# Scoping Report for the *Deepwater Horizon Oil Spill* Programmatic Damage Assessment Restoration Plan and Programmatic Environmental Impact Statement Development



## Summer 2015

**Prepared by**

**National Oceanic and Atmospheric Administration**

# Contents

# Introduction

Federal and state natural resource Trustees are developing a Programmatic Damage Assessment Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS) for the *Deepwater Horizon* oil spill to assist in their completion of a Natural Resources Damage Assessment (NRDA) related to the discharge of oil associated with the *Deepwater Horizon* oil spill. This PDARP/PEIS is being developed according to both OPA and NEPA federal authorities, both of which include a public participation process.

## A.1 Public Participation Process

### A.1.1 Notice of Intent and Scoping Process

The public restoration scoping process included meetings held across the Gulf of Mexico and Washington, DC, in March and April 2011 and fulfilled public scoping requirements of both the Oil Pollution Act (OPA) and the National Environmental Policy Act (NEPA). As described in a Notice of Intent (NOI), the purpose of scoping is to identify the concerns of the affected public and federal agencies, states, and Indian tribes, involve the public early in the decision making process, facilitate an efficient PEIS preparation process, define the issues and alternatives that will be examined in detail, and save time by ensuring that draft documents adequately address relevant issues. More specifically, the purpose of scoping and scoping meetings is two-fold: 1) to receive public input on the identification of broad restoration types that can address natural resource injuries resulting from the spill, and 2) to receive public input on the environmental and socioeconomic impacts of implementing restoration that the federal government should consider when developing the PEIS. NOAA began the formal scoping process by publishing an NOI in the *Federal Register* on Friday, February 17, 2011 (76 Fed. Reg. 9327). The formal public scoping comment period for this first phase of public engagement ended on May 18, 2011. Public scoping meetings were held in 2011 on the following dates and at the following locations:

- **Pensacola, FL, on March 16**: Bayview Community Center, 2001 Lloyd Street. Doors opened at 6:30 p.m.; formal meeting began at 7:30 p.m.
- **Panama City, FL, on March 17**: Bay County Government Center, 840 W. 11th Street. Doors opened at 6:30 p.m.; formal meeting began at 7:30 p.m.
- **Biloxi, MS, on March 21**: Donald Snyder Community Center, 2520 Pass Road. Doors opened at 6:30 p.m.; formal meeting began at 7:30 p.m.
- **Belle Chasse, LA, on March 22**: Belle Chasse Public Library, 8442 Highway 23. Doors opened at 6:30 p.m.; formal meeting began at 7:30 p.m.
- **Mobile, AL, on March 23**: The Battle House Renaissance Mobile Hotel & Spa, 26 North Royal St. Doors opened at 6:30 p.m.; formal meeting began at 7:30 p.m.
- **Houma, LA, on March 24**: Holiday Inn, 1800 Martin Luther King Blvd. Doors opened at 5:30 p.m.; formal meeting began at 6:30 p.m.

- **Grand Isle, LA, on March 28**: Grand Isle Community Center, 3811 Highway 1. Doors opened at 5:30 p.m.; formal meeting began at 6:30 p.m.
- **Morgan City, LA, on March 29**: Bayou Vista Community Center, 1333 Belleview Street. Doors opened at 5:30 p.m.; formal meeting began at 6:30 p.m.
- **Port Arthur, TX, on March 30**: Port Arthur Civic Center, 3401 Cultural Center Drive. Doors opened at 6:30 p.m.; formal meeting began at 7:30 p.m.
- **Galveston, TX, on March 31:** Texas A&M University at Galveston's Ocean and Coastal Studies Building. Doors opened at 6:30 p.m.; formal meeting began at 7:30 p.m.
- **Washington, DC, on April 6:** U.S. Department of Commerce, Herbert Hoover Building Auditorium, 1401 Constitution Ave., NW. Doors opened at 6:30 p.m.; formal meeting began at 7:30 p.m.

Notices of the public scoping meetings were sent through email distribution lists, posted on the Gulf Spill Restoration website (*www.gulfspillrestoration.noaa.gov*) and NOAA social media channels, mailed to public libraries, announced in the *Federal Register*, and published in local and state newspapers. Both through the NOI and the public meetings, NOAA and the other federal and state Trustees requested comments to identify the concerns of the affected public and to receive input on how to achieve the goal of restoring injured natural resources. The scoping process involves the public early in the decision-making process, facilitates efficient PDARP and PEIS preparation, defines the issues and alternatives that will be examined in detail, and saves time by ensuring that draft documents adequately address relevant issues.

At the 11 public meetings, NOAA and the other Trustees gave an overview of the NEPA process and discussed the approach the Trustees plan to take with regard to developing a restoration plan and PEIS. Members of the public who attended the meetings could gather information by speaking one-on-one with individuals or, in a town hall setting, by addressing a larger group.

The Trustees prepared this scoping summary report to ensure the many comments received during the public scoping process were summarized and considered by the Trustees to inform development of the PDARP/PEIS. Public scoping occurred at the very earliest stage of the planning and evaluation process for the draft PDARP/PEIS. As a result, comments from the public helped the Trustees shape the scope of the draft PDARP/PEIS.

## A.2 Summary of Restoration Approaches and Issues Identified

### A.2.1 Overview

NOAA received a total of 7,774 comments from 320 individual submissions via the website (*www.gulfspillrestoration.noaa.gov*), written comments, emails, voicemails, and verbal comments spoken at public scoping meetings. Of the 320 submissions, several included identical letters signed by multiple individuals. Each signature is accounted for as a separate comment. For example, the Sierra Club, Sea Turtle Restoration Project, and the Gulf Restoration Network each submitted form letters signed by about 2,500 members, and other organizations, such as Earthjustice, submitted a single letter with multiple signees. One "comment" is defined as a statement by one individual (whether on behalf of himself or herself or on behalf of an organization). A comment may include multiple ideas related to restoration. In fact, many comments included ideas across multiple restoration categories. Of the 7,774 comments, 23 comments were completely unrelated to the oil spill (mostly in the form of advertisements), and 59 comments were spill-related but outside the scope of restoration (e.g., comments related to response efforts). Those comments are included in the summary statistics, where indicated, but have not been summarized in any detail in this document.

Individual commenters identified an affiliation in 193 of the submissions, representing 137 unique affiliations. Most of these affiliations are environmental, nongovernmental organizations and several more are organizations representing commercial, social, cultural, or recreation associations.

Due to the volume of comments offered during the scoping process, the Trustees needed to establish a system for analyzing them. Reviewers classified the comments by their relevance to restoration scoping and then further categorized them by topic area categories. The restoration-related categories are land acquisition and conservation; marsh restoration; hydrologic restoration (e.g., diversions or culverts); beach, barrier island, and/or dune restoration; submerged aquatic vegetation; shellfish; marine mammals and sea turtles; birds and terrestrial wildlife; offshore resources (including corals and excluding other resources already listed); invasive species removal; human use of natural resources; socioeconomics; implementation approaches (e.g., use of local advisory groups and local labor resources); monitoring and evaluation (related to restoration); and a general category established to capture comments not related to any other category. The remaining categories are outside the focus of restoration and include seafood safety, public health, claims, and response and assessment.

Reviewers further organized the comments by marking the primary and secondary topics of each statement. This step was necessary because most submissions contained more than one comment. In some cases, comments did not have a distinct primary category or the comment applied to multiple restoration types. In these situations, reviewers used their best judgment to select the primary and secondary categories.

The next section of this document provides summary statistics of the comments. Brief summaries of individual comments related to the scoping process are included in Section A.3.

### A.2.2 Synopsis of Comments Directly Related to Natural Resource Restoration

The bulk of comments received were in form letters from the Sierra Club, Gulf Restoration Network, and Sea Turtle Restoration Project. Each comment received is considered independently, yet the effect of

the form letter input is noted. See Figure 5.A-1 for a visual representation of the comment breakdown. The right side of Figure 5.A-1 provides a detailed breakdown of "other" comments, a category that represents 3 percent of all comments received. By percentage composition, each category ranges from 0.04 percent (claims [for compensation]) to 0.55 percent (response [and assessment]) of all comments.

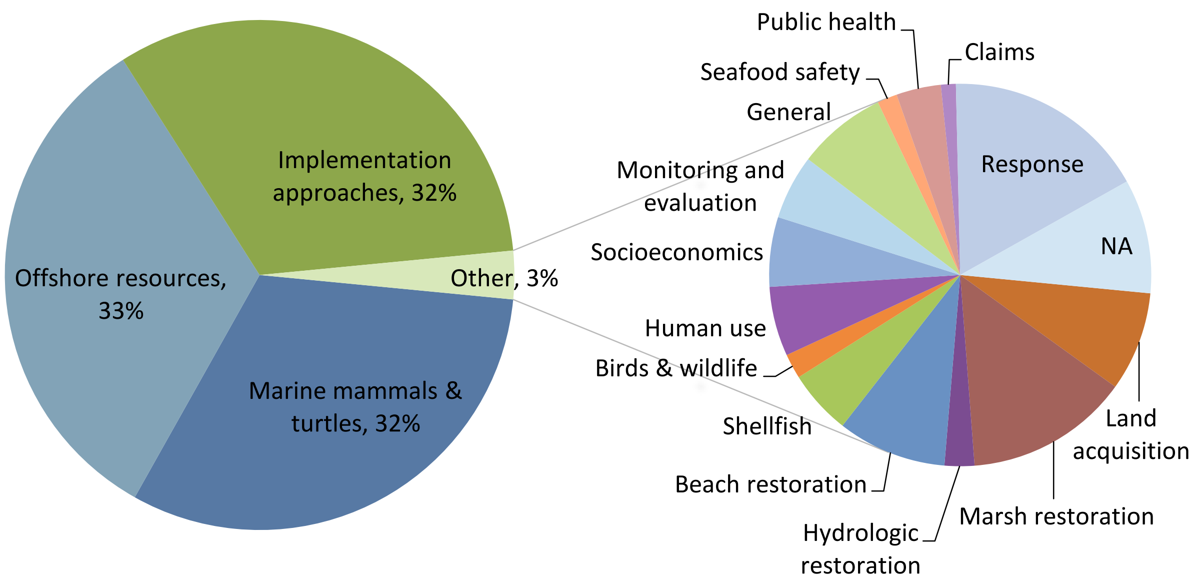


**Figure 5.A-1.** Primary comment categories of all comments received.

To represent the scoping comments not identified in the form letters, the following discussion presents the form letter and other comment results separately.

Figure 5.A-2 provides a further analysis. This graph shows only the primary restoration-related comment categories (with all form letter categories and the nonrestoration-focused comments removed).

Estimates of comment category weight or percentage can be obtained by looking at Figure 5.A-1 and Figure 5.A-2. However, readers need further detail to fully understand the comment counts. Figure 5.A-3 and Figure 5.A-4 give specific information about how many comments were

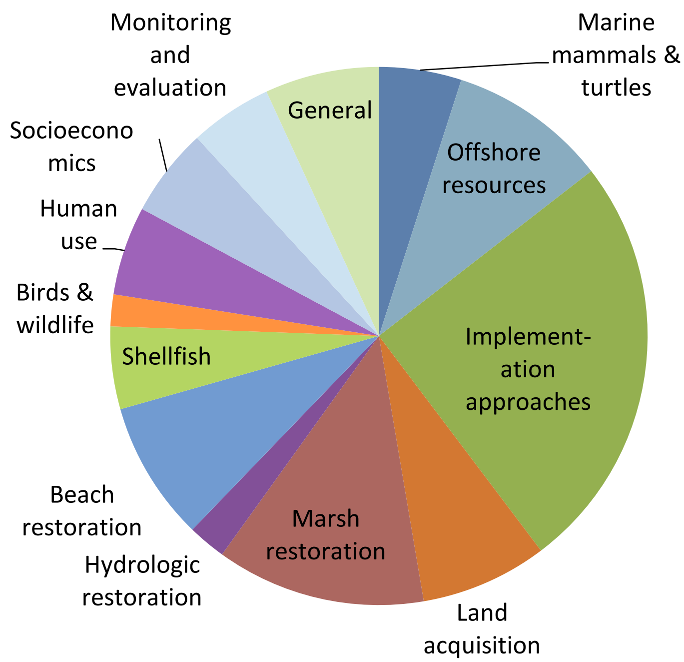


**Figure 5.A-2.** Primary categories related to restoration. (Form letter comments are excluded to show breakdown of other comments.)

received within each category, whether primary or secondary. These two graphs show only the comments falling into the restoration-related categories, both with (Figure 5.A-3) and without (Figure 5.A-4) form letter comments.

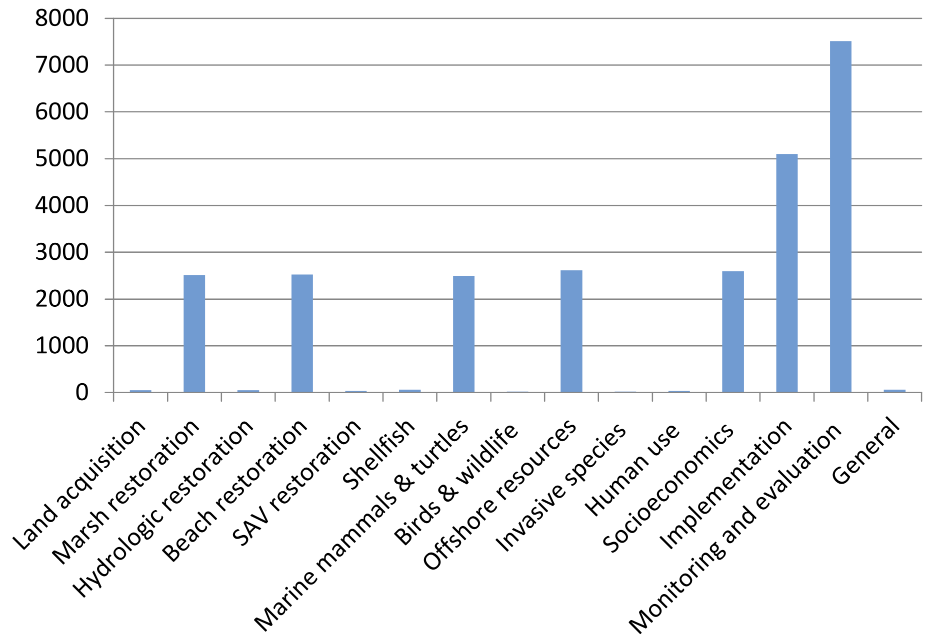


**Figure 5.A-3.** Number of comments referencing restoration-related categories.

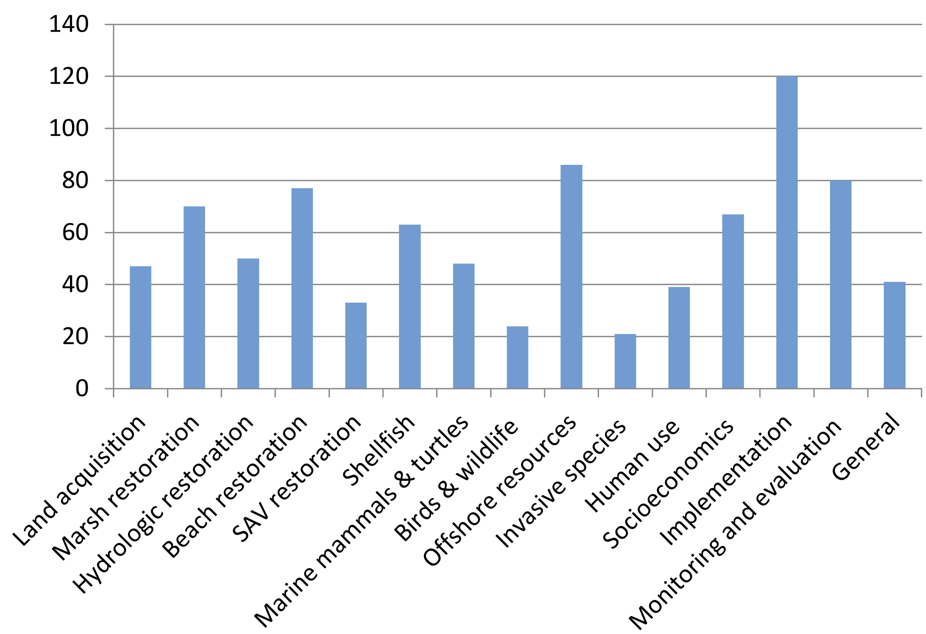


**Figure 5.A-4.** Number of comments referencing restoration categories, excluding form letters.

### A.2.3 Other Comments

In addition to the restoration categories described above, several comments addressed areas outside the scope of the PDARP, and thus of the PEIS. These topics include public health, claims for compensation of lost revenue, and response and assessment. Although comments unrelated to restoration scoping have not been summarized in this document, they have been shared with non-Trustee groups and organizations for their review and consideration. An additional number of comments were not related to the oil spill; these comments included online scripts, advertisements, and similar items. Figure 5.A-5 provides an overview of the comments addressing these out-of-scope topics and includes both the number of comments where the topic is the primary subject and the number of comments that referenced the topic at all, whether as a primary or secondary subject.

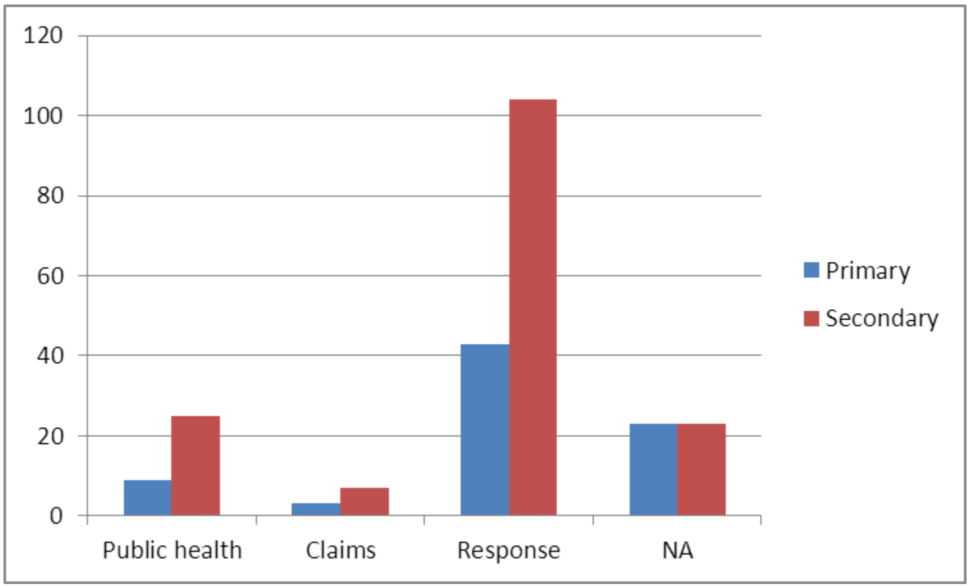


**Figure 5.A-5**. Comments in nonrestoration categories.

### A.2.4 Comment Summaries by State

To provide a different perspective of analysis, a summary of comments broken down by state is provided. A comment's state is representative of either the commenter's identified state of residence or, in the case of the comments received at public meetings in which the commenter did not specifically identify state residence, the state in which the meeting was held. Therefore, the comments from public meetings do not necessarily reflect concerns specific to that state in which meetings were held nor are they representative of respective state governments. Form letter authors were not considered at this level of analysis because the organizations comprise members from multiple states.

There are a total of 342 comments with state affiliations. Of these, 250 comments or approximately 73 percent, originated from a self-identified commenter from one of the five Gulf states. Additional states represented by commenters include California, Michigan, Delaware, Colorado, Maryland, Washington, Pennsylvania, Indiana, Georgia, Virginia, Tennessee, Massachusetts, North Carolina, Utah, Nebraska, Arkansas, Oregon, New York, Illinois, South Carolina, Arizona, and the District of Columbia. From these states, New York had 28 comments, Washington had nine comments, the District of Columbia had seven comments, California had six comments, and the remaining states each had five or fewer comments.

Figure 5.A-6 provides an overview of the comments received from various states, excluding the comments received from form letters.

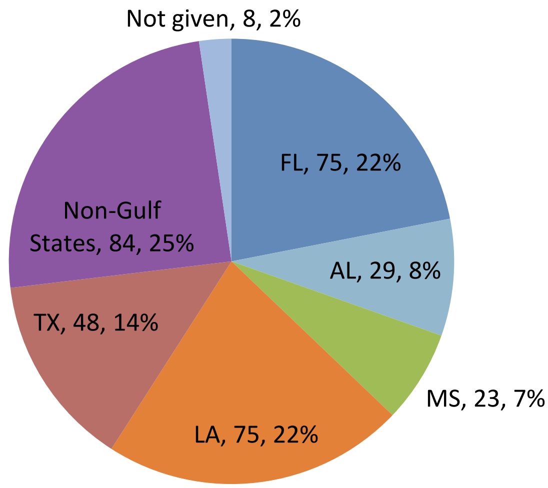


**Figure 5.A-6.** Comments by state, excluding form letters.

A short state-by-state summary is provided in the following pages. For each state summary, the first bullet describes how many comments were received from that state. The second bullet and subbullets under it describes the most prevalent primary topic and subcategories, while the third bullet describes the top secondary categories and subcategories. Each state summary contains a figure that provides counts of the primary topics and the number of times each category is referenced, whether as a primary or secondary topic.

### Florida

- There were 75 comments from Florida.
- Primary topics:
    - Beach restoration, barrier island restoration and dune restoration (13 comments each).
    - Response and assessment (11 comments).
    - Implementation (10 comments).
- Secondary topics:
    - Implementation approaches (21 comments).
    - Beach restoration, barrier island restoration, and dune restoration (19 comments).
    - Offshore resources and response and assessment (17 comments each).

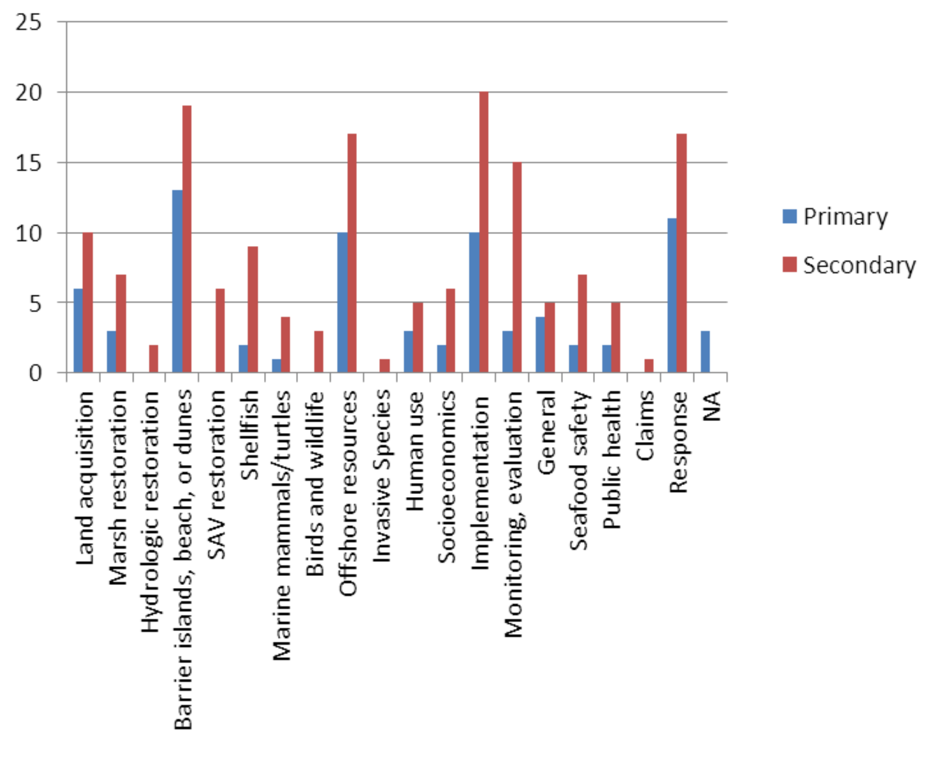


**Figure 5.A-7.** Categories of Comments from Florida.

## Alabama

- There were 29 comments from Alabama.
- Primary topics:
  - Response (4 comments).
  - Land acquisition, shellfish, suman Use of natural resources, Implementation (3 comments each).
- Secondary topics:
  - Shellfish restoration (10 comments).
  - Human use of natural resources, monitoring and evaluation, and response (8 comments each).

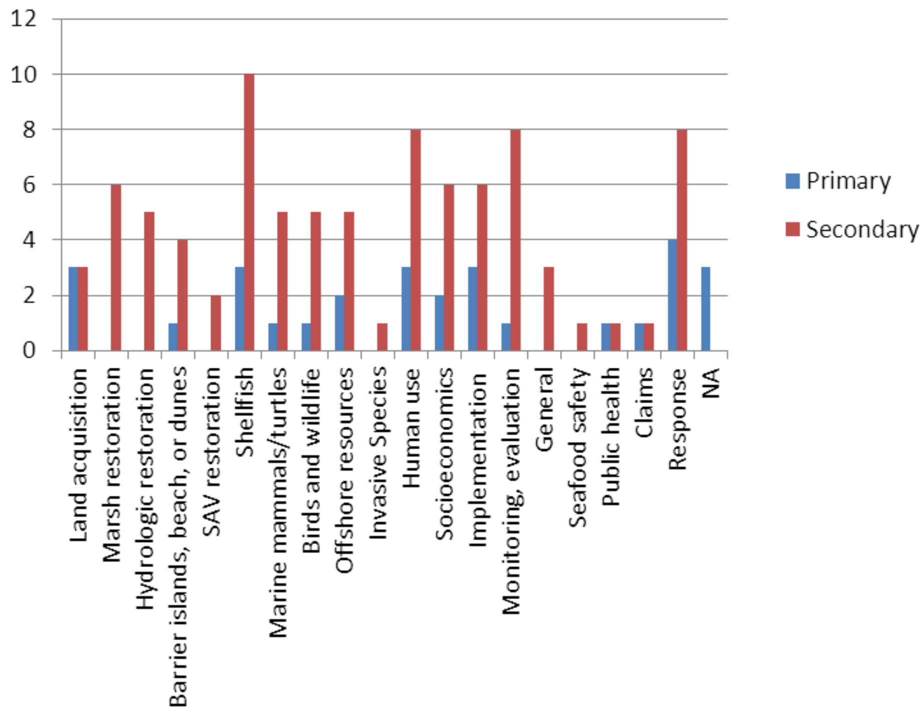


**Figure 5.A-8.** Categories of comments from Alabama.

### Mississippi

- There were 23 comments from Mississippi.
- Primary topics:
  - General (4 comments).
  - Implementation (3 comments).
- Secondary topics:
  - Implementation and public health (9 comments each; these were the most frequently referenced categories).

