
Blainville's Beaked Whale (*Mesoplodon densirostris*)	northern Gulf of Mexico	Worldwide in offshore temperate and tropical waters.	0.15 to 160 kHz	149[6]	Rare	Oceanic	--

[6] Some congeners, such as dwarf and pygmy sperm whales, and Blainville's and Gervais' beaked whales are difficult to differentiate at sea, and sightings of either species are usually categorized as Kogia spp, and Mesoplodon spp., respectively. Therefore, the minimum population estimate for dwarf and pygmy sperm whales, and Blainville's and Gervais' beaked whales are combined (Hayes et al., 2017).

Species	MMPA Stock[1]	Distribution[1]	Hearing Frequency (Hz-hertz; kHz – kilohertz)[2]	Abundance (SAR)[3]	Occurrence in Gulf of Mexico[4]	Habitat[5]	Status (ESA / MMPA Stock)
Gervais' Beaked Whale (*Mesoplodon europaeus*)	northern Gulf of Mexico	Worldwide in deep offshore temperate and tropical waters.	0.15 to 160 kHz		Uncommon	Oceanic	--
Cuvier's Beaked Whale (*Ziphius cavirostris*)	northern Gulf of Mexico	Deep offshore in subtropical and temperate waters.	0.15 to 160 kHz	74	Rare	Oceanic	--
ORDER SIRENIA							
West Indian Manatee (Florida subspecies) *(Trichechus manatus latirostris)*	Florida	Warm waters throughout the south eastern United States.	--	2,394[7]	Common	Shelf-Coastal	Endangered / Strategic

[7] Florida Fish and Wildlife Conservation Commission 2019

Appendix F: List of Preparers and Reviewers

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Mark Defley	Biologist, NRCS Gulf Coast Ecosystem Restoration Team	USDA
Lisa Desfosse	Director, Pascagoula Laboratory, Southeast Fisheries Science Center	NOAA
Dan Foster	Research Fishery Biologist, Pascagoula Laboratory, Southeast Fishery Science Center	NOAA
Peter Hood	Plan Coordinator, Sustainable Fisheries Branch, Southeast Regional Office	NOAA
Amy Piko	Marine Habitat Resource Specialist	ERT
James Reinhardt	Fish and Water Column Invertebrate Restoration Coordinator	NOAA
Eric Weissberger	Marine Habitat Resource Specialist	NOAA
Sea Turtles Team		
Thomas Dolan	Marine Habitat Resource Specialist	ERT
Christy Fellas	DWH Compliance Coordinator and Sea Turtle and Marine Mammal Restoration Coordinator	NOAA
Bob Hoffman	Supervisory Fish Biologist	NOAA
Dianne Ingram	USFWS Sea Turtle Biologist	DOI
Dennis Klemm	Fishery Biologist	NOAA
Barbara Schroeder	National Sea Turtle Coordinator	NOAA
Lesley Stokes	Research Fish Biologist	NOAA
Sara Wissmann	Sea Turtle Ecologist	NOAA
Marine Mammals Team		
Victoria Cornish	Energy Policy Analyst and Liaison	Marine Mammal Commission
Thomas Dolan	Marine Habitat Resource Specialist	ERT
Laura Engleby	Chief, Marine Mammal Branch, NMFS	NOAA
Christy Fellas	DWH Compliance Coordinator and Sea Turtle and Marine Mammal Restoration Coordinator	NOAA
Teri Rowles	Marine Mammal Health and Stranding Program Coordinator	NOAA
Samantha Simmons	Scientific Program Director	Marine Mammal Commission
Lesley Stokes	Research Fish Biologist	NOAA

Name	Title	Agency
Mesophotic and Deep Benthic Restoration Team		
Kris Benson	Mesophotic and Deep Benthic Communities Restoration Coordinator	NOAA
Andy David	Research Fish Biologist	NOAA
Mark Defley	Biologist	USDA
Amanda Demopoulos	USGS Research Benthic Ecologist	DOI
Peter Etnoyer	Marine Biologist	NOAA
Tom Hourigan	Deep-Sea Coral Chief Scientist	NOAA
GP Schmahl	Sanctuary Superintendent	NOAA
Eric Weissberger	Marine Habitat Resource Specialist	NOAA