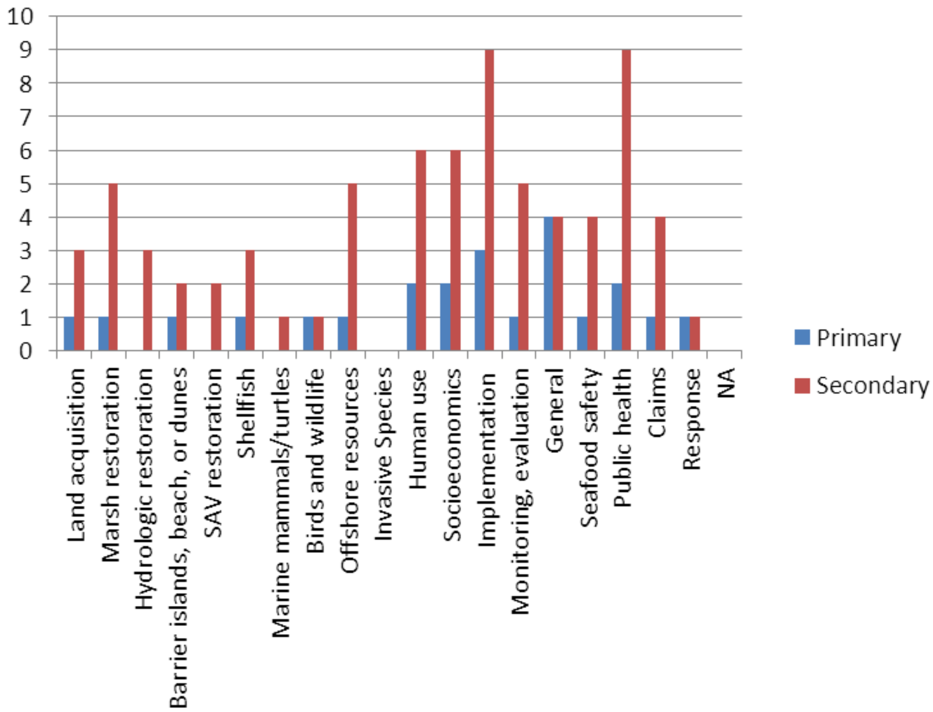


**Figure 5.A-9.** Categories of comments from Mississippi.

## Louisiana

- There were 75 comments from Louisiana.
- Primary topics:
  - Implementation approaches to restoration (18 comments).
  - Marsh restoration (9 comments).
  - Shellfish restoration (7 comments).
  - Response and assessment (7 comments).
- Secondary topics:
  - Implementation (37 comments).
  - Marsh restoration, shellfish restoration, offshore resources, and socioeconomics (22 comments each).

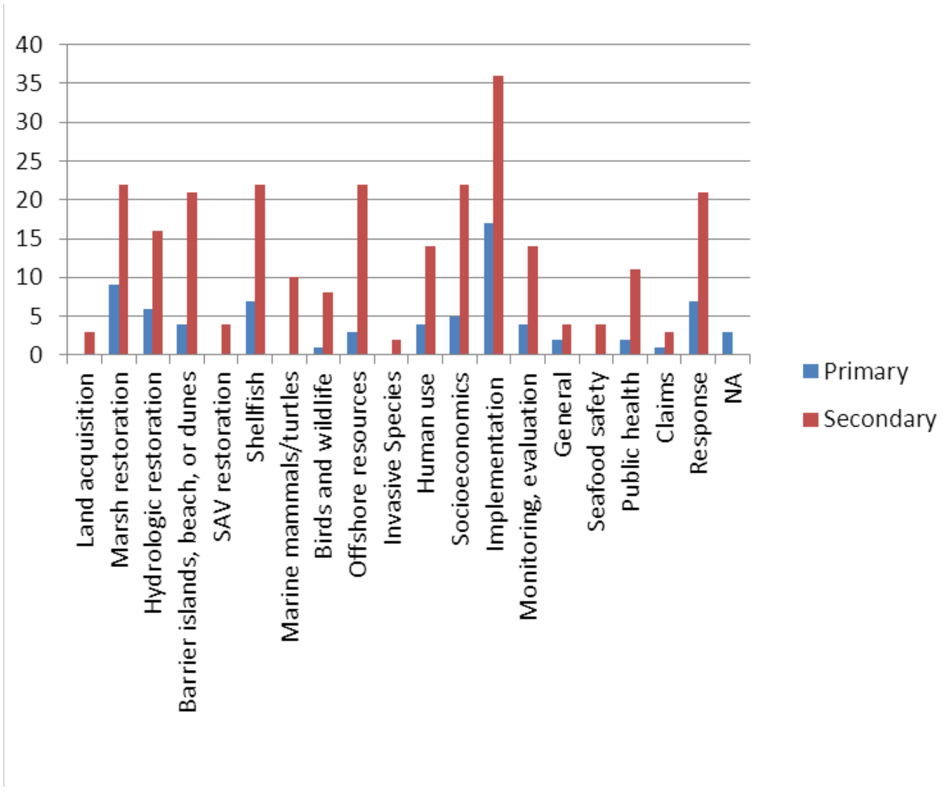


**Figure 5.A-10**. Categories of comments from Louisiana.

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### Texas

- There were 48 comments from Texas.
- Primary topics:
  - Marsh restoration (18 comments).
  - Land acquisition and offshore resources (7 comments each).
- Secondary topics:
  - Offshore resources (28 comments).
  - Land acquisition (24 comments).
  - Marsh restoration (23 comments).

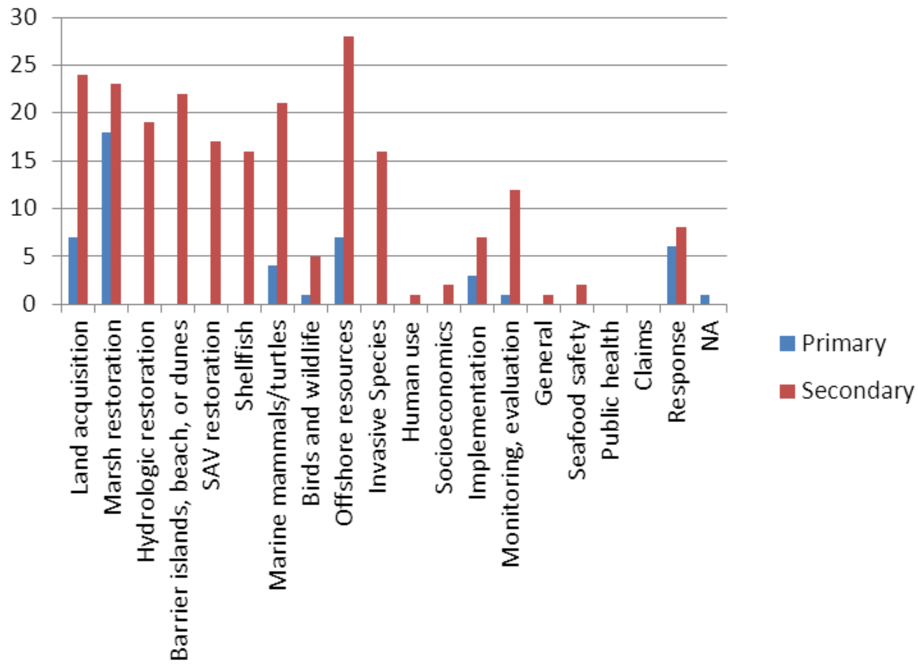


**Figure 5.A-11.** Categories of comments from Texas.

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## A.3 Summaries of Comments Related to the Restoration of Natural Resources

More detail on the comments as they apply to the various restoration categories is provided below. Comment summaries represent one comment unless otherwise noted.

**Table 5.A-1.** Summary of comments by restoration category.

| Category | Total Number of Comments | Number of Supportive Comments | Number of Non-Supportive Comments[a] |
|---|---|---|---|
| Monitoring and evaluation | 7,512 | 7,512 | 0 |
| Implementation approaches for restoration | 5,107 | 5,107 | 0 |
| Offshore resources, including coral reefs and fisheries | 2,614 | 2,611 | 3 |
| Socioeconomics | 2,595 | 67 | 2,528[b] |
| Beach, barrier island, or dune restoration | 2,522 | 2,520 | 2[c] |
| Marsh restoration | 2,515 | 2,515 | 0 |
| Marine mammals and turtles | 2,493 | 2,493 | 0 |
| Shellfish restoration | 63 | 62 | 1 |
| Hydrologic restoration | 50 | 49 | 1 |
| Land acquisition and conservation | 47 | 47 | 0 |
| General | 41 | 41 | 0 |
| Human use of natural resources | 39 | 36 | 3 |
| Submerged aquatic vegetation (SAV) restoration | 33 | 33 | 0 |
| Birds and terrestrial wildlife | 24 | 24 | 0 |
| Invasive species removal | 21 | 21 | 0 |

[a] Nonsupporting comments are those in which the commenter requested that a particular type of restoration not be included, or not emphasized, as part of the restoration.
[b] There were 2,595 comments that referenced socioeconomics, the majority of which opposed economic projects such as port expansion or highway infrastructure.
[c] Note: Ten comments expressed opposition to beach renourishment but supported dune restoration.

### A.3.1 Long-Term Monitoring and Evaluation

There were 7,512 comments that referenced long-term monitoring and evaluation, all of which were in support of this effort.

1. Long-term, ongoing, Gulf-wide monitoring programs are needed to evaluate the status and trends of Gulf ecosystems and fishery resources. (4 comments FL, 2 comments AL, 3 comments TX, 1 comment LA).
2. Use hydroacoustic (BioSonic) technology for monitoring and assessing underwater habitats and resources (WA).
3. Extensive survey and field documentation are direly needed, followed by targeted, intensive testing in all areas adversely affected by the spill (LA).
4. The Trustees should establish a long-term monitoring program and strengthen existing data collection and management systems (NY).

5. The Restoration Plan must include a monitoring schedule that specifies performance goals and corrective measures if goals are not met (3 comments LA, TX and MS, 1 comment each).
6. Monitoring should continue for at least 35 years. Independent scientists should participate (TX and MS, 1 comment each).
7. Set up a comprehensive, independent long-term monitoring program to collect data not only on well-known commercial and recreational fish species but also on their prey items and the ecosystem in which they live (TX).
8. Develop a long-term research strategy for marine wildlife, including seabirds, with full involvement of the leading experts, especially from the southeast region (SC).
9. Recommend that the Council give priority to long-term ecosystem monitoring, research, and adaptive management (TX).
10. Projects should be viewed as long-term investments, and long-term research and monitoring is necessary (DC).
11. Long-term research, monitoring, and management is crucial. BP and responsible parties should be held liable for the restoration of later-discovered injuries; a reopener is essential (1 comment LA, 2 comments IN, 2 comments FL, 2 comments MS, 20 comments from Earthjustice in NY, 2,459 Sierra Club comments, 2,445 Sea Turtle Restoration Project comments).
12. The effects of this disaster could continue for the next three or four decades, and long-term monitoring and testing must be performed to ensure accountability (MS).
13. Implement an endowed Gulf ecosystem research and monitoring program established at the regional or state level (1 comment FL, 15 comments from NGOs in TX).
14. Conduct long-term monitoring for seafood, marine species, beach, and coastal waters in Choctawhatchee Bay and Coast Dune Lakes (FL).
15. First restore beaches, then consider seagrass restoration, dune restoration, water quality improvements, recreational use projects, sea turtle restoration, sea bird and barrier island nesting species restoration, and oyster restoration (FL).
16. Establish a rigorous scientific monitoring study and inventories of wildlife populations in recovery (AL, TX, 2 comments MS, 2 comments LA, 2 comments FL).
17. Conduct more monitoring of offshore areas (LA, 2 comments TX).
18. Use endowments to ensure long-term monitoring and enforcement of easements (TX).
19. Restoration efforts should be monitored for the life of the land (TX).
20. The restoration plan must include monitoring and research to determine the effectiveness of restoration measures and to detect lingering effects of the *Deepwater Horizon* spill (2,528 Gulf Restoration Network comments, all from LA).
21. Use submersibles to monitor what is happening on the ocean floor (FL).
22. Use existing data collected by the public (Mobile Baykeeper and Alabama Coastal Foundation) to check for consistency, baseline, guidance, and more (AL).
23. Plan for science-based, long-term monitoring of the recovery so necessary changes to restoration projects can occur (LA).
24. Long-term monitoring over 20 to 50 years is necessary to ensure effectiveness (LA).
25. It is essential to ensure a mechanism is in place for long-term monitoring of the effects of the spill (2 comments, FL and AL).
26. Alabama should receive more funding for monitoring and studying manatee populations (AL).

27. Gulf waters, sediments, and biota (both nearshore and offshore) need to be sampled intensively for contaminants and chronic impacts for at least the next 20 years (LA).
28. Fund water/sediment long-range monitoring of phosphorus, nitrogen, mercury, etc., in Choctawhatchee Bay, and monitor for oil and marine species (FL).
29. Retrofit existing NOAA data buoys with water quality testing capabilities (FL).
30. Commenter requests extensive ongoing testing concerning all residues in the water with the results open to the public (MS).

### A.3.2 Implementation Approaches and Issues

There were 5,107 comments that suggested approaches and issues to be considered for implementation of restoration projects. The majority of the projects supported the thoughtful implementation of restoration projects.

- Approximately 5,000 comments expressed support for creating and using some type of citizens' advisory council (includes form letter comments from the Gulf Restoration Network and the Sierra Club).
- Approximately 2,500 comments expressed support for using local labor and resources for restoration work (includes form letter comments from the Sierra Club).
- Approximately 2,500 comments expressed support for approaching restoration with a comprehensive, Gulf-wide, ecosystem-based approach (includes form letter comments from the Gulf Restoration Network).
- Approximately 2,500 comments urged the Trustees to ensure transparency and public involvement in the restoration process (includes form letter comments from the Gulf Restoration Network).

#### Comments Supporting Citizens' Advisory Councils

1. Establish a regional or local citizens' advisory group/council with local subject matter experts (NY, TX, DC, 3 comments MS, 2 comments AL, 4 comments FL, 3 comments LA).
2. Commenter proposes the establishment of a restoration committee made up of experts and Trustee representatives and an equal number of qualified local individuals from each affected area within the Gulf (LA).
3. Consider establishing localized (city by city) community action committees formed by citizen volunteers who would serve as a resource and clearinghouse for collaborating restoration efforts (FL).
4. A Regional Citizens' Advisory Council must be established, composed of independent scientists, conservationists, and local fishermen, but excluding business interests (MS).
5. Establish a Public Advisory Council comprising Gulf Coast community leaders and scientific experts to formally participate in the NRDA process (2,459 Sierra Club comments, 2,528 Gulf Restoration Network comments, 20 comments from Earthjustice, NY).
6. Fishermen should be able to participate in a citizens' advisory group (LA).

7. The Oil Spill Commission supports the creation of a Regional Citizens' Advisory Council and a Public Advisory Council (MD).

### Comments Supporting Using Local Labor and Resources

1. Use small businesses, minority owned businesses, and local (Florida) firms for restoration (2 comments FL).
2. Use local expertise; specifically, local studies done by local universities (FL, LA, IN).
3. Gulf residents should be directly involved with restoration, particularly those who have already been involved in the spill (PA, IN, 2 comments LA).
4. Monitoring should be done by locals (FL).
5. The Trustees should ensure that local workers and businesses are employed to implement restoration and monitoring projects (TX, NY, 3 comments LA).
6. NOAA should use local workforce and make sure they are properly trained and certified (TX).
7. Commenter expressed a need for people who have a stake in the area to study the problems (FL).
8. Invest in a community-based oyster shell recycling program (LA).
9. Trustees should give preference to restoration projects that hire from within the Gulf Coast. The Trustees should consider policies described in Oxfam America and the Center for American Progress's recent report, "Beyond Recovery" (LA, 20 comments from Earthjustice in NY).
10. Ecological restoration projects should aim to improve the resilience and sustainability of the region's coastal and marine resources and, to the extent possible, create new local jobs (2,459 Sierra Club comments).
11. Use expertise of local commercial fisherman to plan restoration (LA).
12. Out of work fishermen could be employed to do oyster restoration (FL).
13. Involve local fishermen and hunters in the natural resources assessment process (CO).
14. When an opportunity arises for creating new jobs tied to restoration, include the Mississippi Department of Employment Security on the front end so the department can train and plan to be a part of the employment opportunities that result from restoration (MS).
15. Hire locally and provide career options and training to the unemployed, particularly the Vietnamese community (MS).
16. Involve local nonprofit organizations to help gather comments (LA).
17. Consult with locals who observe spill impacts (LA).

### Comments Supporting the Application of an Ecosystem Approach

1. Ecosystem-based restoration is essential (2 comments DC, 1 comment NY).
2. Restoration projects should be integrated to reflect an ecosystem-based approach (FL, LA, AL, 3 comments TX, 2 comments MS, 20 comments from Earthjustice in NY).
3. Restoration should address long-term and ecosystem scale impacts (DC).
4. The Trustees should focus on restoration of ecosystems as opposed to individual resources (LA).
5. Projects should be landscape-oriented and not state-oriented (2 comments MS).

6. Restoration plans must support ecosystem and science-based strategies. They should have measurable objectives, include a set of priorities on how to implement projects, a timeline, and a process to evaluate their effectiveness (2,528 Gulf Restoration comments, LA).

### Comments Encouraging Transparency and Public Involvement

1. The NRDA process should be more transparent (2 comments FL, 1 comment AL).
2. Make public all information available to the responsible parties and disclose all agreements and communication with BP (NY).
3. The NRDA process must be as transparent as possible and must actively engage and consult with the public (FL, AL, TX, MS).
4. Commenter strongly urges NOAA to carefully consider all the comments offered in the various public scoping meetings and submitted via the public comment database (LA).
5. Please make more public announcements about the restoration scoping process in Mississippi and on the MS coast, and let the local communities have as much say and power over the projects as possible (MS).
6. Increase transparency and expand inclusion of citizens. Form and use a Scientific Advisory Council (AL).
7. Increased transparency is needed to build public trust and shed light on NRDA process (TX and DC, 1 comment each).
8. Expand transparency and public involvement (2 comments LA, 20 comments from Earthjustice in NY).
9. Public opportunity to comment at each stage of the process should be provided for in workshops and in a dedicated area of the NRDA website. The public should have access to the same information provided to Trustees (FL).
10. Public comment and review should continue as NRDA damage data is collected and reviewed and projects are selected. The public should have access to the same information provided to Trustees (FL).
11. Improve publicity of comment period (MS).
12. Incorporate stakeholder input in the decision-making process (2,528 Gulf Restoration Network comments, LA).
13. Make data from long-term monitoring available to the public (2 comments LA).
14. NOAA and the U.S. Environmental Protection Agency (EPA) should reach out to research partners to fill data gaps, and data collection should be transparent (LA).
15. Release a NRDA status report (NY).
16. Work with scientists, nonprofits, and local citizens (IN).

### Other Implementation Comments

1. The 2013 timeline for the final development of a restoration plan is too long a timeframe (2 comments FL and LA).
2. PEIS should also address waste to expedite the review and approval process (LA).
3. Private firms, especially small businesses, should direct restoration efforts (FL).

4. BP should do whatever necessary to restore all that has been destroyed and lives that have been decimated, and they must work with all levels of scientists, nonprofits and local citizens in the area and beyond (IN).
5. Consider recommendations by groups such as the National Audubon Society (CA).
6. Restoration should incorporate the best available science and include ecological, engineering and socioeconomic perspectives/disciplines from federal and state agencies, universities, NGOs and others (MS).
7. Establish an independent scientific peer review process (TX, MS, 20 comments from Earthjustice in NY).
8. Engage tribal members to serve as independent observers to continue to document the impact that the oil spill has had on the shoreline, aquatic resources, and sea life, and consult with them on historic or sacred sites (LA).
9. Establish a process by which NGOs that are not involved in the NRDA process can be certified to perform privately funded "research" in an area where an environmental catastrophe occurs (SC).
10. Louisiana Coastal Tribal Coalition requests that each tribe be considered a consulting party pursuant to 36 CFR § 800.2(c)(5) (4 comments LA).
11. Suggest project prioritization guidelines based on economic, ecosystem, implementation, community support, and monitoring criteria (LA).
12. Evaluate restoration alternatives using guidelines in NRDA regulations and a multidisciplinary/collaborative approach, relationship to broader ecosystem functions, and value-added projects (TX).
13. Criteria for selecting projects should include cost, contribution to goals, likelihood of success, likelihood of preventing further injury, number of resources improved by the project, and its effects on public health and safety (DC).
14. Projects should be prioritized if they provide long-term results to complement critical priority projects (LA).
15. Devise a thorough and rigorous process for proposal evaluation, and choose projects that enhance coastal resiliency (AL).
16. Program selection and research should be based on key restoration needs and priorities (DC).
17. Restoration may need to be compensatory in some places (TX).
18. Use Habitat Equivalency Analyses (TX).
19. Establish an Independent Scientific Council/Panel (DC, NY, MS, FL and FL, 1 comment each).
20. Listen to entrepreneurs with new and creative restoration ideas (LA).
21. Public service employees must not be enlisted to perform PEIS and NRDA tasks on top of or instead of their existing duties (TX).
22. Trustees should develop "reasonable worst case" conservative measures of injury and restoration scale (LA).
23. Trustees should create a matrix that shows how restoration types will be rated and prioritized so that later project submittal can be efficient (FL).
24. Create a learning library (FL).
25. Use existing restoration plans and studies (3 comments LA).
26. Work with nonprofit organizations on existing projects (LA).

27. Restoration projects and types should be dictated and flow from what is learned through the assessment (DC).
28. Bring in other federal agencies like EPA because the state agencies that have been delegated power from EPA are not doing an adequate job, and we need more federal oversight to protect people and nature (MS).
29. BP and responsible parties should be excluded from the restoration process (LA).
30. Consider lost ecosystem services and carryover effects of oil pollution when selecting projects (LA).
31. Slow down to be sure we get restoration right. Obtain more information, including from polluters (LA).
32. The Louisiana Regional Restoration Planning Program should be incorporated by reference into the proposed PEIS (LA).
33. Do not let corporations influence restoration (CO).
34. Do not allow politics to influence restoration (FL).
35. Work with company using mushrooms for restoration (2 comments CO).
36. Commenter expressed concern about balancing project priorities to address human uses and ecological needs (FL).
37. Listen to grassroots groups (LA).

### A.3.3 Offshore Resources

There were 2,614 comments that referenced offshore resources, nearly all of which were in support of this restoration effort.

The offshore resources category is broad, and several comments addressed subcategories such as natural and artificial reefs, fisheries issues, and offshore protected areas.

There were approximately 20 comments related to artificial reefs. Most of these comments were in support of pursuing artificial reef construction, whereas two comments were not in support of artificial reefs. Two additional comments urged the Trustees to consider all the consequences as well as benefits of creating artificial reefs. One commenter expressed opposition to fish hatcheries, and several comments supported the creation of marine protected areas, fish sanctuaries, or no-fish zones.

#### Comments on Natural and Artificial Reefs

1. Avoid funding projects that aim to enhance fisheries through measures such as artificial reefs (FL).
2. Marine protected areas are more important than temporary “rigs-to-reefs” projects (TX).
3. Consider the good and bad consequences of rigs turned to reefs (2 comments TX).
4. When offshore oil rigs are decommissioned, they should be left as artificial reefs (3 comments TX).
5. Use “junk” to construct artificial reefs (NY).
6. Artificial reefs have a large economic benefit (FL).
7. Include artificial reefs placed within 9 miles of the beach all the way across the Gulf from Carrabelle, FL to the west side of LA. The reefs should not be publicized but should be open for fishing (FL).

8. Build up the habitat for the spawning grounds, artificial reefs in particular (FL).
9. Place artificial reef blocks in strategic locations (TX).
10. Support artificial reef enhancements (The 100-1000 Restore Coastal Alabama Plan) (AL).
11. Large scale unpublished artificial reef deployments inside the permitted reefing areas would be a perfect fit for the required remediation of the damage caused by the BP oil spill (TX).
12. Bring in new reefs for fish and marine life to survive in/by (2 comments TX and LA).
13. Build reefs to improve recreational fishing instead of building recreational infrastructure (MS).
14. Protect Dauphin Island Parkway through the creation of 36 acres of aquatic habitat including sandy beaches, oyster reefs, fishing reefs, and enhanced public access through pocket parks (AL).
15. Do things we know how to do first: reefs, islands, marshes, reintroduce the river (LA).
16. Support offshore and inshore reef construction (FL).

### Comments on Fisheries

1. Reduce overfishing and bycatch (LA).
2. Introduce meaningful financial investments in fisheries science and decision support tools to aid management and investments for the development and promotion of more selective and habitat-friendly fishing gear (FL).
3. Restore fishery habitats (2 comments FL and LA).
4. Do not pursue idea of funding fish hatcheries (FL).
5. Pursue marine fish hatcheries (LA).
6. Build up the quantity of healthy seafood in the Gulf (AL).
7. Allow permitting of large-scale aquaculture projects (FL).
8. Designate bay areas as fish “sanctuaries” (FL).
9. Create programs that improve management and monitoring of fisheries stocks (FL and CA, 1 comment each).
10. Keep allowable catches low until extent of damage is known (FL).
11. Pursue projects that restore fisheries to pre-oil spill levels (4 comments LA).
12. Do not pursue dolphin hatcheries, fish hatcheries, and aquaculture (LA).
13. Texas needs increased funding for enhanced fisheries monitoring, surveys, and data collection; and investments in gear conversion programs aimed at reducing bycatch (15 comments from NGOs in TX).
14. Implement no-fish zones or seasons (2 comments MS, 1 comment FL).
15. Restore fisheries and blue water fishing (LA).
16. Fisheries recovery is critical (2 comments LA, 1 comment FL).
17. Commenter expressed concern about the recruitment of all reef and migratory fish in the Gulf and would like to see funds for yearly stock assessments and recruitment studies (2 comments TX).
18. Restore fisheries—especially shrimp, oysters, crab, and bottom dwelling species (LA).
19. Commenter expressed concern about how early fishing waters were opened after the spill (TX).

### Other Offshore Comments

1. Focus on the habitats and resources of both the offshore and deeper waters (corals, reefs, the water column, and seafloor) and the nearshore (marshes, wetlands, beaches, and barrier islands) environments. Impacts on all marine species must be examined (MS).
2. Commenter expressed concern that the focus of early restoration efforts could be allocated disproportionately toward coastal restoration projects, with little remaining for deep sea projects. Establish a system of marine protected areas (MPAs) along the continental shelf, slope, and deep-sea floor (NY).
3. Reduce Gulf hypoxia (2 comments TX, 1 comment IN, 1 comment unknown state).
4. Re-establish or maintain existing corals and protect deep-sea corals from incompatible human activities while allowing sustainable fishing (TX).
5. Designate coastal and marine areas as essential fish habitat (EFH); restoration of the EFH areas is a priority (2 comments TX and FL).
6. Pursue coral reef restoration (LA).
7. Establish marine protected areas for areas that are important biologically and ecologically (TX).
8. Create a larger marine reserve or sanctuary in the Gulf of Mexico (TX).
9. Focus on offshore resources—corals, reefs, water columns, sea floor, and impacts to spawning wildlife—as well as the near-shore (2 comments TX, 3 comments LA).
10. The vast majority of damage occurred offshore in the marine environment; make sure deep water is restored and protected (2,528 Gulf Restoration Network comments, 1 comment DC, 1 comment TX).
11. Both coastal restoration and deep water resource restoration are essential and are connected (2 comments LA).
12. The majority of the damage is going to be found in the benthic layer; therefore a complete restoration of that layer (no matter how troublesome or new the science is) needs to take place (MS).
13. Address deep water impacts on the ocean floor and in the water column (LA, TX).
14. Look at near-shore nurseries for juvenile sharks (LA).
15. Commenter expressed concern about how unrestorable impacts, such as submerged oil around the wellhead, would be compensated for (FL).
16. Put stricter regulations on collecting sharks for pets (MD).



## A.3.4 Socioeconomics

There were 2,595 comments that referenced socioeconomics, the majority of which opposed economic projects such as port expansion or highway infrastructure.

1. Commenter does not want the money to be used for economic projects such as port expansions or highway infrastructure; the restoration should be focused on the environment that was affected (2,528 Gulf Restoration Network comments, 1 comment LA).
2. Strike a balance between investing in natural resource restoration and addressing human (social and economic) needs (2 comments each AL and MS).
3. The PEIS and NRDA should include cultural/human resources as well as natural resources (3 comments LA).

4. Restoration includes health, communities, resilience, and jobs, as well as coastal restoration (2 comments each MS and LA).
5. Please investigate the use of Revitalization Forum software to integrate community revitalization with environmental restoration (DC).
6. Pursue projects that engage young people in conservation projects (IN).
7. Invest in a community-based oyster shell recycling program (LA).
8. As restoration projects are selected and implemented, the Trustees also should seek to rebuild and strengthen the regional economy devastated by the disaster (1 comment AL, 2 comments FL, 20 comments from Earthjustice in NY).
9. Support the E.O. Wilson Biophilia Center for environmental education (FL).
10. Think about how our economy and environment are linked (AL).
11. Fishermen are underemployed because of the scarcity and quality of fish (FL).
12. Fishermen are traveling far distances to catch fish outside the spill area (FL).
13. Commenter expressed concern about how to determine if fish stocks have been damaged when the Marine Fisheries Commission has dropped fisherman quotas to zero (FL).
14. The BP spill ended more than just a way of life; local culture was destroyed (TX).
15. Need to document and put a value on losses from commercially valuable resources (LA).
16. Use coastal restoration to further economic development in the region (3 comments LA).
17. Interpret restoration broadly to include investments in wind and turbine renewable energy (AL).
18. Nature tourism is a good bridge between economic (tourists) and ecological (outreach messages) restoration (AL).
19. Encourage the federal government to turn to the state of Louisiana to learn about a feasibility study that is looking at carbon market trading as a way to fund restoration projects within their region (DC).
20. Many Mississippians missed the opportunity to receive employment as a result of the spill and be employed in the clean up response (MS).
21. The state of Mississippi is sending a mixed message when advertisements say the seafood is safe to eat but the NRDA process is still taking place. Commenter expressed concern about protecting fishing and tourism at the expense of the restoration (MS).
22. Replace lost and unrecoverable jobs with jobs in renewable energy (AL)
23. Protect sacred and historic sites by creating levees and other methods (4 comments LA).
24. Commenter expressed distress over losses to wildlife and human livelihoods (LA).

### A.3.5 Beach, Barrier island, and/or Dune Restoration

There were 2,522 comments that referenced beach, barrier island, or dune restoration. The majority of the comments (2,466) supported pursuing beach, barrier island, or dune restoration, but not as a priority or not until other restoration goals were fulfilled.

There were two comments against beach, barrier island, or dune restoration: one against beach renourishment programs of any type and one against restoring naturally altered ecosystems such as beaches and dunes. One other commenter submitted 10 comments supporting dune restoration (planting sea oats) but opposing beach renourishment.

1. Do not pursue beach nourishment projects of any kind (FL).

2. Avoid funding projects that aim to restore ecosystems altered by natural events, for example, the erosion of beaches and the loss of dunes caused by recent hurricanes or where the loss of these dunes is entirely due to development (FL).
3. Plant sea oats on Okaloosa Island sand dunes, and do not approve planned fill for Okaloosa beach restoration (10 comments FL).
4. Rebuild barrier islands. Use cypress saplings and black mangroves to protect from nutrias. Use HESCO containers (earth-filled defensive barriers) to create an artificial coastline (CA).
5. Support restoration projects that create more wetlands and barriers for the communities affected by the oil spill. Consider creating oyster reefs (LA).
6. Create programs that strengthen barrier islands and dunes (CA).
7. Pursue projects that restore barrier islands in Terrebonne and Lafourche Parishes (4 comments LA).
8. Do things we know how to do first: reefs, islands, marshes, reintroduce the river (LA).
9. Recommend that the Council give priority to restoration of the coast, with emphasis on wetlands, barrier islands, and beaches (TX).
10. Priority habitats in Texas for restoration include coastal marsh and wetlands, barrier islands, sea grass beds, and migratory bird and waterfowl habitat (15 comments from NGOs in TX).
11. Follow conservation land acquisition with coastal habitat restoration, including wetlands, coastal scrub, coastal strand forests, and other upland habitats that protect water and habitat quality and shoreline stability through coastal buffer functions (FL).
12. Thoughtfully and creatively use dredged sediment to build and restore wetlands and islands (3 comments LA, 1 comment AL, and1 comment MS).
13. Restore barrier islands (5 comments LA, 1 comment TX).
14. It is important to restore wetlands and barrier islands because post-nesting and juvenile sea turtles regularly forage in wetlands, coastal embankments, and around barrier islands. In addition, these habitats support healthy crabs, oysters, and other creatures in the sea turtle diet (2,445 comments from the Sea Turtle Restoration Project).
15. Building berms can augment barrier island restoration programs (LA).
16. The Florida panhandle barrier islands need revegetation of overwash/blow out areas (FL).
17. Restore coast for habitat and storm surge protection (LA).
18. Protect coastal dune lakes in Walton County (2 comments FL).
19. Pursue coastal beach restoration (AL).
20. Once cleanup is complete, bring in clean sand for beach areas (not sifted sand) (LA).
21. Protect Dauphin Island Parkway through the creation of 36 acres of aquatic habitat including sandy beaches, oyster reefs, fishing reefs, and enhanced public access through pocket parks (AL).
22. Gulf beach renourishment is probably the number one priority. Dune monitoring restoration is a second tier priority (FL).
23. Have BP contractors use existing equipment to remove degraded asphalt from dunes along coastal roadways (FL).
24. Consider using Gulf Saver Bags to restore barrier beaches, shorelines, and wetlands (4 comments NY, NY, LA and LA).
25. Commenter expressed concern about the state of the beaches (MS).

### A.3.6 Marsh Restoration

There were 2,515 comments that referenced marsh restoration, all of which were supportive of pursuing marsh restoration efforts.

1. Restore wetlands and shorelines by reducing agricultural runoff and restoring waterways to their free flowing states (VA).
2. Pursue construction of freshwater wetland/moist soil units in abandoned rice farmland, current rice farmland, or degraded pasture in the Texas coastal counties (2 comments TX).
3. Restore oil and gas canals to marsh (2 comments FL).
4. Complete cleanup first, then plant new grasses on marshes (AL, LA).
5. Marsh creation, oyster reef restoration, and barrier island building are very important (LA).
6. Support the Restore Coastal Alabama project to construct 100 miles of nearshore oyster reef to protect and promote the growth of more than 1,000 acres of coastal marsh and sea grass (2 comments AL).
7. Consider using Gulf Saver Bags to restore barrier beaches, shorelines, and wetlands (2 comments NY, 2 comments LA).
8. Restore the marshes and wetlands (3 comments LA, 2 comments TX, 2 comments MS, 1 comment CA).
9. Support restoration projects that create more wetlands and barriers for the communities affected by the oil spill. Consider creating oyster reefs (LA).
10. Use pipeline dredged material from the Mississippi River to restore the old bayou and canal banks which control the inner tidal movement. Barrier islands are necessary to protect the marshes (LA).
11. Support restoration of the Empire/Buras marshes located in Plaquemines Parish, LA (LA).
12. Plant vegetation near and bordering the small waterways, the ditches, and the wetlands (MS).
13. Assisting recovery of the wetland conditions to pre-oil contamination conditions is absolutely necessary. Use ammoniated bagasse (fibrous material) to remediate (NY).
14. Do things we know how to do first: reefs, islands, marshes, reintroduce the river (LA).
15. Give priority to restoration of the coast, with emphasis on wetlands, barrier islands, and beaches (TX).
16. Priority habitats in Texas for restoration include coastal marsh and wetlands, barrier islands, sea grass beds, and migratory bird and waterfowl habitat (15 comments from NGOs in TX).
17. Restore wetlands and upland buffers where destroyed (FL).
18. Follow conservation land acquisition with coastal habitat restoration, including wetlands, coastal scrub, coastal strand forests, and other upland habitats that protect water and habitat quality and shoreline stability through coastal buffer functions (FL).
19. Thoughtfully and creatively use dredged sediment to build and restore wetlands and islands (LA).
20. Marsh building can be a good thing but must be done by qualified people (MS).
21. Top the marsh grass while it is fallow for the winter to expose oil for removal and allow the grass and the wetlands/ecosystem to come back stronger (LA).
22. Correct for booms that were not anchored correctly and end up washing up into the marshes (LA).

23. Restore estuaries and coastlines (2 comments LA).
24. Provide organizations involved in restoration with grant dollars to develop/finalize the science that is needed to determine how much carbon wetlands can sequester (LA).
25. Support the Barataria Terrebonne Estuary Program's plans (LA).
26. Restore vegetated riparian buffers (FL).
27. Restore wetlands at the same rate as the land loss is occurring. Restoration projects should mimic natural processes (LA).
28. Improve wetland health for juvenile sea turtle habitat (2,445 comments from the Sea Turtle Restoration Project).

### A.3.7 Marine Mammals and Sea Turtles

There were 2,493 comments that referenced marine mammals and sea turtles, all of which were supportive of pursuing marine mammal and sea turtle restoration efforts.

1. Clean all nesting beaches of oil, build protective corrals for nests, improve wetland and barrier island ecosystem health, and establish safe swimways (3 comments each NY, CA, IL, and Sea Turtle Restoration Project—2,447 comments)
2. Commenter would like more efforts and money spent on rehabilitating wildlife and their young (CA).
3. Restoration funds should be used to help coastal property owners install sea turtle friendly lighting and for sea turtle predator control (FL).
4. Support the Kemp's Ridley Sea Turtle Recovery Program at the Padre Island National Seashore (PAIS) (TX).
5. Recommend that the Trustees give priority to restoration of protected species such as sea turtles, birds, and cetaceans (TX).
6. Implement existing recovery plans, survey and monitor population trends, and conduct research on marine mammals and sea turtles (15 comments from NGOs in TX).
7. Restore sea turtle habitat by establishing marine protected areas, overhauling offshore oil operations, and reducing commercial trawl and longline fishing. Also, use funding to increase sea turtle beach monitoring and predator patrols, reduce beachfront light pollution, enforce the Endangered Species Act, support the Gulf of Mexico Sea Turtle Stranding and Salvage Network, and improve and increase rescue and rehabilitation facilities (TX).
8. Support marine turtle monitoring and population restoration (FL).
9. Correct for wildlife (turtles) killed during response (LA).
10. To identify the sea turtle restoration projects, the NRDA must more accurately assess the sea turtles that have been killed and harmed by this spill. Improve the Gulf of Mexico sea turtle stranding network (TX).
11. Consider the impacts to migrating animals, both the adults and young, and count the injury to that animal in both the Gulf and the final destination (2 comments CO and TX).
12. Give guidance on how dolphin tour boat operators can meet tourist desire and Marine Mammal Protection Act demands. The animals are stressed by oil and almost constant boat presence (AL).
13. Address impacts to marine mammals and sea turtles (TX, LA).

### A.3.8 Shellfish Restoration

There were 63 comments that referenced shellfish, the majority of which were supportive of this restoration effort. One commenter was against shellfish restoration, specifically against building oyster reefs.

1. Strategies to build oyster reefs are irresponsible when severe public health issues remain (MS).
2. Commenter expressed the need for extensive restoration of nearshore oyster reefs (VA).
3. Move oyster beds farther offshore in response to freshwater diversions. Create artificial beds for the spat to adhere to—keep them in the correct pH and nutrient-rich waters (CA).
4. There should be rigorous replanting of oyster beds. Limestone rocks planted on top of existing live oysters and shells has proven to be quite successful in the past and should be continued (AL).
5. Oyster reef restoration is very important (2 comments LA).
6. Support the Restore Coastal Alabama project to construct 100 miles of nearshore oyster reef to protect and promote the growth of more than 1,000 acres of coastal marsh and sea grass (AL).
7. Support the development of oyster reefs as barriers and restore the oyster population that has been affected/depleted by the oil spill (LA).
8. Oyster contamination will upset the ecological order alongside public use benefits (AL).
9. If restoring natural bay way flows, ensure pH balance protects oyster beds (AL).
10. Invest in a community-based oyster shell recycling program (LA).
11. Pursue projects that restore oyster beds to pre-oil spill levels (4 comments, LA).
12. Protect Dauphin Island Parkway through the creation of 36 acres of aquatic habitat including sandy beaches, oyster reefs, fishing reefs, and enhanced public access through pocket parks (AL).
13. Put oyster reefs and sea grass beds back where they were before overfishing, dredging, and water quality declines (2 comments FL).
14. Create something like an Oyster Progress Administration and an oyster protected area (LA).
15. Re-establish or maintain existing oyster reefs (2 comments TX and FL).
16. Support artificial reef enhancements (The 100-1000 Restore Coastal Alabama Plan) (2 comments FL and AL).
17. Use artificial oyster reefs to improve shoreline stabilization (LA).
18. Funding is needed for large-scale oyster reef restoration and monitoring, particularly in Galveston Bay (15 comments from NGOs in TX).
19. Pursue shellfish (oyster reef) restoration as oyster and wildlife habitat and shoreline protection. Use techniques learned from past successes and be sure not to waste valuable oyster shells (2 comments AL and LA).
20. Use recycled oyster shells from local restaurants to build reefs (AL).
21. Support oyster repopulating and restoration (FL).
22. Construct a concrete rubble reef from state line to state line in Mississippi set at the half mile limit (MS).
23. Support creating submerged breakwaters with limestone for oysters to settle (FL).
24. Commenter expressed the need for more cleaning before restocking oysters (AL).
25. Restore oysters killed as a result of opening Mississippi flows (LA).

26. Determine what problems are affecting reefs before pursuing restoration (LA).
27. A large part of the PEIS, at least one chapter, should address oyster recovery. Develop oyster reservations, plant cultch materials on sea grounds, and develop oyster hatcheries. Begin projects immediately (LA).
28. Restore oyster fisheries (2 comments LA).
29. Restore oyster reefs by placing suitable substrate in panhandle bays (FL).

### A.3.9 Hydrologic Restoration

There were 50 comments that referenced hydrologic restoration, nearly all of which were supportive of pursing this category of restoration. One commenter did not support large freshwater diversions.

1. Restore wetlands and shorelines by reducing agricultural runoff and restoring waterways to their free flowing states (VA).
2. Restore all historic oil and gas canals to marsh (FL).
3. Pursue river/freshwater sediment diversions (CA).
4. Use freshwater sources to replenish land (2 comments LA).
5. Pipeline dredged material from the Mississippi River to control the inner tidal movement (2 comments LA).
6. Dig the Hwy 98 Bay Way up and rebuild a bridge so the water from the delta and rivers can once again flow naturally. Ensure pH is at proper level to not harm oyster beds (AL).
7. Restore the hydrologic characteristics of the Empire/Buras to as close to natural as possible (LA).
8. Support the creation/restoration of the smaller watersheds that have been altered by humans (MS).
9. Acquire and purchase water rights to ensure freshwater flows (CA, 2 comments TX).
10. Use settlement funds to pay the incremental cost above the Federal Standard to use sediment dredged by the USACE from navigation maintenance projects for beneficial use (TX).
11. Pursue projects that backfill oil canals and restore fresh water flow to combat increased salinization (4 comments LA).
12. Do things we know how to do first: reefs, islands, marshes, reintroduce the river (LA).
13. Support the Mobile Bay Causeway Restoration—river replacement of a land dam with flow-through bridging (AL).
14. Adequate freshwater inflows are essential to maintaining the salinity gradient that supports productive fisheries and healthy bays and estuaries (15 comments from NGOs in TX).
15. Replace culverts with bridges to reduce erosion into lakes (FL).
16. Restore natural river flows to build wetlands and barrier islands through natural sediment input and address other hydrologic restoration needs (3 comments AL, 3 comments LA, 1 comment MS).
17. Stop the Intracoastal Waterway from widening (TX).
18. Oppose large freshwater diversions (LA).
19. Commenter expressed concern about the impact of dredging operations on sea turtles. Supports halting sand dredging in appropriate areas to ensure that the habitat is not harmed (TX).
20. Control sediment from the Mississippi to reduce the oxygen dead zones (DC).

### A.3.10 Land Acquisition and Conservation

There were 47 comments that referenced land acquisition, all of which were supportive of pursuing land acquisition and similar conservation efforts. Several comments expressed support for land acquisition by land trusts.

1. Protect wetlands and estuarine areas through public ownership or acquisition by accredited land trusts (2 comments AL).
2. Important lands on the Texas coast should be acquired by land trusts and conservation groups, and not by the federal and state governments (2 comments TX).
3. Incorporate land acquisition—fee simple would provide the most benefit for restoration purposes. Engage in conversations with accredited land trusts (2 comments AL).
4. Give the Mississippi Coastal Land Trust the funds to buy up some of the watersheds (2 comments MS).
5. Acquire and purchase conservation easements on privately owned coastal estuary lands with qualified nonprofit groups holding the easement (TX).
6. Create programs to obtain lands containing key wildlife habitats and procure conservation easements (CA).
7. The only way to protect land is to buy it and keep it undeveloped (FL).
8. Acquiring and restoring degraded lands in coastal watersheds should be a high priority (FL).
9. Use land acquisition to protect bird and sea turtle nesting sites (TX).
10. Direct funds toward habitat protection and acquisition projects (DC).
11. Use land acquisition to protect and restore coastal marshland (15 comments from NGOs in TX, 1 comment TX).
12. Land conservation is a great place to put money into (FL).
13. Acquire coastal conservation lands, with emphasis on those proximate to existing conservation lands, those including or adjacent to sensitive habitats, and those with restoration potential (FL).
14. Acquire habitat likely to be under development threat (LA).
15. Land acquisition for boat ramps is a second tier priority (FL).
16. Use land set asides to protect wetlands (MS).
17. Make sure that there is land acquisition, Gulf-wide, of ecologically sensitive coastal properties that will protect migratory bird habitat and sustain our wetlands (AL).
18. Purchase land along Coastal Dune Lakes and beachfront in Walton County (3 comments FL).
19. Purchase specific parcels of land in Florida that are nesting grounds for birds and are seagrass habitat (FL).
20. Use land acquisition for the addition of lands to add to, protect, and buffer wildlife refuges in Texas (2 comments TX).
21. Provide funds for the acquisition of Cade Ranch in Galveston County, TX (TX).
22. Conserve existing wetlands and beach habitats that did not receive damage from the BP spill. Additionally, conservation is needed on the upper Texas coast (TX).
23. Recommend acquisition by the state of additional portions of Elmer's Island and support the Woodlands Conservancy's Greenway Corridor projects in Orleans and Plaquemines Parish (LA).

### General Comments

There were 41 restoration related comments on topics that did not fit into defined categories. These comments include suggestions such as incorporating climate change, controlling other pollution, and addressing enforcement and compliance.

1. Mitigation of other areas in lieu of spill-area restoration is not acceptable (LA).
2. Develop an accurate database of ownership of islands off the coast of LA and other Gulf states (SC).
3. Give priority to restoration of sensitive and vulnerable coastal and marine habitats (TX).
4. Support D'Olive Bay and Three Mile Creek Restoration (AL).
5. Improve sewer infrastructure in North Mobile County to reduce the number of pathogens entering the Mobile Bay and connected water bodies (AL).
6. Restoration should be comprehensive; foster the sustainability of the region's coastal and marine resources; and be well-integrated, adaptive, and equitably distributed (20 comments from Earthjustice in NY).
7. The final restoration plan should incorporate adaptation measures that address climate change (FL, LA, MS, TX, 20 comments from Earthjustice in NY).
8. Conduct species inventories and improve stormwater management (FL).
9. Trustees should focus all or the majority of resources on in situ restoration of natural resources. Reduce water pollution and cut greenhouse gas emission. (LA).
10. Increase enforcement and compliance of coastal protection (TX).
11. Restore previous degradation also (AL, MS).
12. Account for synergistic effects across ecosystems (TX).
13. Commenter expressed concern about widespread disappointment in and distrust of government agencies (LA).
14. Commenter noted he would be submitting written and online comments (LA).
15. Commenters expressed appreciation for restoration efforts (FL, MS).
16. Commenters expressed concern that damage will not be restorable (WA, MS).
17. Restoration of all habitats must be completed fully (IL).
18. Do not allow any further drilling offshore (MS).



### A.3.11 Human Use of Natural Resources

There were 39 comments that referenced human use of natural resources, the majority of which were in support of this type of restoration effort. Three comments were against addressing human use of natural resources, specifically against building recreational infrastructure such as piers and fishing docks.

1. Do not build more piers and wharves with restoration money (MS).
2. Strategies to build piers are irresponsible when severe public health issues remain (MS).
3. Instead of building hardscape fishing docks and so forth, bring fishermen and hunters into the natural resources assessment process (CO).
4. Do not to use this category for concrete ramps and boat access. Build reefs to improve recreational fishing instead (MS).

5. Propose habitat restoration work and public access projects to mitigate for the lost recreational opportunities and damages to fish and wildlife resources (LA).
6. Strike a balance between investing in natural resource restoration and addressing human (social and economic) needs (MS).
7. Consider building the Dauphin Island Parkway Bridge to improve access to the coast (AL).
8. Use the Alabama statewide Waterfront Access Study Committee report to improve public access to the waterfront (AL).
9. Support small, local creek/river access, in a greenway fashion (MS).
10. Consider creative re-use of the Interstate 10 Byways, for example, converting one entire span for public recreational use as a five-mile linear waterfront park for walking, biking, and outdoor activities (LA).
11. Any restoration of recreation access and opportunities must take into consideration the impact this will have on natural habitats for fish and wildlife (CA).
12. Protect Dauphin Island Parkway through the creation of 36 acres of aquatic habitat including sandy beaches, oyster reefs, fishing reefs, and enhanced public access through pocket parks (AL).
13. Give priority to ecosystem services by improving infrastructure at appropriate places, support responsible fisheries management, and acquire and improve maintenance of natural areas (TX).
14. Improve recreational infrastructure (LA).
15. Recreational loss projects, including land acquisition for boat ramps, the actual building of boat ramps, and more walls and dune crossovers are a second tier priority (FL).
16. Commenter expressed concern about loss of human use. Provide alternative activities to replace unusable beaches (FL).
17. Recommend restoration and management of public use at Elmer's Island and the Caminada Headland and the rehabilitation of the fishing pier Caminada Pass at Grand Isle (LA).
18. Restore human use losses through restoration projects that increase the quality, quantity, or access to natural resources, like reestablishing dune systems in front of developed/denuded beachfront. Infrastructure projects (e.g., fishing piers, boat ramps, and beach dune walkovers) should be pursued in moderation and only if supported by strong resource management plans or if they enhance public access to natural resources. Use restoration funds to eliminate fee-based park entry (unknown state).
19. Consider putting a moratorium on dolphin cruise boats for the time to allow the populations to recover (AL).
20. Restore public access to the coastlines (AL).
21. Teach sustainable viewing of marine species to boat captains and crew (AL).
22. Put NRDA dollars toward protected areas and national parks for public use (LA).
23. Do not just assess value by how much a person would pay for the recreation service or how often they visit a natural area; these are not complete enough measures (AL).
24. Commenter expressed concern about balancing project priorities to address human uses and ecological needs (FL).
25. Commenters expressed concern about the effects of the spill on human activities such as fishing, beach-going, and gardening (FL, MS).

### A.3.12 Submerged Aquatic Vegetation

There were 33 comments that referenced submerged aquatic vegetation, all of which were supportive of pursuing submerged aquatic vegetation restoration efforts.