Appendix G: List of Repositories

State	Repository	Address	City	ZIP
AL	Dauphin Island Sea Laboratory, Admin Building	101 Bienville Boulevard	Dauphin Island	36528
AL	Thomas B. Norton Public Library	221 West 19th Avenue	Gulf Shores	36542
AL	Alabama Department of Conservation and Natural Resources, State Lands Division, Coastal Section Office	31115 5 Rivers Boulevard	Spanish Fort	36527
AL	Weeks Bay National Estuarine Research Reserve	11300 US Highway 98	Fairhope	36532
AL	Mobile Public Library, West Regional Library	5555 Grelot Road	Mobile	36606
FL	Franklin County Public Library	29 Island Drive	East Point	32328
FL	Okaloosa County Library	185 Miracle Strip Parkway, SE	Ft. Walton	32548
FL	Panama City Beach Public Library	125000 Hutchison Boulevard	Panama City Beach	32407
FL	Escambia Southwest Branch Library	12248 Gulf Beach Highway	Pensacola	32507
FL	Wakulla County Library	4330 Crawfordville Highway	Crawfordville	32327
FL	Walton County Library, Coastal Branch	437 Greenway Trail	Santa Rosa Beach	32459
FL	Santa Rosa County Clerk of Court, County Courthouse	5841 Gulf Breeze Parkway	Gulf Breeze	32561
FL	Bay County Public Library	898 W. 11th Street	Panama City	32401
FL	Gulf County Public Library	110 Library Drive	Port St. Joe	32456
FL	Jefferson R.J. Bailar Public Library	375 S. Water Street	Monticello	32344
FL	Taylor County Public Library	FL 403 N. Washington Street	Perry	32347
FL	Dixie County Public Library	16328 SE 12 Avenue	Cross City	32628
FL	Levy County Public Library	7871 NE 90th Street	Bronson	32621
FL	Homosassa Public Library	4100 S. Grandmarch Avenue	Homosassa	34446
FL	Hernando County Public Library	238 Howell Avenue	Brooksville	34601
FL	Land O'Lakes Branch Library	2818 Collier Parkway	Land O' Lakes	34639
FL	Pinellas Public Library	1330 Cleveland Street	Clearwater	33755
FL	Temple Terrace Public Library	202 Bullard Parkway	Temple Terrace	33617
FL	South Manatee Branch Library	6081 26th St	West Bradenton	34207
FL	Jacaranda Public Library	4143 Woodmere Park Boulevard	Venice	34293
FL	Mid County Regional Library	2050 Forrest Nelson Boulevard	Port Charlotte	33952
FL	Riverdale Branch Library	2421 Buckingham Road	Fort Myers	33905
LA	St. Tammany Parish Library	310 W. 21st Avenue	Covington	70433
LA	Terrebonne Parish Library	151 Library Drive	Houma	70360
LA	New Orleans Public Library, Louisiana Division	219 Loyola Avenue	New Orleans	70112
LA	East Baton Rouge Parish Library	7711 Goodwood Boulevard	Baton Rouge	70806
LA	Jefferson Parish Library East Bank Regional Library	4747 W. Napoleon Avenue	Metairie	70001

State	Repository	Address	City	ZIP
LA	Jefferson Parish Library West Bank Regional Library	LA 2751 Manhattan Boulevard	Harvey	70058
LA	Plaquemines Parish Library	8442 Highway 23	Belle Chase	70037
LA	St. Bernard Parish Library	1125 E. St. Bernard Highway	Chalmette	70043
LA	St. Martin Parish Library	201 Porter Street	Martinville	70582
LA	Alex P. Allain Library	206 Iberia Street	Franklin	70538
LA	Vermillion Parish Library	405 E. St. Victor Street	Abbeville	70510
LA	Martha Sowell Utley Memorial Library	314 St. Mary Street	Thibodaux	70301
LA	South Lafourche Public Library	16241 E. Main Street	Cut Off	70345
LA	Calcasieu Parish Public Library Central Branch	301 W. Claude Street	Lake Charles	70605
LA	Iberia Parish Library	445 E. Main Street	New Iberia	70560
LA	Mark Shirley, Louisiana State University AgCenter	1105 West Port Street	Abbeville	70510
MS	Biloxi Public Library, Local History and Genealogy Department	580 Howard Avenue	Biloxi	39530
MS	West Biloxi Public Library	2047 Pass Road	Biloxi	39531
MS	Waveland Public Library	333 Coleman Avenue	Waveland	39576
MS	Vancleave Public Library	12604 Highway 57	Vancleave	39565
MS	Hancock County Library System	312 Highway 90	Bay St. Louis	39520
MS	Gulfport Harrison County Library	1708 25th Avenue	Gulfport	39501
MS	Pass Christian Public Library	111 Hiern Avenue	Pass Christian	39567
MS	Orange Grove Branch Library	12031 Mobile Avenue	Gulfport	39503
MS	Kathleen McIlwain Public Library	2100 Library Lane	Gautier	39553
MS	Pascagoula Public Library	3214 Pascagoula Street	Pascagoula	39567
MS	Moss Point City Library	4119 Bellview	Moss Point	39563
MS	Ocean Springs Municipal Library	525 Dewey Avenue	Ocean Springs	39564
MS	Kiln Public Library	17065 Highway 603	Kiln	39556
MS	Margaret Sherry Memorial Library	2141 Popps Ferry Road	Biloxi	39532
MS	East Central Public Library	21801 Slider Road	Moss Point	39532
MS	D'Iberville Library	10274 3rd Avenue	D'Iberville	39532
MS	Mercy Housing & Human Development	1135 Ford Street	Gulfport	39507
MS	Center for Environmental and Economic Justice	336 Rodenberg Avenue	Biloxi	39531
MS	Coalition for Vietnamese-American Fisher Folks and Families	1636 Popps Ferry Road, Suite 228	Biloxi	39532
MS	STEPS Coalition	610 Water Street	Biloxi	39530
MS	Gulf Islands National Seashore Visitors Center	3500 Park Road	Ocean Springs	39564
TX	Jack K. Williams Library, Texas A&M University at Galveston	Texas A&M University at Galveston; Building #3010, 200 Seawolf Parkway	Galveston	77554
TX	Port Arthur Public Library	4615 9th Avenue	Port Arthur	77672
TX	Library, Texas A&M, Corpus Christi	6300 Ocean Drive	Corpus Christi	78412
TX	Rosenberg Library	2310 Sealy Street	Galveston	77550