1. Support the Restore Coastal Alabama project to construct 100 miles of nearshore oyster reef to protect and promote the growth of more than 1,000 acres of coastal marsh and seagrass (AL).
2. Put oyster reefs and seagrass beds back where they were before overfishing, dredging, and water quality declines (FL).
3. Restore, reestablish or maintain existing seagrass beds (2 comments TX).
4. Pursue seagrass restoration (LA).
5. Seagrass beds are a second tier priority (FL).
6. Commenter expressed the need for living submerged grass beds (MS).
7. Protect seagrass beds by revegetating barrier islands (FL).
8. Priority habitats in Texas for restoration include coastal marsh and wetlands, barrier islands, seagrass beds, and migratory bird and waterfowl habitat (15 comments from NGOs in TX).

### A.3.13 Birds and Terrestrial Wildlife

There were 24 comments that referenced birds and terrestrial wildlife, all of which were supportive of bird and terrestrial wildlife restoration efforts.

1. Protect islands on the upper Texas coast that are critical for the success of ground nesting and other colonial waterbirds (TX).
2. Design and construct bird nesting and resting in Barataria and Terrebonne Bays and other coastal waters and establish Woodlands Conservancy's Greenway Corridor projects in Orleans and Plaquemines Parishes to ensure habitat for migratory birds and recreational access in perpetuity (LA).
3. Spend more effort and money on rehabilitating wildlife and their young (CA).
4. Give priority to restoration of protected species such as sea turtles, birds, and cetaceans (TX).
5. Priority habitats in Texas for restoration include coastal marsh and wetlands, barrier islands, seagrass beds, and migratory bird and waterfowl habitat (15 comments from NGOs in TX).
6. Protect critical bird nesting and feeding areas from development (LA).
7. Support sea bird and barrier island nesting species monitoring and restoration and repopulation (FL).
8. Protect breeding colonies, especially in Audubon's important bird areas (2 comments LA, 1 comment AL, 1 comment MS).
9. Support the design and construction of bird nesting and resting in Barataria and Terrebonne Bays and other coastal waters (LA).
10. Consider bird habitats and potential issues that may develop for the birds as we move ahead. Also, look at restoring capacity to ensure that national wildlife refuges and areas like the Chandeleurs are also addressed (TX).
11. Address impacts to birds and bird habitat, as the Gulf is an important flyway (LA).

### A.3.14 Invasive Species Removal

There were 21 comments that referenced invasive species, all of which were supportive of invasive species removal efforts.

1. Funding is needed for invasive species removal in coastal marshlands (15 comments from NGOs in TX).
2. Remove invasive and exotic species (2 comments FL and LA).
3. Control invasive species (2 comments AL and LA).
4. Use restoration funds for invasive species removal in parks (unknown state).

## A.4 Conclusion

All public comments in their entirety have been made a part of the administrative record for this case. This document is only intended to be a summary of the comments received during the public scoping process. Although comments unrelated to restoration scope have not been summarized in this document, they have been retained and can be shared for additional review and consideration.

## Appendix B: Early Restoration

**Table 5.B-1**. Early Restoration Projects in Phases I–V. Budgets include all costs including contingency.

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Lake Hermitage Marsh Creation—NRDA Early Restoration Project | I | LA | The Lake Hermitage Marsh Creation—NRDA Early Restoration Project is designed to create 104 acres of brackish marsh. Marsh areas will be constructed entirely within the base CWPPRA project's terrace boundary. Sediment will be hydraulically dredged from a borrow area in the Mississippi River and pumped via pipeline to create new marsh in the project area. Over time, natural dewatering and compaction of dredged sediments should result in elevations within the intertidal range, which will be conducive to the establishment of emergent marsh. The 104-acre fill area will be planted with native marsh vegetation to accelerate benefits to be realized from this project. | $13,200,000 | Wetlands, Coastal, and Nearshore Habitats |
| Louisiana Oyster Cultch Project | I | LA | The Louisiana Oyster Cultch Project involves 1) the placement of oyster cultch onto approximately 850 acres of public oyster seed grounds throughout coastal Louisiana and 2) construction of an oyster hatchery facility that will serve to improve existing oyster hatchery operations and produce supplemental larvae and seed. | $14,874,300 | Oysters |
| Mississippi Oyster Cultch Restoration | I | MS | This project will restore and enhance approximately 1,430 acres of the oyster cultch areas within the Mississippi Sound in Hancock and Harrison Counties. | $11,000,000 | Oysters |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Mississippi Artificial Reef Habitat | I | MS | The Mississippi Artificial Reef Habitat project deploys nearshore artificial reefs in the Mississippi Sound. Currently there are 67 existing nearshore artificial reef areas that are each approximately 3 acres in size. At present, approximately half of these existing reef areas have a low profile and consist of crushed concrete or limestone. With the Mississippi Artificial Reef Habitat project, approximately 100 acres of crushed limestone will be added to the 201-acre footprint of the existing reef areas or hard substrate habitats. | $2,600,000 | Oysters |
| Marsh Island (Portersville Bay) Marsh Creation | | AL | The Marsh Island (Portersville Bay) Restoration Project involves the creation of salt marsh along Marsh Island, a state-owned island in the Portersville Bay portion of Mississippi Sound, Alabama. This project adds 50 acres of salt marsh to the existing 24 acres of Marsh Island through the construction of a permeable segmented breakwater, the placement of sediments and the planting of native marsh vegetation. Additionally, this project will protect the existing salt marshes of Marsh Island, which have been experiencing significant losses due to chronic erosion. | $11,280,000 | Wetlands, Coastal, and Nearshore Habitats |
| Alabama Dune Restoration Cooperative Project | I | AL | The City of Gulf Shores, City of Orange Beach, Gulf State Park, Bon Secour NWR and the BLM form the largest group of coastal land owners along the Alabama Gulf Coast. These owners collectively own and/or manage more than 20 miles of dune habitat. The Alabama Dune Restoration Cooperative Project will result in the formation of a partnership, the Coastal Alabama Dune Restoration Cooperative (CADRC), to restore dune habitat injured by the spill. The CADRC restored approximately 55 acres of primary dune habitat in Alabama by planting native dune vegetation and installing sand fencing. The project will help prevent erosion by restoring a “living shoreline”—a coastline protected by plants and associated dunes rather than hard structures. | $1,480,000 | Wetlands, Coastal, and Nearshore Habitats |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Florida Boat Ramp Enhancement and Construction Project | I | FL | The Florida Boat Ramp Enhancement and Construction Project will provide boaters enhanced access to public waterways within Pensacola Bay, Perdido Bay, and offshore areas. The project involves enhancement of public boat ramps in Escambia County, including repairs to existing boat ramps, construction of new boat ramps, and construction of kiosks to provide environmental education to boaters regarding water quality and sustainable practices in coastal areas of Florida. | $5,067,255 | Provide and Enhance Recreational Opportunities |
| Florida (Pensacola Beach) Dune Restoration | I | FL | The project restored an area of the beach where oiling and the extensive use of all-terrain vehicles and heavy equipment has inhibited plant growth and prevented the natural seaward expansion of the dunes since June 2010. Approximately 394,240 native plants were planted approximately 40 feet seaward of the existing primary dunes within designated project areas Proportions of plants included approximately 70 percent sea oats grasses, 20 percent panic and smooth cord grasses, and 10 percent ground cover plants (sea purslane, beach elder, white morning glories, and railroad vine) to maximize sand stabilization and limit wind erosion. | $585,898 | Wetlands, Coastal, and Nearshore Habitats |
| Enhanced Management of Avian Breeding Habitat Injured by Response in the Florida Panhandle, Alabama, and Mississippi | II | FL, AL, MS | The Enhanced Management of Avian Breeding Habitat Injured by Response in the Florida Panhandle, Alabama, and Mississippi project reduces disturbance to beach nesting habitat for beach nesting birds in the project areas. The project involves three components. The first is placing symbolic fencing around sensitive beach nesting bird nesting sites to indicate the site as off limits to people, pets, and other sources of disturbance. The second component is increased predator control to reduce disturbance and loss of eggs, chicks, and adult beach nesting birds at nesting sites. The final component is increasing surveillance and monitoring of posted nesting sites to minimize disturbance to beach nesting birds in posted areas. | $4,658,118 | Birds |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Improving Habitat Injured by spill Response: Restoring the Night Sky | II | FL, AL | The Improving Habitat Injured by Spill Response: Restoring the Night Sky project reduces disturbance to nesting habitat for loggerhead sea turtles. The project involves multiple components: 1) site-specific surveys of existing light sources for each targeted beach; 2) coordination with site managers on development of plans to eliminate, retrofit, or replace existing light fixtures on the property or to otherwise decrease the amount of light reaching the loggerhead sea turtle nesting beach; 3) retrofitting streetlights and parking lot lights; 4) increased efforts by local governments to ensure compliance with local lighting ordinances; and 5) a public awareness campaign including educational materials and revision of the FWC Lighting Technical Manual to include Best Available Technology. | $4,321,165 | Sea Turtles; Birds |
| Freeport Artificial Reef | III | TX | The Freeport Artificial Reef Project will increase the amount of reef materials in a currently permitted artificial reef site (Outer Continental Shelf Block Brazos BA-336), the George Vancouver (Liberty Ship) Artificial Reef, located within Texas state waters in the Gulf of Mexico, approximately 6 miles from Freeport, Texas. The current reef site is permitted for 160 acres but only has materials in 40 acres. The project will place predesigned concrete pyramids in the remaining portions of the 160-acre permitted area onto sandy substrate at a water depth of 55 feet. As required by the ESA consultation with NMFS, the pyramid designs were modified so that one side of the constructed pyramids will be open on the top half to allow sea turtles to move freely in and out of the structure. These improvements will enhance recreational fishing and diving opportunities. | $2,155,365 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Matagorda Artificial Reef | III | TX | The Matagorda Artificial Reef Project will create a new artificial reef site (Outer Continental Shelf Block Brazos BA-439) within Texas state waters in the Gulf of Mexico, approximately 10 miles offshore of Matagorda County, Texas. The project will create a new artificial reef within the 160-acre permitted area, through deployment of predesigned concrete pyramids onto sandy substrate at a water depth of 60 feet. As required by the ESA consultation with NMFS, the pyramid designs were modified so that one side of the constructed pyramids will be open on the top half to allow sea turtles to move freely in and out of the structure. | $3,552,398 | Provide and Enhance Recreational Opportunities |
| Mid/Upper Texas Coast Artificial Reef - Ship Reef | III | TX | The Ship Reef Project will create a new artificial reef site (Outer Continental Shelf Block High Island HI-A-424) in deep waters of the Gulf of Mexico, about 67 miles south-southeast of Galveston, Texas. The project will create an artificial reef by sinking a ship that is at least 200 feet long within the 80-acre permitted reef site, in waters that are approximately 135 feet deep. The ship will be cleaned of hazardous substances to meet EPA criteria, as well as pass all required federal and state inspections, including EPA, TPWD, and USCG. The project will enhance recreational fishing and diving opportunities. This Early Restoration project proposal will fund a portion of the costs to implement this project. | $1,919,765 | Provide and Enhance Recreational Opportunities |
| Sea Rim State Park Improvements | III | TX | Sea Rim State Park is located along the upper Texas coast in Jefferson County, Texas, southwest of Port Arthur, Texas. The Sea Rim State Park Improvements project will construct two wildlife viewing platforms (Fence Lake and Willow Pond), one comfort station, and one fish cleaning shelter in the Park. These improvements will enhance visitor use and enjoyment of Park resources. | $210,100 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Galveston Island State Park Beach Redevelopment | III | TX | Galveston Island State Park is a 2,000-acre park in the middle of Galveston Island, southwest of the City of Galveston in Galveston County, Texas. The Galveston Island State Park Beach Redevelopment project includes the building of multi-use campsites, tent campsites, dune access boardwalks, equestrian facilities, as well as restroom and shower facilities on the beach side of the Park. These improvements will enhance visitor use and enjoyment of Park resources. | $10,745,060 | Provide and Enhance Recreational Opportunities |
| Louisiana Outer Coast Restoration | III | LA | The Trustees propose to restore beach, dune, and back-barrier marsh habitats at four barrier island locations in Louisiana. From west to east, the four locations are Caillou Lake Headlands (also known as Whiskey Island), Chenier Ronquille, Shell Island (West Lobe and portions of East Lobe), and North Breton Island. | $318,363,000 | Wetlands, Coastal, and Nearshore Habitat; Birds |
| Louisiana Marine Fisheries Enhancement, Research, and Science Center | III | LA | The Louisiana Marine Fisheries Enhancement, Research, and Science Center ("the Center") will establish state-of-the-art facilities to responsibly develop aquaculture-based techniques for marine fishery management. The project will include two sites (Calcasieu Parish and Plaquemines Parish) with the shared goals of fostering collaborative multidimensional research on marine sport fish and bait fish species; enhancing stakeholder involvement; and providing fisheries extension, outreach, and education to the public. Specifically, the project will provide Louisiana with an important management tool for monitoring the long-term health of wild populations of popular recreation marine species by developing the ability to release known numbers of marked juveniles into predetermined habitats as part of well-designed studies that will allow for measurement and detection of changes in wild populations of marine sport fish species. The Center will also establish living laboratories to support a variety of marine fisheries outreach and educational activities for the public. | $22,000,000 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Hancock County Marsh Living Shoreline Project | III | MS | The Hancock County Marsh Living Shoreline project is intended to employ living shoreline techniques including natural and artificial breakwater material and marsh creation to reduce shoreline erosion by dampening wave energy while encouraging re-establishment of habitat that was once present in the region. The project will provide for construction of up to 5.9 miles of living shoreline and approximately 46 acres of marsh creation, and 46 acres of subtidal oyster reef will be created in Heron Bay to increase secondary productivity in the area. The project will include shoreline erosion reduction, creation of habitat for secondary productivity, and protection and creation of salt marsh habitat. | $50,000,000 | Wetlands, Coastal, and Nearshore Habitats |
| Restoration Initiatives at the INFINITY Science Center | III | MS | The project, Restoration Initiatives at the INFINITY Science Center, will provide the public enhanced and increased access to coastal natural resources injured by the spill and response actions. The goal is to restore lost recreational opportunities through the provision of increased access to coastal estuarine habitats, wildlife viewing areas, and educational features. The project will enhance and expand a state-of-the-art interactive science, education, interpretive, and research center for use by visitors seeking to experience and learn about the coastal natural resources of the Gulf of Mexico. The project also will serve as a launching point for a comprehensive scenic byway trail system that can take visitors to beaches and tidal coastal estuarine environments. The INFINITY Science Center is located in Hancock County, Mississippi, and is adjacent to the Hancock County Marsh Preserve and coastal estuarine habitats. | $10,400,000 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Popp's Ferry Causeway Park | III | MS | The Popp's Ferry Causeway Park Project will improve a portion of a site in Back Bay, in Harrison County, Mississippi, that is owned by the City of Biloxi by expanding a park environment where visitors could experience the coastal estuarine ecosystem. The intent is to restore Provide and Enhance Recreational Opportunities. The project will provide for construction of an interpretive center, nature trails, boardwalks, and other recreational enhancements and will enhance visitor access to the adjacent coastal estuarine environment while updating and constructing amenities, which will allow visitors to fish, crab, and observe nature. | $4,757,000 | Provide and Enhance Recreational Opportunities |
| Pascagoula Beach Front Promenade | III | MS | The Pascagoula Beachfront Promenade project is intended to restore lost recreational opportunities resulting from the spill and related response actions. This project will enhance recreational shoreline access via the construction of a lighted concrete beachfront pedestrian pathway adjacent to a sand beach in Pascagoula, Mississippi. Project funds will be used to help complete a two-mile, 10-foot wide, lighted concrete pathway complete with amenities. This Early Restoration project proposal will fund a portion (8,200 feet) of the 10-foot wide promenade, a portion of which has already been constructed. | $3,800,000 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Alabama Swift Tract Living Shoreline | III | AL | The Alabama Swift Tract Living Shoreline project is intended to employ living shoreline techniques that utilize natural and/or artificial breakwater material to stabilize shorelines along an area in the eastern portion of Bon Secour Bay, Alabama. As the lead implementing Trustee, NOAA will create breakwaters to dampen wave energy and reduce shoreline erosion while also providing habitat and increasing benthic secondary productivity. The project will provide for construction of up to 1.6 miles of breakwaters in Bon Secour Bay adjacent to the 615 acre Swift Tract parcel, which is part of the Weeks Bay National Estuarine Research Reserve (NERR). Over time, the breakwaters are expected to develop into reefs that support benthic secondary productivity, including, but not limited to, bivalve mollusks, annelid worms, shrimp, and crabs. | $5,000,080 | Wetlands, Coastal, and Nearshore Habitats |
| Gulf State Park Enhancement Project | III | AL | The Gulf State Park Enhancement Project will implement ecologically-sensitive improvements to Gulf State Park (GSP) including: 1) rebuilding the Gulf State Park Lodge and Conference Center; 2) building an Interpretive Center; 3) building a Research and Education Center; 4) implementing visitor enhancements including trail improvements and extensions, overlooks, interpretive kiosks and signage, rest areas, bike racks, bird watching blinds, or other visitor enhancements; and 5) implementing ecological restoration and enhancement of degraded dune habitat. | $85,505,305 | Provide and Enhance Recreational Opportunities |
| Alabama Oyster Cultch Restoration | III | AL | The Alabama Oyster Cultch project will enhance and improve the oyster populations in the estuarine waters of Alabama. The project will place approximately 30,000 to 40,000 cubic yards of suitable oyster shell cultch over approximately 319 acres of subtidal habitat in Mobile County, Alabama, in proximity to other oyster reefs currently managed by the Alabama Department of Conservation and Natural Resources (ADCNR) and within the historic footprint of oyster reefs in the area. | $3,239,485 | Oysters |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Beach Enhancement Project at Gulf Island National Seashore | III | FL | This project involves removing fragments of asphalt and road-base material (limestone aggregate and some chunks of clay) that have been scattered widely over the Fort Pickens, Santa Rosa, and Perdido Key areas of the Florida District of Gulf Islands National Seashore, managed by the National Park Service, and replanting areas, as needed, where materials are removed. These materials originated from roads damaged during several storms and hurricanes. The asphalt- and road-base-covered conditions are clearly unnatural and affect the visitor experience both aesthetically and physically in these National Seashore lands. This project will enhance the visitor experience in the cleaned-up areas. The exact method for removing the material will be left to the contractor hired if the project is approved, but will involve primarily mechanized equipment, supplemented by small crews using hand tools. | $10,836,055 | Provide and Enhance Recreational Opportunities |
| Gulf Islands National Seashore Ferry Project | III | FL | The DOI Ferry project involves the purchase of up to three ferries to be used to ferry visitors (no automobiles) between the City of Pensacola, Pensacola Beach, and the Fort Pickens area of the Gulf Islands National Seashore (Seashore) in Florida. The need for an alternative means to access the Fort Pickens area of the Seashore was made especially apparent when hurricanes and storms in 2004 and 2005 destroyed large segments of the road, eliminating vehicle access through this 8-mile-long area. A viable ferry service to this area of the Seashore will allow visitors to enjoy the Seashore not only if the road were to be destroyed again, but also by providing alternative options for visitor access. | $4,020,000 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Florida Cat Point Living Shoreline Project | III | FL | The Cat Point (Franklin County) Living Shoreline project is intended to employ living shoreline techniques that utilize natural and/or artificial breakwater material to reduce shoreline erosion and provide habitat off Eastpoint, Florida. Combining these objectives, this project will create breakwaters to reduce wave energy, increase benthic secondary productivity, and create salt marsh habitat. Activities include expanding an existing breakwater by creating up to 0.3 miles of new breakwater that will provide reef habitat and creating salt marsh habitat. | $775,605 | Wetlands, Coastal, and Nearshore Habitats |
| Florida Pensacola Bay Living Shoreline Project | III | FL | The Pensacola Bay Living Shorelines project is intended to employ living shoreline techniques that utilize natural and/or artificial breakwater material to reduce shoreline erosion and provide habitat at two sites within a portion of Pensacola Bay. This project will create reefs to reduce wave energy, increase benthic secondary productivity, and create salt marsh habitat. Activities include constructing breakwaters that will provide reef habitat and creating salt marsh habitat at both sites. In total, approximately 18.8 acres of salt marsh habitat and 4 acres of reefs will be created. | $10,828,063 | Wetlands, Coastal, and Nearshore Habitats |
| Florida Seagrass Recovery Project | III | FL | The Florida Seagrass Recovery project will address boat damage to shallow seagrass beds in the Florida panhandle by restoring scars located primarily in turtle grass (*Thalassia testudinum*) habitats located in St. Joseph Bay Aquatic Preserve in Gulf County, with additional potential sites in Alligator Harbor Aquatic Preserve in Franklin County, and St. Andrews Aquatic Preserve, in Bay County. A boater outreach and education component of the project will install nonregulatory Shallow Seagrass Area signage, update existing signage and buoys where applicable, and install educational signage and provide educational brochures about best practices for protecting seagrass habitats at popular boat ramps in St. Joseph Bay, Alligator Harbor, and St. Andrews Bay. | $2,691,867 | Wetlands, Coastal, and Nearshore Habitats |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Perdido Key State Park Beach Boardwalk Improvements | III | FL | The Perdido Key project will improve a number of existing boardwalks in Perdido Key State Park in Escambia County. The improvements include removing and replacing six existing boardwalks leading to the beach from two public access areas. | $588,500 | Provide and Enhance Recreational Opportunities |
| Big Lagoon State Park Boat Ramp Improvement | III | FL | The Big Lagoon State Park project will involve enhancing an existing boat ramp and surrounding facilities in the Big Lagoon State Park in Escambia County. These improvements will include adding an additional lane to the boat ramp, expanding boat trailer parking, improving traffic circulation at the boat ramp, and providing a new restroom facility to connect the park to the Emerald Coast Utility Authority (ECUA) regional sanitary sewer collection system. | $1,483,020 | Provide and Enhance Recreational Opportunities |
| Bob Sikes Pier Parking and Trail Restoration | III | FL | The Bob Sikes Pier project will improve access to a fishing pier in the Pensacola area in Escambia County as well as enhancing the quality of the experience for its recreational users. The improvements include renovating parking areas, enhancing bicycle/pedestrian access, and making aesthetic improvements to the surrounding area. | $1,023,990 | Provide and Enhance Recreational Opportunities |
| Florida Artificial Reefs | III | FL | The Florida Artificial Reef Creation and Restoration project involves creating artificial reefs in Escambia, Santa Rosa, Okaloosa, Walton, and Bay Counties. These improvements include emplacing artificial reefs in already permitted areas. As required by the ESA consultation with NMFS, the pyramid designs originally planned for this project were modified so that one side of the constructed pyramids will be open on the top half to allow sea turtles to move freely in and out of the structure. | $11,463,587 | Provide and Enhance Recreational Opportunities |
| The Florida Gulf Coast Marine Fisheries Hatchery/Enhancement Center | III | FL | The Florida Gulf Coast Marine Fisheries Hatchery/Enhancement Center project will involve constructing and operating a saltwater sportfish hatchery in Pensacola, Florida. This project will enhance recreational fishing opportunities. | $18,793,500 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Scallop Enhancement for Increased Recreational Fishing Opportunity in the Florida Panhandle | III | FL | The Scallop Enhancement for Increased Recreational Fishing Opportunity in the Florida Panhandle project will involve enhancing local scallop populations in targeted areas in the Florida Panhandle. The improvements include the harvesting and redistribution of naturally occurring juvenile scallops supplemented with stocking from a commercial scallop hatchery. | $2,890,250 | Provide and Enhance Recreational Opportunities |
| Shell Point Beach Nourishment | III | FL | The Shell Point Beach Nourishment project will involve the renourishment of Shell Point Beach in Wakulla County. The improvements include the placement of approximately 15,000 cubic yards of sand on the county-owned section of the beach from an approved upland borrow area to restore the width and historic slope/profile of this beach. | $882,750 | Provide and Enhance Recreational Opportunities |
| Perdido Key Dune Restoration Project | III | FL | The Perdido Key Dune Restoration project will restore appropriate dune vegetation to approximately 20 acres of degraded beach dune habitat in Perdido Key, Florida, including habitat used by the federally endangered Perdido Key beach mouse. The project will consist of planting appropriate dune vegetation (e.g., sea oats, panic grasses, cord grasses, sea purslane, and beach elder) approximately 20 to 60 feet seaward of the existing primary dune to provide a buffer to the primary dune and enhance dune habitats. In addition, gaps in existing dunes within the project area will be revegetated to provide a continuous dune structure. | $611,234 | Wetlands, Coastal, and Nearshore Habitats |
| Florida Oyster Cultch Placement Project | III | FL | The Florida Oyster Cultch project will enhance and improve the oyster populations in Pensacola Bay, Andrew Bay and Apalachicola Bay. The improvements include the placement of a total of approximately 42,000 cubic yards of suitable cultch material over 210 acres of previously constructed oyster bars for the settling of native oyster larvae and oyster colonization in three Florida Bays. | $5,370,596 | Oysters |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Strategically Provided Boat Access Along Florida's Gulf Coast | III | FL | This project will improve and enhance boat access at six sites on the Florida Gulf Coast. These improvements include boat ramps, boat docks, and other access-related infrastructure. | $3,248,340 | Provide and Enhance Recreational Opportunities |
| Walton County Boardwalks and Dune Crossovers | III | FL | This project will enhance boardwalks and crossovers and other beach access infrastructure at four sites in Walton County, including Ed Walline Beach, Gulfview Heights Beach, and Bayside Ranchettes Park. | $386,291 | Provide and Enhance Recreational Opportunities |
| Gulf County Recreation Projects | III | FL | This project will improve water access facilities at three sites in Gulf County including the Highland View Boat Ramp, Beacon Hill Veteran's Memorial Park, and the Windmark Pier. | $2,118,600 | Provide and Enhance Recreational Opportunities |
| Bald Point State Park Recreation Areas | III | FL | The Bald Point State Park Recreation Areas project will improve the existing visitor areas at Bald Point State Park in Franklin County. The project activity will involve constructing a visitor day-use area including picnic pavilions, a restroom with an aerobic treatment system and associated septic system drainfield, and an integrated system of boardwalks providing access through the area to a new floating dock, and a canoe/kayak launch area on Chaires Creek. | $470,800 | Provide and Enhance Recreational Opportunities |
| Enhancement of Franklin County Parks and Boat Ramps | III | FL | This project will improve four existing boat access project components in Franklin County including the Waterfront Park in Apalachicola, the Indian Creek Park boat launch facility, the Eastpoint Fishing Pier, and the public St. George Island Public Fishing Pier. | $1,771,385 | Provide and Enhance Recreational Opportunities |
| Apalachicola River Wildlife and Environmental Area Fishing and Wildlife Viewing Access Improvements | III | FL | This project will improve public access at Cash Bayou and Sand Beach in the Apalachicola River Wildlife and Environmental Area. | $262,989 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Navarre Beach Park Gulfside Walkover Complex | III | FL | The Navarre Beach Park Coastal Access project will improve access for the public seeking to access the beach and water of Santa Rosa Sound from the existing pavilion/parking lot areas. In addition, construction of a new canoe/kayak launch will increase access opportunities to the waters of the sound for recreational boaters. The enhancement of the recreational experience from these infrastructure improvements will also be complemented by the restoration of a roughly 1-acre parcel of degraded dune habitat in the project area. | $1,221,847 | Provide and Enhance Recreational Opportunities |
| Navarre Beach Park Coastal Access | III | FL | The Navarre Beach Park Gulfside Walkover Complex project will enhance access to the shoreline at Navarre Beach Park to enhance recreational use of the natural resources. The improvements include constructing an entrance, driveway, and parking area; constructing a restroom facility; constructing pavilions with boardwalk connections; installing a lifeguard tower; and constructing a dune walkover that will provide access to the beach. | $614,630 | Provide and Enhance Recreational Opportunities |
| Gulf Breeze Wayside Park Boat Ramp | III | FL | The Gulf Breeze Wayside Park Boat Ramp Improvements project will improve the existing boat ramp at Wayside Park in the City of Gulf Breeze, Santa Rosa County, Florida. The improvements include repairing the existing boat ramp and seawall cap, constructing a public restroom facility, and repairing and enhancing the parking area to improve access. | $309,669 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Developing Enhanced Recreational Opportunities on the Escribano Point Portion of the Yellow River Wildlife Management Area | III | FL | The Developing Enhanced Recreational Opportunities on the Escribano Point Portion of the Yellow River Wildlife Management Area project will improve public access and enjoyment of natural resources at the Escribano Point portion of the Yellow River Wildlife Management Area. The improvements include a one-time assessment and mapping activities necessary for developing the site for outdoor recreation purposes; hurricane debris removal and road repair; and constructing an entrance kiosk, information facilities, parking facilities, interpretive facilities, fishing facilities, picnicking facilities, primitive camping sites, wildlife viewing areas, and bear-proof containers for trash and food storage. | $2,576,365 | Provide and Enhance Recreational Opportunities |
| Norriego Point Restoration and Recreation Project | III | FL | The Norriego Point Restoration and Recreation project will involve stabilizing, enhancing, and re-establishing recreational activities available at Norriego Point. Improvements will include constructing erosion control structures and new park amenities, including a picnic pavilion with restrooms, showers, and drinking fountains; educational signage; a multiuse trail; bike racks; and vehicle parking along the access road adjacent to the park land. | $10,228,130 | Provide and Enhance Recreational Opportunities |
| Deer Lake State Park Development | III | FL | The Deer Lake State Park Recreation Areas project will improve the existing visitor areas at Deer Lake State Park in Walton County. The improvements will include adding a paved access road, parking, picnic shelters, restroom facilities, plantings (trees, grass, and shrubs), and necessary utilities (water, sewer, and electrical). | $588,500 | Provide and Enhance Recreational Opportunities |
| City of Parker- Oak Shore Drive Pier | III | FL | The City of Parker Oak Shore Drive Pier project will construct a fishing pier at Oak Shore Drive in the City of Parker, Bay County Florida. The work includes construction of a fishing pier. | $993,649 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Panama City Marina Fishing Pier, Boat Ramp, and Staging Docks | III | FL | The Panama City Marina Fishing Pier, Boat Ramp, and Staging Docks project will provide additional recreational fishing opportunities for the public in Panama City in Bay County. The improvements include constructing a fishing pier, replacing a poorly functioning boat ramp, and constructing new staging docks associated with the boat ramp at the Panama City Marina. | $2,000,000 | Provide and Enhance Recreational Opportunities |
| Wakulla Mashes Sands Park Improvements | III | FL | The Wakulla County Mashes Sands Park Improvements project will improve recreation areas at the Wakulla County Mashes Sands Park. The improvements include constructing observation platforms, boardwalks, and walking paths; improving the boat ramp area and picnic areas; renovating the parking area and the restroom facility; and constructing a canoe/kayak launch site. | $1,500,000 | Provide and Enhance Recreational Opportunities |
| Northwest Florida Estuarine Habitat Restoration, Protection, and Education- Fort Walton Beach | III | FL | The Northwest Florida Fort Walton Beach Educational Boardwalk project will construct new boardwalks and connect them to existing boardwalks as well as conducting several small natural resource and habitat enhancement projects in Fort Walton Beach. The improvements include constructing a new educational and interactive boardwalk, expanding an existing intertidal oyster reef, and restoring a degraded salt marsh. | $4,643,547 | Provide and Enhance Recreational Opportunities |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Texas Rookery Islands | IV | TX | The Texas Rookery Islands project will restore and protect three rookery islands in Galveston Bay and one rookery island in East Matagorda Bay using coastal engineering techniques. The primary goal of the project is to increase nesting of colonial waterbirds, including brown pelicans, laughing gulls, terns (royal and sandwich terns), and wading birds (great blue herons, roseate spoonbills, reddish egrets, great egrets, snowy egrets, tricolored herons, and black-crowned night herons). Restoration actions at each rookery island will increase the amount of available nesting habitat by increasing the size of the island, enhancing the quality of habitat through the establishment of native vegetation, and increasing the longevity of the habitat through the construction of protective features, such as breakwaters or armoring. These restoration actions will result in an increase in the numbers of nesting colonial waterbirds. Rookery islands in Galveston Bay include Dickinson Bay Island II, located within Dickinson Bay; Rollover Bay Island, located in East (Galveston) Bay; and Smith Point Island, located west of the Smith Point Peninsula. Dressing Point Island lies in East Matagorda Bay, and is part of the Big Boggy National Wildlife Refuge. | $20,603,770 | Birds |
| Restore Living Shorelines and Reefs in Mississippi Estuaries | IV | MS | The Restoring Living Shorelines and Reefs in Mississippi Estuaries project will restore intertidal and subtidal reefs and use living shoreline techniques in four bays. Projects are located in Grand Bay, Graveline Bay, Back Bay of Biloxi and vicinity, and St. Louis Bay, all located in Jackson, Harrison, and Hancock Counties. The project will provide for the construction of more than 4 miles of breakwaters, 5 acres of intertidal reef habitat and 267 acres of subtidal reef habitat across the Mississippi Gulf Coast. | $30,000,000 | Wetlands, Coastal, and Nearshore Habitats |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Bike and Pedestrian Use Enhancements at Davis Bayou, Mississippi District, Gulf Islands National Seashore | IV | MS | This project will involve implementing roadway improvements for pedestrians and bicyclists in the Davis Bayou Area of Gulf Islands National Seashore. In response to prior public scoping meetings conducted outside of the Early Restoration process, NPS developed two action alternatives for this project. The NPS Preferred Alternative will widen the existing road surface on Park Road and Robert McGhee Road to accommodate multiple-use bicycle-pedestrian lanes. The other alternative will reduce the amount of automobile traffic in the park by limiting access to VFW Road during certain times of the day. Both alternatives will include two traffic-calming medians on Park Road. | $6,996,751 | Provide and Enhance Recreational Opportunities |
| Bon Secour National Wildlife Refuge Trail Enhancement Project, Alabama | IV | AL | This project will involve repairing and improving, to an American with Disabilities Act (ADA) standard, an existing trail (Jeff Friend Trail) on Bon Secour National Wildlife Refuge (NWR). The NWR is located on the Gulf Coast, 8 miles west of the city of Gulf Shores, Alabama, in Baldwin and Mobile Counties. This aged boardwalk and gravel trail will be repaired and improved to ensure safe public access and to enhance the quality of visitor experience. An observation platform will also be constructed along the trail, and two handicapped parking spaces will be widened to better accommodate visitors. The project is not expected to significantly increase visitation, but rather to provide a safe and enhanced experience for visitors to the Refuge. | $545,110 | Provide and Enhance Recreational Opportunities |
| Osprey Restoration In Coastal Alabama | IV | AL | The restoration project will install five osprey nesting platforms along the coast in Mobile and Baldwin Counties, Alabama, in order to provide enhanced nesting opportunities for piscivorous (fish-eating) raptors. | $45,000 | Birds |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Point aux Pins Living Shoreline | IV | AL | The Point aux Pins Living Shoreline project will employ living shoreline techniques that utilize natural and/or artificial breakwater materials to stabilize shorelines along an area in Portersville Bay in the Mississippi Sound near Point aux Pins in Mobile County, Alabama. The project will be located adjacent to an existing living shoreline project previously constructed by the ADCNR utilizing other funding sources. Construction activities will include placement of breakwater materials along the shoreline to dampen wave energy and reduce shoreline erosion while also providing habitat and increasing benthic secondary productivity. The specific breakwater elevations, construction techniques, and design will be developed to maximize project success and meet regulatory requirements. Over time, the breakwaters are expected to provide habitat that supports benthic secondary productivity, including, but not limited to, bivalve mollusks, annelid worms, shrimp, crabs, and small forage fishes. | $2,300,000 | Wetlands, Coastal, and Nearshore Habitats |
| Shell Belt and Coden Belt Roads Living Shoreline | IV | AL | The Shell Belt and Coden Belt Roads Living Shoreline project will employ shoreline restoration techniques to increase benthic productivity and enhance the growth of planted native marsh vegetation. The project will be located in the Portersville Bay portion of Mississippi Sound, seaward of the southernmost portions of Shell Belt and Coden Belt Roads in Coden, Alabama. This project will be constructed to dampen wave energy and protect newly planted emergent vegetation while also providing habitat and increasing benthic secondary productivity. The specific breakwater elevations, construction techniques, and design will be developed to maximize project success and meet regulatory requirements. Over time, the breakwaters are expected to develop into reefs that support benthic secondary productivity, including, but not limited to, bivalve mollusks, annelid worms, shrimp, and crabs. Marsh vegetation is expected to become established, further enhancing both primary and secondary productivity adjacent to the breakwaters. | $8,050,000 | Wetlands, Coastal, and Nearshore Habitats |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Seagrass Recovery Project at Gulf Islands National Seashore, Florida District | IV | FL | The Seagrass Recovery project at Gulf Islands National Seashore's Florida District will restore shallow seagrass beds in the Florida panhandle. It will restore 0.02 acres of seagrass injured by propeller scars, blow holes, and human foot traffic, primarily in turtle grass (*Thalassia testudinum*) habitats on DOI-managed lands located along the south side of the Naval Live Oaks Preserve in Santa Rosa Sound, in Santa Rosa County, Florida. Project activities will include harvesting and transplanting seagrass, installing bird stakes to condition sediments to promote seagrass survival, and installing signage to educate visitors about the restoration project and the ecological importance of seagrass. | $136,700 | Wetlands, Coastal, and Nearshore Habitats |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Sea Turtle Early Restoration | IV | Gulf-wide | The Sea Turtle Early Restoration project is a multifaceted approach to restoration that collectively addresses identified needs for a variety of species and life stages of sea turtles, consistent with long-term recovery plans and plan objectives for sea turtles in the Gulf of Mexico. The Sea Turtle Early Restoration project consists of four complementary project components:<br>• The Kemp's Ridley Sea Turtle Nest Detection and Enhancement project component will provide needed additional staff, infrastructure, training, education activities, equipment, supplies, and vehicles over a 10-year period in both Texas and Mexico for Kemp's ridley sea turtle nest detection and protection.<br>• The Enhancement of the Sea Turtle Stranding and Salvage Network (STSSN) and Development of an Emergency Response Program project component will enhance the existing STSSN beyond current capacities for 10 years in Texas and across the Gulf as well as develop a formal Emergency Response Program within the Gulf of Mexico.<br>• The Gulf of Mexico Shrimp Trawl Bycatch Reduction component will enhance two existing NOAA programs, which will work to reduce the bycatch of sea turtles in shrimp trawls in the Gulf of Mexico. The two programs are the Gear Monitoring Team (GMT) and the Southeast Shrimp Trawl Fisheries Observer Program (Observer Program).<br>• The Texas Enhanced Fisheries Bycatch Enforcement component will enhance TPWD enforcement activities for fisheries that incidentally catch sea turtles while they operate primarily in Texas State waters within the Gulf of Mexico, for a 10-year period. | $45,000,000 | Sea Turtles |

| Project | Early Restoration Phase | Location | Description | Project Budget | Restoration Type |
|---|---|---|---|---|---|
| Pelagic Longline Bycatch Reduction Project | IV | Gulf-wide | The Pelagic Longline Bycatch Reduction Project will restore open-ocean (pelagic) fish that were affected by the spill. The Gulf pelagic longline (PLL) fishery primarily targets yellowfin tuna and swordfish, but incidentally catches and discards other fish, including marlin, sharks, bluefin tuna, and smaller individuals of the target species. The project aims to reduce the number of fish accidentally caught and killed in fishing gear by compensating PLL fishermen who agree to voluntarily refrain from PLL fishing in the Gulf during an annual six-month repose period that coincides with the bluefin tuna spawning season. The project will also provide participating fishermen with two alternative gear types to allow for the continued harvest of yellowfin tuna and swordfish during the repose period when PLL gear is not used. | $20,000,000 | Fish and Water Column Invertebrates |
| Florida Coastal Access Project | V | FL | The proposed Florida Coastal Access Project is intended to enhance public access to surrounding natural resources and to increase recreational opportunities through the acquisition and/or enhancement of coastal parcels in the Florida Panhandle. This proposed early restoration project will be implemented in two phases. The first phase ($34,372,184) includes four locations in the Florida Panhandle where land will be acquired and/or improved to increase recreational uses and coastal access. This project includes American Disabilities Act (ADA) compliant park amenities. It also includes funding for ten years of operation and maintenance activities to be utilized by the respective county or city through grant agreements with the Florida Department of Environmental Protection. The second phase ($11,043,389) will be completed using the same criteria for selecting parcels as was used for the first phase. | $45,415,573 | Provide and Enhance Recreational Opportunities |

**Table 5.B-2.** Early Restoration projects for each Restoration Area. (Note: Dollar amounts for each early restoration project are estimates and include contingencies. Actual payments received for each Early Restoration project will be determined after receipt of the final early restoration payment).

| Regionwide | |
|---|---|
| Sea Turtle Early Restoration (TX, DOI, & NOAA) | $25,035,000 |
| Improving Habitat Injured by Spill Response: Restoring the Night Sky (FL & DOI) | $4,221,165 |
| **Sea Turtles Total** | **$29,256,165** |
| Enhanced Management of Avian Breeding Habitat Injured by Response in the Florida Panhandle, Alabama, and Mississippi (FL & DOI) | $1,823,118 |
| **Birds Total** | **$1,823,118** |
| **Region-wide Early Restoration Total** | **$31,079,283** |

| Open Ocean[a] | |
|---|---|
| Bike and Pedestrian Use Enhancements, Davis Bayou, Mississippi District Gulf Islands National Seashore | $6,996,751 |
| Bon Secour National Wildlife Refuge Trail Enhancement, AL | $545,110 |
| Beach Enhancement Gulf Islands National Seashore | $10,836,055 |
| Gulf Islands National Seashore Ferry Project | $4,020,000 |
| **Provide and Enhance Recreational Opportunities Total** | **$22,397,916** |
| Pelagic Long Line Bycatch Reduction Project | $20,000,000 |
| **Fish and Water Column Invertebrates Total** | $20,000,000 |
| **Open Ocean Early Restoration Total** | **$42,397,916** |

[a] The Open Ocean Restoration Area includes four Early Restoration projects that were approved in Phases III and IV for $22,397,916 million for restoration on federally managed lands. These projects are reflected in Open Ocean for purposes of Early Restoration accounting. For purposes of subsequent project identification and selection associated with this Draft PDARP/PEIS, the remaining Open Ocean funding is allocated to fish and water column invertebrates, sturgeon, sea turtles, marine mammals, birds, and mesophotic and deep benthic communities.

| Restoration in Alabama | |
|---|---|
| Gulf State Park (RU) | $85,505,305 |
| **Provide and Enhance Recreational Opportunities Total** | **$85,505,305** |
| Marsh Island (Portersville Bay)Restoration Project | $11,280,000 |
| Swift Tract Living Shoreline | $5,000,080 |
| Alabama Dune Restoration Cooperative Project | $1,480,000 |
| Shell Belt & Coden Belt Roads Living Shorelines | $8,050,000 |
| Point aux Pins Living Shorelines | $2,300,000 |
| **Wetlands, Coastal, and Nearshore Habitats Total** | **$28,110,080** |
| Alabama Oyster Cultch Restoration Project | $3,239,485 |
| **Oyster Total** | **$3,239,485** |
| Improving Habitat Injured by Spill Response: Restoring the Night Sky | $100,000 |
| Osprey Restoration in Coastal Alabama | $45,000 |
| **Birds Total** | **$145,000** |
| **Restoration in Alabama Early Restoration Total** | **$116,999,870** |

| Restoration in Florida | |
|---|---|
| Bob Sikes Pier Parking and Trail Restoration | $1,023,990 |
| Perdido Key State Park Boardwalk Improvements | $588,500 |
| Shell Point Beach Nourishment | $882,750 |
| Big Lagoon State Park Boat Ramp Improvements | $1,483,020 |
| Florida Boat Ramp Enhancement and Construction Project | $5,067,255 |
| Scallop Enhancement for Increased Recreational Fishing Opportunity in the Florida Panhandle | $2,890,250 |
| Florida Artificial Reef Creation and Restoration | $11,463,587 |
| Florida Gulf Coast Marine Fisheries Hatchery/Enhancement Center | $18,793,500 |
| Strategic Boat Access Along Florida's Gulf Coast | $3,248,340 |
| Walton County Boardwalks & Dune Crossovers | $386,291 |
| Gulf County Recreation Projects | $2,118,600 |
| Bald Point State Park Recreation Areas | $470,800 |

| Restoration in Florida | |
|---|---|
| Enhancement of Franklin County Parks & Boat Ramps | $1,771,385 |
| Apalachicola River Wildlife & Environmental Area Fishing Access | $262,989 |
| Navarre Beach Park Gulfside Walkover Complex | $1,221,847 |
| Navarre Beach Park Coastal Access | $614,630 |
| Gulf Breeze Wayside Park Boat Ramp | $309,669 |
| Developing Enhanced Recreational Opportunities Escribano Point | $2,576,365 |
| Norriego Point Restoration & Recreation Project | $10,228,130 |
| Deer Lake State Park Development | $588,500 |
| City of Parker-Oak Shore Drive Pier | $993,649 |
| Panama City Marina Fishing Pier, Boat Ramp & Docks | $2,000,000 |
| Wakulla Marshes Sands Park Improvements | $1,500,000 |
| NW FL Estuarine Habitat Restoration, Protect & Education-Fort Walton Beach | $4,643,547 |
| Florida Coastal Access Project | $45,415,573 |
| **Provide and Enhance Recreational Opportunities Total** | **$120,543,167** |
| Florida Dune (Pensacola Beach) Restoration Project | $585,898 |
| Pensacola Bay Living Shoreline Project (FL & NOAA) | $10,827,863 |
| Cat Point Living Shoreline Project | $775,605 |
| Perdido Key Dune Restoration | $611,234 |
| Florida Seagrass Recovery | $2,691,867 |
| Seagrass Recovery Project at Gulf Islands National Seashore GUIS Florida District | $136,700 |
| **Wetlands, Coastal, and Nearshore Habitats Total** | **$15,629,367** |
| Enhanced Management of Avian Breeding Habitat Injured by Response in the Florida Panhandle, Alabama, and Mississippi (FL & DOI) | $2,835,000 |
| **Birds Total** | **$2,835,000** |
| FL Oyster Cultch Placement | $5,370,596 |
| **Oysters Total** | **$5,370,596** |
| **Restoration in Florida Early Restoration Total** | **$144,378,130** |

| Restoration in Louisiana | |
|---|---|
| Louisiana Marine Fisheries Enhancement, Research, and Science Center | $22,000,000 |
| **Provide and Enhance Recreational Opportunities Total** | **$22,000,000** |
| Louisiana Outer Coast Restoration<br>(LA, DOI, & NOAA) | $246,425,700 |
| Lake Hermitage Marsh Creation – NRDA Early Restoration Project | $13,200,000 |
| **Wetlands, Coastal, and Nearshore Habitats Total** | **$259,625,700** |
| Louisiana Oyster Cultch Project | $14,874,300 |
| **Oyster Total** | **$14,874,300** |
| Louisiana Outer Coast Restoration- Breton Island Component | $71,937,300 |
| **Birds Total** | **$71,937,300** |
| **Restoration in Louisiana Early Restoration Total** | **$368,437,300** |

| Restoration in Mississippi | |
|---|---|
| Pascagoula Beach Promenade | $3,800,000 |
| Popp's Ferry Causeway Park Project | $4,757,000 |
| Restoration Initiatives at the INFINITY Science Center | $10,400,000 |
| **Provide and Enhance Recreational Opportunities Total** | **$18,957,000** |
| Hancock County Marsh Living Shoreline MS & NOAA) | $50,000,000 |
| Restoring Living Shorelines and Reefs in Mississippi Estuaries | $30,000,000 |
| **Wetlands, Coastal, and Nearshore Habitats Total** | **$80,000,000** |
| Mississippi Oyster Cultch Restoration Project | $11,000,000 |
| Mississippi Artificial Reef Habitat Project | $2,600,000 |
| **Oyster Total** | **$13,600,000** |
| **Restoration in Mississippi Early Restoration Total** | **$112,557,000** |

| Restoration in Texas | |
|---|---|
| Sea Rim State Park Improvements | $210,100 |
| Galveston Island State Park Beach Redevelopment | $10,745,060 |
| Mid-Upper Texas Coast Artificial Reef-Ship Reef | $1,919,765 |
| Freeport Artificial Reef | $2,155,365 |
| Matagorda Artificial Reef | $3,552,398 |
| **Provide and Enhance Recreational Opportunities Total** | **$18,582,688** |
| | |
| Sea Turtle Early Restoration (TX, DOI, & NOAA) | $19,965,000 |
| **Sea Turtles Total** | **$19,965,000** |
| | |
| Texas Rookery Islands | $20,603,770 |
| **Birds Total** | **$20,603,770** |
| **Restoration in Texas Early Restoration Total** | **$59,151,458** |

# Appendix C. Restoration Screening Overview

## C.1 Introduction

The purpose of the screening process was to identify and compile a broad set of restoration approaches to carry forward for consideration in developing restoration project types and planning alternatives. There were three steps in the screening process: 1) identification of restoration ideas and options, 2) organization of restoration ideas into restoration approaches, and 3) initial evaluation of restoration approaches for suitability under this natural resource damage assessment (NRDA). As the Trustees were compiling the list of restoration alternatives, they performed an initial evaluation of restoration options. Those that were not appropriate under NRDA were not carried forward into feasibility screening.

The Trustees took this information and grouped similar ideas into broad restoration approaches and, within those approaches, included more specific techniques to capture methods or options for implementing a particular approach. The Trustees developed and added to the restoration approaches over time in order to continue to incorporate new information coming in from the project submittal database and from the Early Restoration process. All these approaches were evaluated during the screening process to determine which should continue to move forward into the alternatives evaluation. The Trustees evaluated the appropriateness of the restoration options from an OPA perspective consistent with OPA § 990.53 (a)(2). This evaluation focused on the feasibility and applicability of restoration options in restoring for injured natural resources, and was necessarily iterative to account for incorporating new information over time to ensure that the feasibility of all potential approaches and techniques was considered.



## C.2 Information Used to Inform Restoration Approaches

To develop the restoration approaches for consideration, the Trustees relied on a variety of information sources to identify restoration ideas and options. These information sources included public scoping comments, regional restoration planning documents (including plans developed by co-Trustees, nongovernmental organizations [NGOs], academia, and other sources), ideas submitted in a project submittal database, Trustees' agency- and resource-specific restoration expertise, and restoration categories evaluated and reviewed by the public as part of *Deepwater Horizon* (DWH) Early Restoration planning.

### C.2.1 Restoration Scoping

The Trustees conducted a 90-day restoration scoping period in 2011. The public comments received during the scoping period informed the restoration screening process. Scoping comments received from the public included identification of restoration approaches in the following categories: land acquisition and conservation; marsh restoration; hydrologic restoration (e.g., diversions and culverts); beach, barrier island, and/or dune restoration; submerged aquatic vegetation (SAV); shellfish; marine mammals and sea turtles; birds and terrestrial wildlife; offshore resources (including corals but excluding other resources already listed); invasive species removal; human use of natural resources; socioeconomics; restoration implementation approaches and issues (e.g., use of local advisory groups and local labor resources); long-term monitoring and evaluation (related to restoration); and a general category established to capture comments not related to any other category. A more detailed scoping summary

report is presented in Appendix 5.A. The restoration approaches identified during scoping served as the foundation for the restoration approaches considered in the screening process. This initial list was added to and refined over time to ensure that the most comprehensive list of restoration ideas were considered during screening.

### C.2.2 Regional Restoration Planning Documents

Significant regional planning efforts and resource-specific planning efforts have been undertaken by various entities for restoration in the Gulf of Mexico. Examples of these planning efforts include, but are not limited to, the following:

- Restoring the Gulf Coast's Ecosystem and Economy (GCERC 2013).
- Louisiana's Comprehensive Master Plan for a Sustainable Coast (CPRA 2012).
- Toward a Healthy Gulf of Mexico: A Coordinated Strategy for Sustainable Fisheries in the Gulf (NFWF 2012).
- Gulf of Mexico Regional Ecosystem Restoration Strategy (GCERTF 2011).
- Strategy for Restoring the Gulf of Mexico (a cooperative NGO report) (Brown et al. 2011).
- Gulf of Mexico Initiative (NRCS 2011).
- A Once and Future Gulf of Mexico Ecosystem: Restoration Recommendations of an Expert Working Group. Pew Environment Group (Peterson et al. 2011).
- America's Gulf Coast: A Long Term Recovery Plan after the *Deepwater Horizon* Oil Spill (Mabus 2010).
- Mississippi Coastal Improvements Program (MsCIP): Hancock, Harrison, and Jackson Counties, Mississippi. Comprehensive Plans and Integrated Programmatic Environmental Impact Statement (USACE 2009).

These plans were broadly consistent with each other in calling for restoration actions to restore and conserve habitats and resources such as wetlands, barrier islands and beaches, SAV, and oysters, as well as improving water quality and relying on science and adaptive management to help guide decision-making. Several of these plans also noted the need for restoration actions that would directly address offshore resources such as oceanic pelagic fishes and deep benthic communities. The restoration ideas and concepts from these plans were binned into the restoration approaches that were evaluated in the screening process.

### C.2.3 Project Submittal Database

The Trustees invited the public to provide restoration project ideas through Internet-accessible databases. Over 1,100 project ideas were submitted, all of which can be viewed at several web pages.[1] As of July 2, 2015, the Trustees downloaded and reviewed all projects to ensure that all public submittals were considered. Because projects are not being identified and selected as part of this Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact statement (PDARP/PEIS), the Trustees wanted to ensure that all projects would be evaluated for OPA feasibility as part of the evaluation of the restoration approaches. Therefore, the projects were reviewed to ensure that they would match one or more restoration approaches that were being evaluated.

### C.2.4 Trustee Agency Expertise

Trustee agencies bring decades of experience and deep knowledge of the Gulf ecosystem to the DWH restoration planning effort. Trustee personnel have worked on numerous NRDA restoration planning efforts, as well as restoration efforts conducted pursuant to other authorities. Supplementing this internal expertise, the Trustees have engaged with experts from the academic, private, and NGO sectors to support development of elements of the restoration plan. This Trustee expertise helped identify restoration ideas and ensure that the binning of ideas into restoration approaches was appropriate and would allow for the Trustees to incorporate new ideas within the broader approaches over time.

### C.2.5 Early Restoration

The Trustees conducted a formal public scoping process as part of the Early Restoration Phase III Programmatic Environmental Impact Statement development and held public meetings during public review periods for each of the four Early Restoration plans/environmental analyses released to date. Although these Early Restoration processes are not formally a part of scoping for this PDARP/PEIS, this continued and evolving public input is an important and continued source of public input for the Trustees as restoration options are developed. Phase III Early Restoration scoping, particularly, reemphasized the public's interest in a complete description of the injuries to resources and services caused by the spill and the corresponding public request for the Trustees to prepare a comprehensive restoration plan responsive to the full suite of injuries.



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[1] The Trustees established the following websites:

- NOAA, Gulf Spill Restoration, available at http://*www.gulfspillrestoration.noaa.gov*/.
- DOI, *Deepwater Horizon* Oil Spill Response, available at *http://www.fws.gov/home/dhoilspill/*.
- Texas Parks and Wildlife Department, *Deepwater Horizon* Oil Spill, available at *http://www.tpwd.state.tx.us/landwater/water/environconcerns/damage_assessment/deep_water_horizon.phtml/*.
- Louisiana, *Deepwater Horizon* Oil Spill Natural Resource Damage Assessment, available at *http://losco-dwh.com/*.
- Mississippi Department of Environmental Quality, Natural Resource Damage Assessment, available at *http://www.restore.ms/*.
- Alabama Department of Conservation and Natural Resources, NRDA Projects, available at *http://www.alabamacoastalrestoration.org*.
- Florida Department of Environmental Protection, *Deepwater Horizon* Oil Spill Response and Restoration, available at *www.deepwaterhorizonflorida.com*.

## C.3 Organization of Restoration Ideas into Restoration Approaches

The Trustees took the variety of information sources and grouped similar ideas into broad restoration approaches; then within those approaches, they included more specific techniques to capture methods or options for implementing a particular approach. The restoration approaches organize restoration ideas from multiple different sources in ways that are meaningful regarding how they would address the injury. The restoration approaches necessarily evolved over time—new approaches and new techniques were added to existing approaches—because the Trustees continued to evaluate new sources of information and consult with experts to refine approaches that could best restore for injured resources. Although the restoration approaches can be implemented individually to provide benefit, when used in combinations, greater benefit for the injured resources may be attained.

The Trustees evaluated all the identified restoration approaches during the screening process to determine which should continue to move forward to be incorporated into restoration project types and, ultimately, into the alternatives. The screening process was necessarily iterative to account for new information being incorporated over time to ensure that the feasibility of all potential approaches and techniques was considered.

## C.4 Initial Evaluation of Restoration Ideas and Approaches

### C.4.1 Restoration Approaches Considered and Not Carried Forward to Feasibility Screening

As part of the compilation of restoration approaches, the Trustees determined which restoration approaches were clearly outside the scope of the NRDA process. This subset of restoration approaches was not carried forward for further feasibility evaluation. Below is a summary of the restoration approaches that were not considered further:

- Restoration without a nexus (connection) to injured resources or lost services, including the following, for example:
  - Infrastructure construction or improvements with no nexus to resources likely to have been injured; for example, the construction of a recycling center or an improvement to a first-grade education facility.
  - Alternative energy projects, such as investment in alternative energy demonstration projects or the development of alternative energy sources and capacity.
  - Flood reduction projects, such as a structural flood proofing for risk reduction.
  - Land use planning projects, such as siting of hazardous waste sites and landfills to reduce runoff during flood events.
  - Community resilience projects such as improvements to a community's emergency preparedness or efforts to conduct a Gulf of Mexico seafood and environmental contaminant assessment.

- Projects promoting phytoplankton growth by pumping deep water to the surface.

- Restoration that requires the development of new legislation or regulations or is currently mandated through existing legislation or regulations, for example:
  - Reduction of pollution from point sources as required in existing permits.
  - Restoration of wetlands previously mandated through an existing consent order.
  - Funding to enhance federal enforcement of existing legislation.
  - Alteration to existing water consumption legislation.
- Restoration to support response activities, such as:
  - Bioremediation of oil.
  - Building protective berms.
  - Increasing spill response capacity, technology, and readiness.
  - Filtering deep-sea water to remove oil.
  - Funding early warning systems that could detect possible releases of petroleum hydrocarbons in the marine environment.
- Restoration related to the recovery of private or commercial losses.



### C.4.2 Restoration Approaches Considered and Not Carried Forward into Alternatives

The remaining restoration approaches were carried forward for further feasibility analysis to determine those approaches that should be included within the restoration project types that make up Alternatives A and B. In this step in the screening process, the Trustees evaluated the feasibility and applicability of restoration options in restoring for injured natural resources. The following restoration approaches are examples of the types of approaches that were not carried forward into restoration project types and alternatives because of feasibility and applicability considerations:

- **Reduce Mississippi River Basin nutrient inputs and hypoxia within the Gulf of Mexico.** From 1985 to 2013, the area of hypoxia along the northern Gulf of Mexico has averaged approximately 14,000 square kilometers and is correlated with Mississippi River nitrogen load (Forrest et al. 2011; Greene et al. 2009; Scavia & Donnelly 2007; Turner et al. 2006). Nutrient loadings from the Mississippi River Basin could be reduced to reduce the spatial extent and severity of the hypoxia to benefit a range of fish and invertebrates along the northern Gulf of Mexico. The Mississippi River Basin drains over 41 percent of the contiguous U.S. land area. Therefore, nutrient reductions at this scale would require a comprehensive nutrient reduction strategy that incorporates restoration with state and federal policies to address a range of nutrient sources (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force 2008). The Trustees evaluated the potential nutrient reduction that could be achieved through the

implementation of agricultural conservation practices in the Mississippi River Basin.[2] Results indicated that significant nutrient reductions could be achieved; however, within the context of the DWH oil spill, the scale of the work (e.g., comprehensive nutrient strategy factoring in state and federal policies) that would be required within the Mississippi River Basin for this approach to benefit injured resources was not feasible. Since restoration approaches that improve water quality are an important part of a portfolio of restoration, the Trustees did include water quality restoration approaches that will target water quality issues in coastal watersheds where the sources of pollution are concentrated over a smaller area and there is greater potential for providing reductions in pollution to benefit injured habitats or resources without the need to incorporate state and federal policies.

- **Remove and/or remediate leaking derelict pipelines and/or wellheads and shell mounds.** Opportunity for implementing this approach does exist. However, the understanding of the scope of the problem is limited, both in spatial extent and the potential for contamination from shell mounds and derelict pipelines and/or wellheads. In addition, the Trustees are concerned that removing shell mounds or derelict oil and gas infrastructure would resuspend contaminated sediments, which could present liability issues for the project implementers. Therefore, the technical uncertainty in this restoration approach creates questions about the nexus and the net potential benefits.
- **Purchase latent permits in shrimp, longline, red snapper, and other fisheries to prevent future expansions of effort.** This approach would only be feasible if implemented for a limited access fishery in which future expansion (i.e., more permits) were not going to be allowed. Since these latent permits are not currently being used to harvest fish, the Trustees are uncertain of the potential benefits of this approach.
- **Pay charter boat captains not to fish (by buying positions on their boats).** The challenge with this approach is that it is difficult to ensure that there is no reallocation of effort. In addition, focusing on one sector of a fishery could be less feasible than including both recreational and commercial sectors. Thus, the Trustees are uncertain of the potential benefits from this approach.
- **Rent permits to reduce catch of bluefin tuna in U.S. Atlantic waters.** During the screening evaluation, Amendment 7 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan was finalized (NMFS 2014), which precludes using this approach in the Atlantic purse seine fishery (NMFS 2014). Under Amendment 7, any unused quota would be



[2] One recent study published by the National Academy of Sciences indicates that if agricultural conservation investments could be targeted to the most cost-effective locations, a combined federal, state, local, and private investment of $2.7 billion per year could reduce the size of the hypoxic zone in the northern Gulf of Mexico by 45 percent (Rabotyagov et al. 2014). A number of qualifications apply to this estimate. Notably, it only considers conservation practices installed on agricultural lands in production, specifically, overland flow practices, edge-of-field practices, and improvements in irrigation efficiency. It does not consider innovative approaches to preventing nutrient runoff that have the potential to further reduce costs, such as agricultural drainage water management and bioreactors, saturated buffers, cover crops, use of easement for wetlands restoration/creation, streambank conservation, and/or advances in technologies such as urease inhibitors or slow-release fertilizers.

reallocated to other categories on an annual basis. In addition, because the Atlantic purse seine fishery does not fish every year, the Trustees are uncertain of the potential benefits of this approach even if it were not precluded by Amendment 7.

- **Reduce mercury concentrations in the Gulf of Mexico.** Due to the complex nature of the mercury cycle, the Trustees are uncertain whether mercury reduction actions will directly affect methylmercury production and bioaccumulation by coastal and marine fish in the Gulf of Mexico system. The major source of methylmercury to the Gulf food web is not clear (Harris et al. 2012; Rice et al. 2009). Many other factors also affect mercury methylation, and the extent of methylation is not solely based on mercury loadings to the system (Fitzgerald et al. 2007). This uncertainty raises questions about the potential benefits of this restoration approach.

- **Purchase water rights to restore freshwater flows.** This approach would involve purchasing water rights to ensure that a proportion of water rights are left in rivers for freshwater flow into estuaries. Opportunity for implementing this approach does exist. However, there are several issues associated with this approach. Evaluation of water consumption rights is permitted and authorized by the states, which could cause interagency conflict where waters cross state boundaries. Additionally, water rights in priority basins may already be fully allocated in existing water rights, limiting the availability of water-rights purchasing as an approach. Additionally, understanding is limited about the site-specific quantities of fresh water needed to restore a habitat and what deviation from normal or historical freshwater flows is acceptable to various stakeholders. As such, the technical uncertainty in this restoration approach creates questions about the nexus and the net potential benefits. This finding does not preclude other efforts to restore freshwater flows, such as dam or sill removal and maintenance or replacement of underperforming water control structures.



### C.4.3 Restoration Approaches Carried Forward into Alternatives

The Trustees carried forward the remaining restoration approaches for consideration in the development of restoration project types and alternatives. These restoration approaches are further detailed in Appendix 5.D. After the screening process, the Trustees continued to refine the approaches to add additional detail on implementation to achieve maximum benefits for injured resources. For natural resources where the Trustees have a lot of experience in restoration, such as marsh, the approaches are more straightforward and many of them were included in Early Restoration because they were well understood. For other natural resources, where the Trustees have less restoration experience, such as deep water corals or directly restoring fish, the Trustees developed the approaches based on restoration that has been implemented in shallower water or based on tools that have been used in fisheries management. However, it is important to include this diverse range of restoration approaches so that the Trustees can develop alternatives that can be used in combination to maximize benefits to injured resources and the Gulf ecosystem.

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# Appendix D. Restoration Approaches and OPA Evaluation

## Contents

In this appendix, the Trustees describe 39 individual restoration approaches that could be used to implement the restoration plan. The restoration approaches were developed with public and expert input. Some approaches can apply to more than one of the Restoration Types, and each approach may be used either individually or in combination to develop larger, more complex restoration projects. The restoration approaches are generally grouped together for purposes of this appendix into habitat, water quality, fish, sea turtle, marine mammal, bird, mesophotic and deep benthic, and recreational use approaches. This generic grouping reduces the redundancy of repeating approaches that are applicable to multiple Restoration Types. The Restoration Types and the approaches included within each are described in Section 5.5, Alternative A: Comprehensive Integrated Ecosystem Restoration (Preferred Alternative). The Restoration Type icons are also included with each approach to allow mapping of the restoration approaches to the Restoration Types (Figure 5.D-1).

Because this is a programmatic document, projects are not being identified and selected; restoration project development and selection will occur in subsequent, tiered restoration plans (Chapter 5, Section 5.10.4). Rather, this appendix provides a more detailed discussion of options for restoration approaches, including potential techniques, where applicable. This discussion includes important implementation considerations, as well as an evaluation of the consistency of each approach with the Oil Pollution Act (OPA) evaluation criteria. As restoration implementation and science in the northern Gulf of Mexico evolves, the Trustees may also update this appendix to ensure the list of restoration approaches reflects the best available to the Trustees throughout the entire lifespan of the PDARP/PEIS implementation. Significant changes to the appendix would be made available to the public for review and comment.

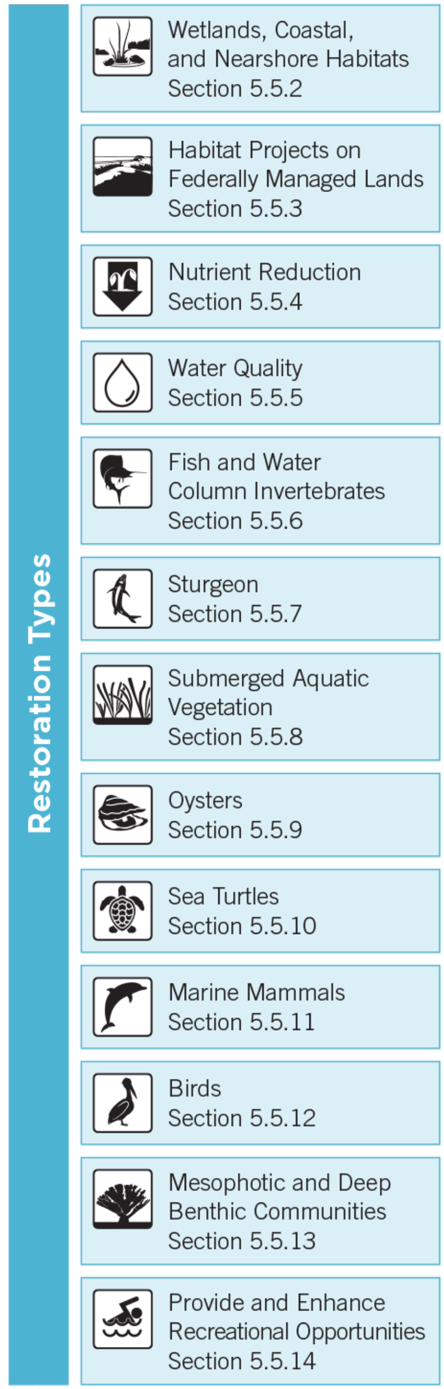
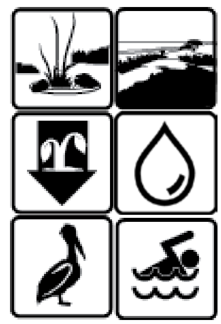



**Figure 5.D-1**. Restoration Types. Each restoration approach described in this appendix is associated with one or more Restoration Types. The icons are used throughout the appendix to indicate which Restoration Types may be used to implement the restoration approach.

## D.1 Habitat Restoration Approaches

1. Create, restore, and enhance coastal wetlands
2. Restore and preserve Mississippi-Atchafalaya river processes
3. Restore oyster reef habitat
4. Create, restore, and enhance barrier and coastal islands and headlands
5. Restore and enhance dunes and beaches
6. Restore and enhance submerged aquatic vegetation
7. Protect and conserve marine, coastal, estuarine, and riparian habitats

### D.1.1 Create, Restore, and Enhance Coastal Wetlands



This restoration approach focuses on the creation, restoration, and enhancement of coastal wetlands, including marshes, mangroves, and pine savannahs, that provide benefits to injured resources. This approach includes replacing injured wetland resources, providing habitat for injured faunal resources and/or their prey, and improving water quality to benefit injured resources in coastal watersheds. Coastal wetlands are the backbone of the northern Gulf of Mexico coastal and nearshore ecosystem, providing a wide range of important ecological functions and services. They also serve as important habitat for fish and wildlife species, improve water quality, stabilize shorelines, reduce storm surge, and capture and store carbon in organic soils (Armentano & Menges 1986; Costanza et al. 2008; Moody & Aronson 2007; NMFS & NOAA 2014; Woodward & Wui 2001; Zimmerman et al. 2000). Multiple restoration techniques can be used, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Create or enhance coastal wetlands through placement of dredged material.** This technique would restore coastal wetlands by placing dredged material into shallow water habitats or degraded wetlands to raise elevations to levels appropriate to create the hydrologic conditions needed to sustain native marsh vegetation and/or black mangroves (see Figure 5.D-2 through Figure 5.D-4). Dredged material can be deposited in shallow open water and manipulated to appropriate marsh elevations, with appropriate hydrologic connectivity. It can also be discharged into existing, degraded wetlands by placing material in thin layers to enhance growth of existing wetland vegetation and improved coastal wetland habitat (Ford et al. 1999; La Peyre et al. 2009; Mendelssohn & Kuhn 2003; Slocum et al. 2005; Stagg & Mendelssohn 2010; C. Tong et al. 2013; Turner & Streever 2002). Sediment placement can also be used to stabilize eroding natural wetland shorelines, and dewatered sediment can be used to construct erosion barriers that help restore degraded wetlands. Sediment could either be derived from beneficial use of dredged materials from existing dredge activities (USACE 1987) or from dedicated dredging of nearby areas for a specific restoration project. Sediment could be transported short distances from borrow areas near coastal restoration sites or pumped considerable distances into interior marshes via a dedicated pipeline (see Figure 5.D-2). Appropriate borrow sources will be

evaluated on a project-by-project basis. Creeks and channels would be excavated in appropriate locations to allow for the ebb and flow of tidal waters, thereby providing for ingress and egress of estuarine species and maximizing ecological function (Minello & Rozas 2002; Minello et al. 1994; Rozas & Zimmerman 2000).

***Source:*** *CWPPRA Task Force.*

**Figure 5.D-2.** Dredged sediment pumped via pipeline to the CWPPRA Bayou Dupont restoration project, Mississippi River Sediment Delivery System—Bayou Dupont (BA-39), Jefferson and Plaquemines Parishes, Louisiana.

***Source:*** *CWPPRA Task Force.*

**Figure 5.D-3.** Aerial view of the CWPPRA Lake Hermitage Marsh Creation project (BA-42), Plaquemines Parish, Louisiana.


***Source:*** *NOAA Restoration Center.*

**Figure 5.D-4.** Helen Wood Park Wetland Restoration, Mobile Bay, Alabama, NOAA Restoration Center Community-based Restoration Program.

- **Backfill canals.** Many Gulf coastal wetlands, particularly those in Louisiana, have experienced extensive oil and gas exploration and production and the associated construction of networks of access canals (see Figure 5.D-5). When these canals are abandoned, they become conduits for saltwater transport into previously freshwater or brackish-water marshes, leading to the degradation of healthy marshes (Ko & Day 2004). Dead-end canals can also result in degraded water quality due to a lack of tidal flushing. This technique would restore vegetated habitat and appropriate tidal flux to coastal wetlands degraded by the construction of canals and associated spoil banks. It would involve regrading spoil banks to appropriate emergent marsh elevations and partially or completely filling the canal footprint. It could include backfilling drainage canals, access canals built for oil and gas exploration, and canals constructed for other purposes (e.g., recreational and residential use). In most cases, canals would be filled using sediment derived from the adjacent spoil bank (Baustian & Turner 2006; Turner et al. 1994). However, if the sediment in the spoil bank is insufficient to completely fill the canal to the desired intertidal elevation, additional dredged sediment could be used (Baustian et al. 2009). Alternatively, if limited sediment is available, portions of the canal could be strategically filled (plugged) to halt saltwater intrusion.

*Source: National Agriculture Imagery Program (NAIP), U.S. Department of Agriculture Farm Service Agency.*

**Figure 5.D-5.** Aerial view of canal network in coastal marshes in Plaquemines Parish, Louisiana.

- **Restore hydrologic connections to enhance coastal habitats.** This technique would restore or maintain salinity gradients across the estuarine landscape by re-establishing natural hydrologic flow regimes to enhance existing coastal habitats, including marshes, mangroves, and pine savannahs. Restoration of hydrologic connections in coastal systems allows for the recolonization of vegetation native to the natural salinity regime, removes barriers to the flow of organisms and materials between habitats, and facilitates the removal of excess nutrients and other pollutants by wetlands (Fell et al. 2000; Hinkle & Mitsch 2005; Peck et al. 1994; Roman et al. 2002; Swamy et al. 2002). This technique could include the restoration of natural tidal exchange and/or the restoration of the natural flow of fresh water across the landscape (see Figure 5.D-6). Implementation of this technique could encompass a wide range of actions, including removing or breaching spoil banks, dikes, artificial levees, and other barriers to water flow; creating tidal creeks; grading sediment to adjust elevation; modifying existing water control structures; and constructing, enlarging, and/or repairing malfunctioning conveyances (e.g., culverts or bridges). This technique could also include the creation of small gaps or crevasses in delta distributary channel levees to transport river sediment and fresh water into interdistributary basins and initiate subdelta formation (Boyer et al. 1997; Cahoon et al. 2011; Turner & Streever 2002) (see Figure 5.D-7). It does not, however, include implementing controlled river diversions, which are included under the restoration approach “Restore and preserve Mississippi-Atchafalaya river processes” (see Section D.1.2).

***Source:*** *CWPPRA Task Force.*

**Figure 5.D-6.** CWPPRA Freshwater Reintroduction South of Highway 82 project (ME-16), Cameron Parish, Louisiana.

***Source:*** *CWPPRA Task Force.*

**Figure 5.D-7.** Crevasse in deltaic distributary channel levee, CWPRRA Delta Management at Fort St. Phillip (BS-11), Plaquemines Parish, Louisiana.

- **Construct breakwaters.** This technique would protect coastal wetland habitat through the construction of offshore and/or nearshore breakwaters parallel to the shoreline for the purpose of reducing shoreline erosion. Offshore breakwaters are typically freestanding structures positioned adjacent to the shoreline beyond low-tide contours. They reduce wave energies and currents acting on shorelines, induce sediment deposition, and provide shelter for wetland plants and shoreline habitats (Chasten et al. 1993; Hardaway Jr. et al. 2002; Williams & Wang 2003). These breakwaters counter the extensive shoreline erosion and loss experienced in coastal areas along the Gulf of Mexico. Nearshore breakwaters are typically freestanding

structures positioned along the foreshore at intertidal contours to buffer the impact of wave energy (see Figure 5.D-8). For example, the seaward edge of a wetland shoreline can sometimes be protected from scouring by waves and currents using a riprap revetment at the toe of the wetland.

***Source:*** *CWPPRA Task Force.*

**Figure 5.D-8.** CWPPRA Gulf Intercoastal Waterway—Perry Ridge West Bank Stabilization project (CS-30), Calcasieu Parish, Louisiana.

#### D.1.1.1 Implementation Considerations

Regardless of the specific restoration technique employed, coastal wetland creation, restoration, and enhancement projects should be designed to provide similar ecological functions and services as natural wetlands. Projects should aim to establish or re-establish the tidal hydrology, salinity gradients, native salt and brackish vegetation, and marsh-dependent animal communities that are characteristic of natural, undisturbed coastal wetlands. This restoration approach can be designed to maximize specific services such as habitat for fish or birds and shoreline stability. Desired outcomes could drive specific design considerations.

For example, coastal wetland creation, restoration, and enhancement projects intended to benefit juvenile shrimp, crabs, and some fish species should be undertaken in a manner that incorporates significant open water and marsh edge into the marsh complex. A number of studies have established the value of marsh edge for these species in different estuaries of the northern Gulf of Mexico (Baltz et al. 1993; Minello et al. 2008; Neahr et al. 2010; Rozas & Minello 2015; Zimmerman et al. 2000). Another study has examined the optimal amount of edge for shrimp and crabs (Minello & Rozas 2002). In areas with high rates of subsidence, created marshes will disintegrate over time (Environmental Work Group 2006). Although this disintegration would increase the amount of edge habitat, thereby increasing suitability for fish, this progression toward the eventual loss of emergent wetlands should be considered in the initial design, so that the project remains sustainable and that benefits are maximized over the project's entire life. In areas with more stable geology, some historical marsh creation efforts using sediment placement have resulted in solid marsh with inadequate tidal hydrologic connectivity to open

water (i.e., tidal channels and ponded areas), and, therefore, little value to fishery species that must access the marsh surface along marsh edges (Minello et al. 1994; Shafer & Streever 2000). Elevations should also vary across the created marsh to provide a range of habitats for a variety of wetland-dependent species, and include some areas above high-tide level that can serve as suitable marsh and ground-bird nesting habitat.

In many cases, native salt/brackish vegetation will naturally recolonize restored coastal wetlands once the appropriate intertidal elevation has been achieved (Edwards & Mills 2005; Edwards & Proffitt 2003). However, in some instances, more rapid establishment of desired vegetation cover can be achieved through seeding, propagating, and/or transplanting marsh plants from nearby existing marshes (Allen et al. 1986; Environmental Work Group 2006). Such vegetative planting could be implemented using most of the coastal wetland restoration techniques listed above. Where mangrove restoration is desired, salt marsh restoration techniques could be implemented at locations near enough to an established mangrove population to allow for natural colonization under the right physical conditions (Alleman & Hester 2010, 2011). Alternatively, propagules from established mangroves could be transported to restoration sites for manual dispersal. These less-intensive methods should be adopted over the planting of mangrove seedlings, because seedling success has been limited along the northern Gulf Coast (Alleman & Hester 2011). This region is at the northern end of the black mangrove geographic range and, generally, seedlings successfully establish only during those years when a hard freeze does not occur (Guo et al. 2013; Osland et al. 2013; Pickens & Hester 2010; Saintilan et al. 2014).

Proper siting is a critical consideration when planning the construction of breakwaters and other hard structures. If improperly sited, breakwaters can alter wave and current energies in ways that can cause scouring of benthic habitats and erosion of adjacent shorelines (Bulleri & Chapman 2010). Proper planning should integrate local and regional sediment management plans and programs and include a complete understanding of the sediments and physical processes within the area (Edwards & Namikas 2011; Penland et al. 2005; Roland & Douglass 2005; Stauble & Tabar 2003). Care should also be taken to minimize impacts on biological resources and their habitats. In all cases, breakwaters would be designed to allow for the ingress and egress of marine organisms (e.g., by incorporating gaps or dips into the design) to avoid impairing the nursery function of shoreline habitats.



#### D.1.1.2 OPA Appropriateness Evaluation

The restoration approach “Create, restore, and enhance coastal wetlands” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by supporting the development and maintenance of vegetated coastal wetland habitats, associated species and communities (e.g., resident marsh fauna, estuarine-dependent water column resources, and birds), and the full suite of ecological functions they provide. Additionally, this approach can help compensate for the interim services losses to coastal wetland habitats, including salt/brackish marshes and mangroves.

This approach has been successfully implemented in the region in the past and has a high likelihood of success in restoring ecological functions in areas of the northern Gulf of Mexico with relatively stable substrates. Collateral injury to other natural resources is expected to be minimal, and best management practices (BMPs) would be used during construction for all techniques to avoid or minimize any collateral injury. The Trustees do not anticipate that the approach will negatively affect public health or

safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by developing and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.1.2 Restore and Preserve Mississippi-Atchafalaya River Processes

This restoration approach seeks to provide large-scale benefits for the long-term sustainability of deltaic wetlands in coastal Louisiana by managing river diversions from the Mississippi-Atchafalaya River systems. Flood levees and river channelization have cut deltaic wetlands off from the Mississippi and Atchafalaya Rivers and the sediments, fresh water, and nutrients that originally created them (Day et al. 2007; Day et al. 2000). Large-scale river management operations aim to re-introduce renewable, sustainable sources of sediment that are necessary for the long-term replenishment and sustainability of the deltaic wetlands in this region (Day et al. 2007; Kemp et al. 2014; Kim et al. 2009; Paola et al. 2011; Wang et al. 2014). River diversions represent a long-term strategy to restore injured wetlands and resources by reducing widespread loss of existing wetlands. This large-scale restoration approach would increase the long-term resilience and sustainability of other wetland restoration implemented in the region (Day et al. 2007; Kemp et al. 2014).

Under this restoration approach, controlled river diversions[1] may be implemented within the Mississippi-Atchafalaya River system at a variety of different scales to create, restore, and enhance coastal wetlands in the Mississippi River delta region. Currently, no controlled, large-scale sediment diversions have been constructed on the Mississippi River. However, Louisiana's Comprehensive Master Plan for a Sustainable Coast has identified controlled, large-scale sediment diversion projects as an important restoration action for the region (CPRA 2012). Under this approach, implemented river diversions could vary in size from less than 10,000 cubic feet per second to greater than 50,000 cubic feet per second, depending on the intended goals of the project. Expectations of the outcomes of this type of project would be re-evaluated throughout the process of implementation due to the potential for changes in sediment load, sea level rise, and climate change. At all scales, river diversions would be designed to convey both fresh water and sediment to deltaic wetlands and the shallow nearshore environment (Teal et al. 2012; Wang et al. 2014).



Small-scale diversions could be used to achieve site-specific benefits, rather than the regional benefits associated with larger-scale diversions. They would be designed to restore the natural deposits and landforms associated with deltaic distributary channels, rather than restoring larger-scale riverine processes (Boyer et al. 1997; Cahoon et al. 2011; Roberts et al. 1997). However, multiple small-scale diversions operating together and/or with medium-scale diversions can have regional impacts similar to those of large-scale diversions. Large-scale river diversions can alter sedimentation patterns enough to initiate new deltaic formations if sited and engineered correctly, especially when designed with sediment retention enhancement devices or access channels to facilitate sediment trapping prior to flood-0stage opening (Allison & Meselhe 2010).

[1] Small uncontrolled river diversions (e.g., crevasses) are included in the "Restore hydrologic connections to enhance coastal habitats" technique under the "Create, restore, and enhance coastal wetlands" approach (see Section D.1.1 above).

### D.1.2.1 Implementation Considerations

Under this approach, any river diversions would be controlled diversions.[2] Controlled diversions are gated structures that allow river water and associated nutrients and sediments to be released into adjacent deltaic wetland areas at prescribed times and rates. These controls on water movement maximize desired ecological benefits and reduce undesired impacts such as shoaling in shipping and anchorage areas, flooding in low-lying surrounding land, and storm surge (Allison & Meselhe 2010). This approach could also employ siphon structures, which use pipes that can be opened to route water from the river. The capacity of the structure is constrained by the river's water-surface elevation (which drives hydraulic head) and its variability over a typical year (Allison & Meselhe 2010). During periods of low flow, controlled diversion structures can be operated to reduce the quantity of water diverted to retain minimum water levels in the river and allow continued navigation (Lane et al. 2006; Snedden et al. 2007).

Studies have indicated that diversions, when correctly sited, have built land in subsiding areas along the Mississippi-Atchafalaya delta (Andrus 2007; Day et al. 2012; Kolker et al. 2012; Lane et al. 2006). In addition to creating and maintaining freshwater marsh in the immediate receiving area, river diversions would provide indirect benefits to coastal wetlands across a larger area of the deltaic plain through the re-introduction of large quantities of fine sediment to the shallow coastal environment (Allison et al. 2000; Falcini et al. 2012). A substantial portion of the sediment load of the Mississippi River is currently discharged from the river's mouth, where it is largely transported off the edge of the continental shelf and lost to the coastal system (Allison et al. 2012). By contrast, fine sediments that are discharged into the nearshore environment are available to be reworked onshore during storm events (e.g., winter cold front passages and tropical storms), where they can contribute to vertical accretion in coastal wetlands across a broad geographic area (Cahoon et al. 1995; Guntenspergen et al. 1995; Reed 1989; Tweel & Turner 2012). Research in Atchafalaya Bay and the Chenier Plain regions of coastal Louisiana indicates that sediment derived from the Atchafalaya River and the uncontrolled Wax Lake Outlet diversion contributes to the creation and maintenance of coastal wetlands in those regions and increases their resilience to storm impacts (Carle & Sasser 2015; Carle et al. 2015; Draut et al. 2005; Huh et al. 2001; Roberts et al. 2015).

The controlled river diversions considered under this restoration approach would differ in several critical ways from the salinity control structures that are currently in operation along the lower Mississippi River (e.g., Caernarvon and Davis Pond). These existing structures were designed primarily to convey fresh water into coastal wetlands adjacent to the river to reverse the impacts of saltwater intrusion and re-establish salinity gradients within the upper estuaries. By contrast, the river diversion projects considered under this restoration approach would be specifically designed to maximize the delivery of riverine sediment into existing marshes and shallow open water areas to build new marshes and increase the elevation of existing, degraded marshes. Unlike the existing salinity control structures, these river diversions would be constructed at locations along the river with a high potential for natural sediment accumulation. The diversion structures would also be built so that they are deep enough to capture the high concentration of sediment and larger grain sizes (i.e., sand and silt) that are



[2] Small uncontrolled river diversions (e.g., crevasses) are included in the "Restore hydrologic connections to enhance coastal habitats" technique under the "Create, Restore, and Enhance Coastal Wetlands" approach (see Section D.1.1 above)

transported in the lower portion of the water column. Pulses of mineral sediment delivered by river diversions during the river's annual flood stage would provide a stable substrate for the development of healthy new marshes and enhance the stability of existing marshes. The increased sediment delivery from the river diversions included in this restoration approach are expected to provide greater benefits to the receiving wetlands than the existing salinity control structures, and will help minimize concerns related to potential negative impacts associated with the existing structures.

Because no examples currently exist in the environment for the type of diversions considered in this restoration plan, there is uncertainty concerning their exact impacts, and additional studies will be needed to address these issues. However, the existing salinity control structures do provide some insights into potential impacts that will need to be evaluated. One concern about the diversion of Mississippi River water into degraded coastal wetlands in the deltaic plain is that the river's nutrient loads have increased dramatically over historic levels (Mitsch et al. 2001; Turner & Rabalais 1991). Some studies have suggested that increased nutrient loading to coastal wetlands could affect marsh soil shear strength and belowground biomass, which could reduce the resilience of the marsh to disturbances such as hurricanes (Deegan et al. 2012; Kearney et al. 2011; Turner 2011). However, studies that have looked specifically at the effects of the existing salinity control structures on soil stability, belowground biomass, and the accumulation of soil organic matter have shown mixed results (Day et al. 2013; DeLaune et al. 2003; DeLaune et al. 2013; Howes et al. 2010; Swarzenski et al. 2008). Research also indicates that wetlands in the deltaic plain are very efficient at removing nutrients, which should help limit any negative impacts associated with the river's nutrient loads (Day et al. 2003; DeLaune et al. 2005; VanZomeren et al. 2012). Further, the marshes surrounding the mouth of the Atchafalaya River and the uncontrolled Wax Lake Outlet diversion in Atchafalaya Bay show considerable resilience to storm impacts (Carle & Sasser 2015; Rosen & Xu 2013), indicating that high nutrient loads are not negatively affecting the stability of these marshes that receive large amounts of both sediment and fresh water from the Mississippi River. This suggests that negative impacts to soil stability would not be expected for diversions that are specifically designed to deliver high sediment loads.

River diversions will result in changes to salinity patterns and gradients, at least during the operation of the diversion and for some period of time after the diversion is closed. These changes could affect the distribution and reproductive patterns of some estuarine-dependent fish species and affect the sustainability of local oyster populations (Soniat et al. 2013). These changes would affect available habitat, including Essential Fish Habitat (de Mutsert & Cowan Jr. 2012; Rose et al. 2014; Rozas & Minello 2011; Rozas et al. 2005). Changes in salinity patterns would also likely alter marine mammal habitat and/or negatively affect marine mammal health, especially for resident stocks of bay, sound, and estuary (BSE) bottlenose dolphins in the receiving basins, who would not be expected to leave their home areas (LaBrecque et al. 2015; Miller 2003; Miller & Baltz 2009; Waring et al. 2015). The impacts associated with river diversions would depend on their size, location, design, and operation. To aid in better understanding the effects of sediment diversions, the state of Louisiana, through CPRA, is conducting a robust set of studies and analyses on proposed sediment diversion projects. Using the best tools and information available, the studies are analyzing the effects of proposed river diversions within and outside of the Mississippi River. The studies and analyses will evaluate potential changes in wetland area, habitat, fisheries, and communities.

River diversion projects would be overseen by the U.S Army Corps of Engineers (USACE) and the Mississippi River Commission, a presidentially appointed group that oversees the management of the river. These entities have jurisdictional oversight of the river and develop policies that could affect implementation of river diversion projects, particularly projects that affect navigation (e.g., cause shoaling). In addition, river diversion project design and implementation would likely be informed by the findings of the Mississippi River Hydrodynamic and Delta Management restoration study for the Louisiana Coastal Area (LCA), an ongoing study initiated by USACE and the state of Louisiana. This study identifies and evaluates a combination of large-scale management and restoration features to address the long-term sustainability of the Mississippi-Atchafalaya delta region. It is intended to help guide the multiple uses of the river system; determine the magnitude of impacts; help identify project scale, scope, and location; and evaluate diversion alternatives. Hydrodynamic models and other forecasting tools will be used to refine projections of how water and sediment resources could be best used to restore and sustain deltaic growth.

One important variable that influences the rebuilding of deltaic wetlands is the sediment load of the Mississippi-Atchafalaya distributary system, which has decreased by approximately 50 percent from its historical load as a result of lock and dam construction in the Mississippi River watershed and improved agricultural practices (Allison et al. 2012; Blum & Roberts 2009; Keown et al. 1986; Kesel 1988, 2003; Meade & Moody 2010). The length of time before new land is created varies with the size and location of riverine diversions and whether a diversion is designed to maximize delivery of suspended sediments or riverine bedload into area wetlands (Allison & Meselhe 2010; Snedden et al. 2007). Many projects associated with the management of river waters and sediment have taken years to decades to create new wetlands (Andrus 2007; Kolker et al. 2012; Roberts et al. 2003; Roberts et al. 1997). The time required for the formation of new land is in part a function of the size, depth, and sediment trapping efficiency of the receiving basin; operation of the diversion; and the grain-size distribution and total sediment load of the effluent (Allison et al. 2012; Allison & Meselhe 2010).

Planned river diversions into wetlands could have both beneficial and potential adverse impacts on the ecosystem and on human communities in the area that have since adapted over the past 100 years to river levees and the current environmental dynamics in the area. This restoration approach will be carefully evaluated at both project-level and distributary-system-level scales for environmental and economic impacts that need to be avoided, minimized, and/or mitigated, as appropriate. Because river diversions represent an inherently large-scale restoration approach, the projects with the greatest potential for beneficial effects also need to be evaluated both individually and in combination with other projects to understand their cumulative impacts, both within the project footprint and through the distributary system. The impacts associated with any large-scale diversions, in particular, will need to be addressed through siting and operations plans, mitigation and adaptive management measures, and a long-term monitoring and evaluation plan (Allison & Meselhe 2010; Teal et al. 2012).



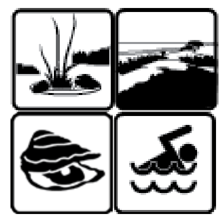
#### D.1.2.2 OPA Appropriateness Evaluation

The restoration approach “Restore and preserve Mississippi-Atchafalaya River processes” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline, as well as compensate for interim losses, by re-introducing riverine fresh water, sediments, and nutrients to deltaic wetlands, which will help stabilize substrates and

reduce coastal wetland loss rates. Stabilizing and rebuilding deltaic wetlands and the nearshore environment will help maintain the Louisiana coastal landscape and its ability to overcome other environmental stressors, such as relative sea level rise and tropical storm impacts.

This approach has been implemented in the past at small to medium scales, and has effectively built new wetlands and increased elevation and plant community productivity in existing wetlands. Furthermore, large-scale, uncontrolled river diversions at the mouths of the Atchafalaya River and Wax Lake Outlet have resulted in substantial increases in deltaic wetlands, providing support for potential large-scale river diversions. Collateral injury to other natural resources can be minimized through careful selection and siting, development of operations plans that minimize adverse impacts, application of mitigation measures as needed, and long-term, basin-scale monitoring and evaluation to provide continual support for adaptive management of river diversion operation. The Trustees do not anticipate that the approach will negatively affect public health or safety. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.1.3 Restore Oyster Reef Habitat



This restoration approach focuses on the restoration, creation, and enhancement of oyster reef habitat, resilient oyster populations, and diverse benthic and fish communities. Oysters are considered "ecosystem engineers" for their role in creating reefs that modify, through their physical presence, the surrounding environment while also providing habitat, refuge, and foraging areas for many other species including benthic organisms and fish (Coen & Luckenbach 2000; Powers et al. 2009; VanderKooy 2012; Wong et al. 2011). Oysters are most abundant in shallow, semi-enclosed water bodies (less than 12 meters in depth) in areas where salinity levels are between 15 and 30 parts per thousand (VanderKooy 2012). Multiple restoration techniques are available for use, either individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Restore or create oyster reefs through placement of cultch in nearshore and subtidal areas.** This restoration technique places cultch material in areas with appropriate conditions to provide hard structure for oyster recruitment and to restore or create three-dimensional oyster reef habitat (see Figure 5.D-9 and Figure 5.D-10). This technique can be used to restore lost oyster reef habitat, expand existing oyster reef habitat, or enhance oyster abundance at existing reefs. Cultch placement projects would be sited and designed to maximize oyster recruitment and survival, serve as a source of oyster larvae to the regional larval pool, and restore injured benthic and fish communities. Reef restoration design would also seek to restore habitat structure (e.g., reef size and reef height) and functions (e.g., shoreline protection). Cultch material can consist of either loose or contained oyster or other bivalve shell, limestone rock, crushed concrete, and other similar material that, when placed in areas with adequate larval abundance, provides a substrate on which free-floating oyster larvae can attach and grow (see Figure 5.D-9 and Figure 5.D-10). The availability of oyster or other bivalve shell for restoration can be limited in some areas; therefore, increasing the capacity of existing shell recycling

programs, establishing new shell recycling programs, or implementing actions to increase shell availability for restoration may be a necessary component of this technique. This technique can be used in areas such as the margins of marshes, tidal creeks, estuaries, and bays.

***Source:*** *Dr. Earl Melancon.*

**Figure 5.D-9**. Gabion mats with oyster shell used to restore fringing oyster reefs on the north shore of Terrebonne Bay, Louisiana.

***Source:*** *Thomas Mohrman, The Nature Conservancy.*

**Figure 5.D-10.** Oyster shell deployment from a barge to restore subtidal oyster reefs in St. Louis Bay, Mississippi.

- **Construct living shorelines.** This restoration technique involves the construction of living shorelines to 1) reduce/attenuate wave energy reaching the shoreline, thereby inducing sediment deposition and stabilizing shoreline habitats; 2) create substrate for colonization by

oysters and other reef organisms; 3) provide shelter for benthic and fish communities; and 4) re-establish ecological connections at the land:water interface. Living shorelines can include a variety of shoreline stabilization and habitat restoration techniques that span coastal habitat zones and use both structural and organic materials (Walker et al. 2011) (see Figure 5.D-11). The techniques generally involve the restoration of nearshore oyster reefs using materials conducive to oyster colonization, and may be combined with restoration techniques for marsh and/or submerged aquatic vegetation (SAV) restoration. Living shorelines are often built in foreshore waters, detached from the shoreline and oriented parallel to the shore. When constructed this way, they reduce the height of waves arriving at the shoreline, creating a low-energy environment that traps and retains sediment between the structure and the shore and provides a quiescent zone for submerged and/or emergent vegetation to establish (Currin et al. 2009; Erdle et al. 2008; Swann 2008). This technique could also be combined with placing cultch in nearshore areas and along the marsh shoreline to create fringing reefs, which enhance habitat for estuarine fauna and stabilize coastal wetland shorelines (LaPeyre et al. 2014; Meyer et al. 1997; Piazza et al. 2005; Rodney & Paynter 2006; Scyphers et al. 2011; Stricklin et al. 2010).

***Source:*** *Jeff DeQuattro, The Nature Conservancy.*

**Figure 5.D-11**. Crews deploying oyster reefs along Coffee Island in Portersville Bay near Bayou LaBatre, Alabama.

- **Enhance oyster reef productivity through spawning stock enhancement projects such as planting hatchery raised oysters, relocating wild oysters to restoration sites, oyster gardening programs, and other similar projects.** Planting spat on shell/cultch or cultchless seed oysters can improve oyster abundance and density at existing or restored oyster reefs (Figure 5.D-13). This technique can be used on existing reefs with low productivity, in combination with cultch placement for new reefs, or as part of a living shoreline project. Studies show that spawning stock enhancement projects are technically feasible (Brumbaugh & Coen 2009; Southworth & Mann 1998); however, the technique of planting seed oysters is most effective in areas with limited larval supply and sufficient substrate for oyster settlement (Geraldi et al. 2013). Large-

scale use of these techniques may also require enhancement of regional hatchery capacity to produce sufficient oyster larvae for restoration. If planting with cultchless seed or spat on shell/cultch, the size and density used is critical for oyster survival and growth (Puckett & Eggleston 2012; Southworth & Mann 1998). A high-seeding density may also be required at restoration sites with highly variable conditions (Gregalis et al. 2008; Knights & Walters 2010; Puckett & Eggleston 2012). Stocking juvenile or adult oysters on a restoration site may be more costly than seeding with spat on shell, but larger oysters have a much higher fecundity (VanderKooy 2012);therefore, this technique may be warranted in some areas. Other factors in addition to site suitability must be considered: oysters must be large enough to survive relocation, and the risk of transporting pathogens must be minimal. To protect public health, the Trustees will follow BMPs to ensure compliance with regulations and shellfish control authorities (Leonard & Macfarlane 2011; VanderKooy 2012). Planted oysters may be moved from reefs in areas of poor habitat conditions or obtained through hatcheries or oyster gardening programs. Oyster gardening is the recreational culture of oyster seed to adult size. Commonly, the "oyster gardener" obtains seed and places it in homemade oyster floats tied to piers or docks (see Figure 5.D-12).

***Source**: P.J. Waters, Mississippi-Alabama Sea Grant Consortium.*

**Figure 5.D-12.** A typical oyster garden from the Mobile Bay Oyster Gardening Program (Alabama).

- **Develop a network of oyster reef spawning reserves.** Creating special management areas, such as oyster spawning reserves, is an increasingly common restoration strategy because of their importance as a source of oyster larvae (Brumbaugh & Coen 2009; Powers et al. 2009). Studies investigating the use of oyster reserves in recovering oyster populations in North Carolina (Mroch III et al. 2012; Powers et al. 2009) have demonstrated the feasibility and benefits of this strategy. Spawning reserves can also have additional ecological advantages, including increased oyster size and fecundity (e.g., larvae production), resilience to disease and localized impacts from disturbances (e.g., hurricanes and freshets), and greater overall ecosystem functioning (Puckett & Eggleston 2012; VanderKooy 2012). In 2012, an Oyster Technical Task Force for the Gulf States Marine Fisheries Commission published an updated Gulf of Mexico Oyster Fishery Management Plan (VanderKooy 2012). The importance of specific, high productivity reefs as

larval contributors was identified by the task force as a concept that could be used to "create and protect donor sites for seed and brood stocks for restoration projects, as natural reservoirs for oyster populations to repopulate wider areas, and as research sites" (VanderKooy 2012). In addition, this concept was further discussed as a measure to increase production in combination with shell/cultch planting to create and restore oyster habitat (VanderKooy 2012). This technique would identify specific, limited areas that would be closed to harvest to protect spawning oysters and serve as sources of oyster larvae to other reefs (including public oyster grounds). Reserves would be designed using a network approach to enhance the regional larval pool and maintain oyster populations over a broad area. In order to maximize benefits to oyster populations, distances between reserves would be compatible with local oyster larvae dispersal dynamics to maximize reserve connectivity and restore metapopulation dynamics (Kim et al. 2013; Puckett et al. 2014; USACE 2012).

#### D.1.3.1 Implementation Considerations

Successful restoration of oysters depends on three major factors: 1) appropriate site conditions; 2) adequate supply of oyster larvae to recruit to available cultch material; and 3) adequate amounts of substrate for recruitment (i.e., clean, unburied cultch in suitable habitat) (Brumbaugh & Coen 2009; Cake Jr. 1983; Powell & Klinck 2007).

Management experience and research on the success of cultch placement for restoration have advanced our understanding of key siting considerations such as salinity, firmness of bottom substrate, recruitment, fouling organisms, predation and disease, tidal flushing, water quality, wave energy, and appropriate water depths (Beseres et al. 2012; Cake Jr. 1983). In addition, important design considerations include cultch material type, reef height, cultch volume, and implementation timing (Gregalis et al. 2008; LaPeyre et al. 2014). For living shorelines, site-specific feasibility must account for wave dynamics (e.g., fetch), and the project must be sited and designed to create favorable conditions for nearshore habitats and species. For example, the sustainability of oysters as part of a living shoreline project depends greatly on salinity and conditions such as substrate firmness, subsidence, sea level rise, and water circulation.

*Deepwater Horizon* (DWH) natural resource damage assessment (NRDA) studies show recruitment is low or absent in many areas, indicating that lack of recruits rather than lack of substrate alone is delaying oyster recovery. The lack of oyster recruitment recovery is likely due in large part to the direct loss of nearshore oysters, which would otherwise serve as a regional source of larvae. In addition, nearshore oyster reefs serve as a source of larvae to subtidal reefs; however, larval transport within subtidal reefs primarily remains in the subtidal zone. When siting restoration projects, it is important to consider both habitat suitability and availability of larvae for recruitment. Although, under some conditions, oyster larvae may settle locally (within the same reef), many reefs rely on larval transport between reefs for recruitment of new oysters. Therefore, the Trustees will prioritize restoration at sites that could serve as sources of oyster larvae to areas that are suitable for, but currently lack, oysters. Oyster reefs and living shorelines will also be restored in larvae settlement areas with high spatfall in order to maximize recruitment and increase oyster abundance. This technique would be especially important in areas of high larvae retention, where the restoration of oyster reefs will be critical for sustainable populations within a Restoration Area (Kim et al. 2013; Lipcius et al. 2008).

Spawning populations can be restored through cultch placement and living shoreline projects to increase oyster density within an area and, if needed, by planting oysters if recruitment may be insufficient or the current or expected abundance of adult oysters is insufficient for adequate spawning. In addition to suitable site conditions and the size and density of oysters planted, the availability of spat and adult oysters for restoration is a key consideration. Enhancing regional capacity for hatchery-reared oysters and production of spat on shell (i.e., remote setting) may be necessary to support regional restoration of spawning populations. In addition, enhancing and expanding oyster gardening programs can provide a source of oysters for restoration, while also engaging and educating the public about oyster restoration.

In addition to identifying appropriate locations related to larval transport and recruitment, the Trustees will ensure that restored oyster reefs will be sited and designed to maximize successful recruitment and survival of oyster spat. Restoration of nearshore reefs and living shorelines, especially in oyster habitat areas with abundant subtidal predators, could increase oyster survival and provide important areas for population development (Cake Jr. 1983). Restoration designs that incorporate vertical relief and complex reefs have been shown to reduce disease and predation and increase abundance and recruitment (Gregalis et al. 2008; Lenihan et al. 1999; Melancon Jr. et al. 2013; Soniat et al. 2004). Furthermore, vertical-relief reefs run less risk of being covered by sediment and are, therefore, more sustainable. If a restoration site has sufficient substrate, but spawning oysters are lacking, restoration actions may focus on enhancing spawning stock.

Another important consideration in restoration design and siting is to reduce unregulated or illegal harvest that could severely damage reefs and result in complete loss of reefs (Powers et al. 2009; USACE 2012). Several actions can be taken to reduce illegal harvest on restored reefs, including implementing public outreach, posting signs indicating allowable uses, and, where appropriate, siting restoration projects in nearshore shallow areas where access is difficult or using larger cultch materials that reduce or prevent illegal harvest. The Trustees would evaluate the most effective means to reduce illegal harvest, while considering factors such as compatibility with other uses at or adjacent to the site, existing harvest management policies, and other socioeconomic factors.

In addition to restoring oysters themselves, it is also important to restore oyster services. Restoration selection could evaluate projects to maximize benefits to benthic and fish communities or to enhance shoreline stability while also benefitting oysters. For example, restoration could seek to re-establish the role of oyster reefs as intermediate links between marsh and subtidal bare-bottom or SAV habitat for important fish species. Restoration would also seek to restore oyster reefs and associated benthic communities at sites of ecological significance to fish species. With appropriate design considerations, oyster restoration could also provide benefits to benthic communities and estuarine wetlands injured by the spill. Restoration projects and locations may be prioritized and tailored to maximize benefits to these communities. Living shoreline restoration projects may be sited adjacent to wetland areas with increased shoreline erosion and be designed to reduce the wave energy affecting the shoreline, while creating suitable conditions and substrate for oyster recruitment and sustainability. By identifying opportunities to restore the multiple ecosystem benefits of oyster reefs, the Trustees can accelerate recovery of injured ecosystem functions and achieve a more comprehensive restoration of the nearshore ecosystem.

Collaboration with resource managers and coordination with regional bodies such as the Gulf States Marine Fisheries Commission (GSMFC) and the Gulf Oyster Industry Council are important for implementing spawning reserves. Designation of spawning reserves may take many forms and will need to be compatible with each state's management framework and approach to resource management. It is also critical to involve and work closely with the oyster industry and other stakeholders to develop projects that build on local knowledge, current uses, and other environmental management and restoration projects that may affect oyster resources. Identifying ecologically significant oyster habitat located where typical water circulation patterns would direct larvae to recruitment-limited reefs is critical in establishing reserves; this information would need to be collected where not currently available. In addition to site-specific conditions, other factors critical to success must also be determined: optimal spacing, number, and size for reserves; and larval source and sink dynamics at a larger scale (Puckett et al. 2014). In some cases, spawning stock on existing reefs or on newly restored reefs identified as reserves may need to be supplemented (Brumbaugh & Coen 2009; Kennedy et al. 2011). To ensure long-term sustainability, the Trustees would locate reserves in areas where future conditions will remain or become appropriate for oyster survival. Therefore, hey would need to coordinate these efforts with larger Gulf Coast restoration efforts, such as river diversion projects.

As with other oyster restoration techniques, a key concern for spawning reserves is poaching, which reduces the effectiveness of oyster reserves (Powers et al. 2009). To limit poaching, outreach efforts will be essential to help the oyster industry and public understand the importance of spawning reserves in restoring recruitment to public oyster grounds and other oyster reefs regionally. A network of reserves to protect spawning oysters in specific areas would facilitate restoration of self-sustaining oyster populations and enhance regional oyster abundance and productivity. Reserves would be located at selected sites, such as ecologically significant areas that serve as high-quality habitat for oysters and areas with dense oyster populations or where restoration actions could create dense populations. Areas selected for restoration and as reserves would also ideally have water circulation patterns that support larvae transport outside the reserves to achieve regional restoration goals. Additionally, reserves may be created using methods that discourage poaching, such as the use of large-sized cultch materials or the, placement of cultch in shallow or relatively inaccessible waters. Implementation opportunities and the likelihood of public support for this technique could be increased if it is implemented with other resource restoration projects or other oyster restoration techniques, such as living shorelines.



#### D.1.3.2 OPA Appropriateness Evaluation

The restoration approach "Restore oyster reef habitat" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by 1) restoring key physical conditions through placing cultch or constructing living shorelines to allow recovery of oyster cover, recruitment, and oyster habitat services; 2) restoring oyster reef productivity and spawning stock, and 3) restoring the regional larvae pool as a factor affecting the recovery of oyster populations and oyster reef habitat. Additionally, this approach can help compensate for the interim service losses to oysters and oyster reefs, and to the services they provide to benthic and fish communities and other nearshore habitats adversely affected by the DWH oil spill. It can compensate by restoring and protecting oyster reefs that are the same type (e.g., nearshore reefs and oyster spawning stock) and quality (e.g., source of oyster larvae and ecosystem services) as those injured. Restored

oyster reefs would also be of comparable value to those injured, because the approach would create sheltered nearshore habitats, which support diverse benthic and fish communities.

The techniques described above are commonly used resource management actions. Researchers have documented many previously successful restoration projects using these methods (LaPeyre et al. 2014; Mroch III et al. 2012; Powers et al. 2009; VanderKooy 2012), and they have been recommended in the Gulf of Mexico Regional Oyster Management Plan (VanderKooy 2012). The techniques proposed above have successfully restored oyster reef habitat; expanded existing oyster reef habitat; enhanced oyster density, reef productivity, and spawning stock abundance; and reduced waves and currents in nearshore areas (Brumbaugh & Coen 2009; Scyphers et al. 2011). Collateral injury to other natural resources is expected to be minimal; for example, although benthic habitat at restoration sites will be affected through cultch placement, benthic productivity will increase overall through oyster reef and living shoreline restoration. Collateral effects from oyster reef productivity enhancement activities will be minimized through BMPs for habitat restoration and the protection of public health. These BMPs will ensure, for example, that 1) restoration and enhancement activities are conducted in waters historically suitable for oysters, 2) planted oysters are healthy and of sufficient size to survive planting, 3) donor reefs are minimally affected, 4) oyster health is monitored over time, 5) the Trustees coordinate with state shellfish managers, 5) educational programs are implemented, and 6) the public is notified of harvest restrictions at restoration sites. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Should there be a need to increase oyster-hatchery capacity for stocking purposes, BMPs for siting and construction of such facilities will be followed to minimize construction-related impacts. For more information regarding potential impacts from increasing hatchery capacity, see discussion in Section D.8.2, Enhance Recreational Experiences, under the discussion of the technique "Enhance recreational fishing opportunities through aquaculture." Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



### D.1.4 Create, Restore, and Enhance Barrier and Coastal Islands and Headlands

This restoration approach focuses on restoring barrier and coastal islands, which would provide coastal habitat important to coastal stability and ecology in the Gulf of Mexico. Barrier and coastal islands and headlands provide important habitat for many animal and plant species including, but not limited to, sea turtles, birds, and endangered beach mice. Multiple restoration techniques are available for use individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Restore or construct barrier and coastal islands and headlands via placement of dredged sediments.** Barrier and coastal island and headland restoration involves placing dredged sediments that can create, stabilize, maintain, and restore degraded beach, dune, and back-barrier marsh habitats. Restoration can occur on existing barrier and coastal islands, or new islands can be created. Sediments used for restoration can be obtained by beneficial use of

dredged material from navigation channels or by accessing material from approved borrow areas.

- **Plant vegetation on dunes and back-barrier marsh.** Another essential component of barrier or coastal island restoration or creation is planting vegetation on the newly created dunes and in back-barrier marshes. Vegetative root structure can stabilize marsh and beach sediments and contribute to the stability of the shoreline by helping reduce erosion and encouraging sediment deposition. Planting vegetation can also contribute to the ecosystem function of dunes and back-barrier marshes, providing habitat for fish and invertebrates, birds, and other shoreline wildlife. Restoration plantings are limited to native species, and projects often include invasive species control, stabilization (e.g., using a product such as Geo-web), and watering during early stages.

### D.1.4.1 Implementation Considerations

Barrier and coastal island restoration in the Gulf of Mexico has a long history, particularly in Louisiana where more than 20 projects have been conducted in the last two decades (CPRA 2015). Many of these projects have focused on marshes, and the relationship between dunes and back-barrier marshes is well recognized. For example, restoring barrier island complexes, including planting vegetation to stabilize the surface, is important for building new land and reducing shoreline erosion in the Gulf (Armbruster 2000; Penland et al. 2005).

Several of the projects being implemented as part of the Phase III and IV Early Restoration plans are barrier and coastal island restoration projects. Future projects will benefit from experience gained through implementing these previous projects, but such complex projects will still need to undergo a thorough technical review and stakeholder engagement process. Because of concerns about impacts on sediments and associated natural resources at borrow sites (e.g., sea turtles), and to ensure the efficient and effective use of limited sand resources, the Trustees may find it appropriate to conduct monitoring of borrow sites in order to understand the evolution of the borrow pits (inland, riverine, and offshore) over time, especially the infilling characteristics (rate and types of sediment). Finally, they must consider the potential adverse impacts of placing sand or sediment over existing occupied habitat during project implementation.

Dredged material is typically a close match to the chemical and physical characteristics of sediment at the restoration site, and target borrow areas need to be within reasonable proximity to suitable sites for sediment placement. Although multiple factors can affect the success of these types of projects, local hydrodynamics and sediment transport processes are among the most critical, and will be carefully monitored and modeled prior to implementing this technique. Because the goal is to restore or create an entire barrier or coastal habitat, rather than just the sand beach and dunes, these projects require large volumes of sediment of different grain sizes.

When planning barrier island or headlands restoration, the Trustees would need to consider implementation timing and other options for minimizing impacts to nesting birds and sea turtles. For example, the Trustees must consider any actions that may deter sea turtles from nesting during nesting season (e.g., working at night and using lighting). In addition, coordination is needed for any sea turtle

relocation trawling measures deployed during this time to provide a complete workup and marking/tagging of any sea turtles captured.

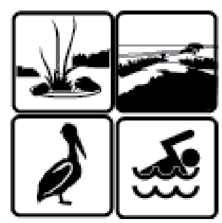
### D.1.4.2 OPA Appropriateness Evaluation

The restoration approach “Create, restore, and enhance barrier and coastal Islands and headlands” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by restoring, rehabilitating, or replacing comparable natural resource services for affected barrier and coastal islands. Additionally, this approach may work to compensate for the interim service losses to barrier and coastal islands caused by the DWH oil spill by slowing barrier island degradation and loss, providing benefits to public safety, and reducing barrier and coastal islands and wetland loss during hurricanes.

In addition, these techniques are reasonable and established in the scientific restoration literature, and previous successful restorations of barrier and coastal islands are well documented. Collateral injury to other natural resources is expected to be minimal overall. To ensure that collateral effects are minimal, construction will be scheduled to avoid bird and turtle nesting locations and times; agency consultations and evaluations will be undertaken, as needed; and BMPs will be implemented, as appropriate. The Trustees do not anticipate that this approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



## D.1.5 Restore and Enhance Dunes and Beaches



This restoration approach involves restoring dunes and beaches through various techniques that provide important coastal habitat for shorebirds, federally listed threatened and endangered beach mice, and sea turtles. The approach will also serve to restore popular recreational areas for local visitors and tourists. A variety of restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Renourish beaches through sediment addition.** Beach renourishment or replenishment involves placing suitable material from sources outside the natural sources of sediment for the eroding beach. Sediment is typically taken from a borrow site where the physical and chemical sediment characteristics closely match those at the restoration site. Sediment needs to be added continually over long periods of time to achieve maximum effectiveness as beaches continue to erode, which is a particular concern with sea level rise and interruptions in longshore sediment transport.

- **Restore dune and beach systems through the use of passive techniques to trap sand.** Passive techniques can be used to trap sand transported by winds and waves to restore dune and beach systems. Passive restoration techniques could include, but are not limited to, placing sand fencing, hay bales, and recycled Christmas trees to capture sand. These techniques would also

help retain sand and other materials needed to maintain a sand dune system healthy enough to support wildlife and naturally provide sand to eroding beaches.

- **Plant vegetation on dunes.** Planting vegetation on dunes can restore the plant community and provide additional foraging and nesting habitat for shoreline animals. Vegetative root structure stabilizes beach sediments and contributes to the stability of the shoreline by reducing erosion and encouraging sediment deposition. Planting vegetation can also contribute to the ecosystem function of dunes by providing habitat for fish and invertebrates, birds, and other shoreline wildlife. Vegetation near project sites would be identified to determine the proportions of different species that are typically found in dune habitat in specific areas. Native plants that are cultivated from seeds or cuttings from local coastal areas would be used to ensure appropriate genetic stocks, which will contribute to project success.

- **Construct groins and breakwaters or use sediment bypass methods.** In addition to beach renourishment, constructing engineered structures such as breakwaters and groins and implementing sediment bypass methods can decrease erosion of engineered beaches. These structures can increase the lifespan of renourished beaches near passes, inlets, or in areas where erosion rates are high and where sediment supply is limited. Groins are placed on and perpendicular to the shoreline to slow the rate of sand loss. When used for shore protection, breakwaters are usually built just offshore and oriented parallel to the shore. Depending on their design, breakwaters attenuate wave energy by dissipating, reflecting, or changing the refraction and diffraction patterns of incoming waves. The resulting reduction in wave energy arriving at the shoreline tends to decrease the ability of waves to entrain and transport sediment, thereby decreasing erosion at the shoreline. Breakwaters can extend above the water or be submerged, fully or partially, where they function as reefs or sills. Sediment bypassing consists of the hydraulic or mechanical movement of sand from an area of accretion to a downdrift area of erosion, across a barrier to natural sand transport such as jetty structures. At some locations, the bypassing is continuous; at other locations, it is repeated once the sand accumulates in the updrift area.

- **Protect dune systems through the use of access control.** Installing access controls such as fences, raised boardwalks (to avoid fragmenting dune habitat), and bollards (thick posts to prevent vehicle access) can minimize vehicular and pedestrian traffic on dune systems and limit adverse impacts on those systems. Additionally, reconfiguring or removing visitor access points, such as parking lots, can improve habitat connectivity and reduce visitor impacts. This technique protects dune habitat, allowing it to recover its natural vegetation and processes with as little disturbance as possible. Aboveground boardwalks can be used to avoid fragmenting beach mouse habitat.



#### D.1.5.1 Implementation Considerations

All the techniques discussed above for beach restoration have been used extensively in the past throughout the northern Gulf of Mexico, and several are included in the Early Restoration plans. Thus, the Trustees have many opportunities to benefit from the lessons learned from past projects and improve success for future projects.

One of the key components for beach nourishment is the composition of the sand to be added to the beach. Identifying suitable borrow material is crucial, and sediment color, grain size, contaminants, and other characteristics must be considered. These factors are important because introducing different sediment characteristics could negatively affect aesthetics, erosion potential, and general use by shoreline fauna, as well as decrease the lifespan of the nourished beach. Sand for use in beach nourishment is becoming more difficult to find, because the best-matched sources are being exhausted in some areas. Placing structures such as groins or breakwaters can interfere with the longshore sand transport and result in erosion downdrift; therefore, studies are needed to determine the proper design, location, and fill after construction to minimize potential problems downdrift. Sediment bypass methods are being recognized as effective "soft solutions" to beach erosion problems resulting from the accumulation of sand on the updrift side of jetties at inlets, or even when large amounts of sand are temporarily "trapped" in large sand shoals offshore from the inlet. However, to achieve maximum effectiveness, funding is necessary to continue sediment bypassing over long periods of time.

Dune restoration often includes 1) planting native species, 2) controlling invasive species (both plants and animals), 3) possibly using stabilization techniques (e.g., installing drift fences to stabilize vegetation for beach mice or using a product such as Geo-web to help establish the vegetation), and 4) watering during early stages. Dunes are also sand storage areas that supply sand to eroded beaches. Beach restoration typically involves maintaining sand and sediment to prevent the erosion of beaches, by, for example, adding new material to areas or constructing structures that protect beaches from wave and wind action. The utility of using passive stabilization techniques for specific locations will depend on several factors, including, but not limited to, physical and hydrological characteristics of the beach; the type and prevalence of recreational beach use; and potential interactions with foraging or nesting birds, nesting sea turtles, and/or other wildlife.

Restoration projects could be designed to maximize benefits for specific species such as beach mice. Beach mice are obligate dune residents; conserving, managing, and/or restoring this habitat is a common beach mouse restoration approach. Five species of beach mice live along the Gulf of Mexico Coast; their range is limited to the barrier islands, keys, or coastal peninsulas of Alabama and Florida. Beach mouse habitat is characterized by dunes vegetated primarily by sea oats and other grasses, and all but one species of beach mouse are federally endangered. Habitat loss due to development and episodic population crashes due to hurricanes threaten beach mouse populations. Restoring dune systems, controlling non-native predators, and raising dune crossovers are important considerations for these animals.

When planning beach nourishment projects, the Trustees will need to consider implementation timing and other options to minimize impacts to nesting birds and sea turtles, as well as beach mice. For example, the Trustees must consider any actions that may deter sea turtles from nesting during nesting season (e.g., working at night and using lighting). In addition, coordination is needed for any sea turtle relocation trawling measures deployed during this time to provide a complete workup and marking/tagging of any sea turtles captured. Construction in dune systems can result in habitat fragmentation and habitat destruction and loss (Swilling Jr. et al. 1998). Impacts of development (and corresponding loss of habitat) require coordination with landowners and communities; education and outreach are also important, especially if predator control is proposed.

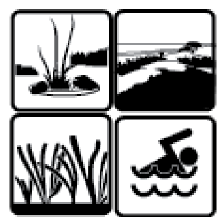
### D.1.5.2 OPA Appropriateness Evaluation

The restoration approach “Restore and enhance dunes and beaches” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by restoring, rehabilitating, or replacing comparable natural resource services for affected beaches, as well as endangered beach mouse habitat. It can also work to compensate for the interim service losses to dunes and beaches adversely affected by the DWH oil spill. This restoration approach can slow sand and sediment loss from coastal shorelines, thus maintaining the important dune and beach system that protects inland areas during hurricanes. This system, in turn, provides benefits to public safety, as well as to the animals living in the dune habitat.

In addition, the techniques described above are reasonable and established in the scientific restoration literature, and previous successful restorations of dunes and beaches are well documented. Collateral injury to other natural resources is expected to be minimal overall. To ensure that collateral effects are minimal, construction will be scheduled to avoid bird and turtle nesting locations and times; agency consultations and evaluations will be undertaken, as needed; and BMPs will be implemented, as appropriate. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



## D.1.6 Restore and Enhance Submerged Aquatic Vegetation



This restoration approach focuses on restoring and protecting SAV habitat. Healthy SAV serves critical ecological functions in the Gulf of Mexico, including habitat and forage for fish and wildlife, decreased wave energy, soil protection, and increased sediment accretion (Beck et al. 2007; Fonseca & Bell 1998; Fonseca et al. 1996; Heck Jr. et al. 2008; NPS 2014; Orth et al. 2006). Therefore, minimizing further deterioration and erosion of sediment and enhancing vegetation communities can improve stability and colonization in SAV beds. SAV can also provide habitat and foraging areas for invertebrates, sea turtles, fish, waterfowl, and wading birds (Fonseca 1996; Fonseca et al. 1998). Multiple restoration techniques are available for use, individually or in combination, as potential restoration projects (Farrer 2010; Fonseca et al. 1994; Fonseca et al. 1998; Paling et al. 2009; Thomson et al. 2010; Treat & Lewis III 2006). This restoration approach could employ, but is not limited to, the following techniques:

- **Backfill scars with sediment.** Filling scars and holes in SAV beds with sediment similar to that of the surrounding area can more quickly return the site to its original grade and reintroduce lost sediment material necessary for SAV repopulation (Farrer 2010; Hammerstrom et al. 2007; McNeese et al. 2006; NOAA 2011; Uhrin et al. 2011) (see Figure 5.D-13). Scars or holes within existing SAV beds are often the result of injury from vessel groundings or propeller damage (Fonseca et al. 2004; Kenworthy et al. 2002; McNeese et al. 2006). These impacts can disturb and remove SAV and sediment and change the seafloor elevation, resulting in limited natural recolonization of the area (Uhrin et al. 2011). This technique prevents further deterioration of

the SAV bed as a result of erosion and prepares the area for recolonization by neighboring or transplanted SAV (Farrer 2010; Uhrin et al. 2011).

*Source: Jud Kenworthy.*

**Figure 5.D-13.** Restoration team deploying biodegradable sediment-filled tubes to restore sediment grade and seagrasses in a vessel grounding site.

- **Revegetate SAV beds via propagation and/or transplanting.** Revegetating SAV beds can reduce deterioration of beds and stabilize sediments, thus preventing erosion. SAV beds can be revegetated through broadcast seeding and transplanting whole plants (Farrer 2010; Fonseca 1994; Fonseca et al. 1994; Fonseca et al. 1998; Treat & Lewis III 2006). Transplanting whole plants (either cultivated or taken from donor beds) requires each plant to be planted by hand (see Figure 5.D-14). Planting with plugs (this technique uses tubes to core plants, keeping surrounding sediment and rhizomes intact) or staples helps anchor the new transplant to the sediment until the roots take hold.

*Source: Jud Kenworthy.*

**Figure 5.D-14.** SCUBA diver installing seagrass transplanting units at a restoration site in the Florida Keys National Marine Sanctuary.

- **Enhance SAV beds through nutrient addition.** Many coastal areas suffer from high levels of nitrogen loading from nonpoint sources, but the relatively diffuse spread of these nutrients is not as effective in fostering SAV recovery as a concentrated release of nitrogen and phosphorous fertilizer from "bird stakes" (Fourqurean et al. 1995; Hall et al. 2012; Kenworthy et al. 2000). This method of fertilization uses the nutrient composition of bird feces deposited from birds resting on stakes and has been documented to be an effective treatment to facilitate colonization of SAV in areas of disturbed sediments and/or to promote faster growth of transplants (Fourqurean et al. 1995; Hall et al. 2012; Kenworthy et al. 2000) (see Figure 5.D-15). This technique is only suitable for areas where SAV is suffering from nutrient limitations (Farrer 2010; Kenworthy et al. 2000). Appropriate use of bird stakes or fertilizer spikes in SAV beds includes monitoring to ensure nutrient requirements are met, but not exceeded, to avoid negatively affecting the surrounding area with excessive nutrient loading. Adding nutrients to SAV beds is often used in combination with another SAV restoration technique, such as transplanting plants, but can also be used alone to encourage natural colonization (Fonseca et al. 1994; Fonseca et al. 1998; Kenworthy & Fonseca 1992).

***Source:*** *Jud Kenworthy.*

**Figure 5.D-15.** Cormorants perched on two bird roosting stakes installed in a vessel grounding restoration site in the Florida Keys National Marine Sanctuary.

- **Protect SAV beds with buoys, signage, and/or other protective measures.** Establishing boater restrictions or buffer zones within uninjured, injured, or restored SAV beds can be implemented using buoys or signs marking SAV bed boundaries to protect existing SAV beds and the services they provide (Stowers et al. 2006). Other examples of protective measures could include restrictions to reduce propeller scarring, “no motor” zones, “pole and troll” zones, and SAV markers. This technique could minimize scarring and reverse SAV loss.

- **Protect and enhance SAV through wave attenuation structures.** Once SAV is lost, slow current velocity and wave action are necessary for clonal fragments to propagate and seedlings to re-establish (EPA 2000; Fonseca et al. 1998). Segmented living shorelines or permeable barriers (e.g., oyster reef) that dissipate wave energy and enable SAV to naturally regenerate behind them have been previously used in the coastal areas of Louisiana and elsewhere on the Gulf Coast. This technique could also include maintaining the integrity of existing living barriers, such as barrier islands (Thomson et al. 2010). Similar projects have been constructed in the Jean Lafitte National Historical Park and Preserve. These projects could inform basic design and construction of projects within other locations in coastal Louisiana.

### D.1.6.1 Implementation Considerations

In planning and conducting SAV restoration activities, site selection criteria should be established and critically evaluated before implementation (Fonseca et al. 1998; Short et al. 2002). Areas with suitable water quality conditions for SAV growth should be selected and water quality maintained. Additionally, existing SAV should be protected, and, ideally, restoration should take place where SAV has previously existed. Sites should also be selected where water depth, light, salinity, temperature, and sediment quality are appropriate.

Local sediment with similar grain size and physical characteristics would be used to backfill propeller scars and blow holes. Both loose sediment and sediment encapsulated in biodegradable materials can be used to fill the scars (Hall et al. 2012; Hammerstrom et al. 2007) (see Figure 5.D-13). Local climate, currents, and winds should be considered when selecting the appropriate fill technique. The scars would be filled several inches above grade to provide plenty of the material necessary for SAV repopulation (NOAA 2011). In general, any excavation with an escarpment (i.e., dropoff) greater than 5.9 inches (15 centimeters) in depth at the perimeter is considered a potential candidate for filling (Kenworthy et al. 2002; NOAA 2011).The material would be allowed to settle for 60 days before any other restoration activity (e.g., replanting or staking) would be implemented (NOAA 2011). During the restoration process, all activities (including transportation from the sediment borrow site to the restoration site, if necessary) would be conducted to avoid any negative impacts on adjacent SAV communities (NOAA 2011).

Planting can be completed in one or multiple years, at different densities, during different seasons, and with plants from different donor sites (Fonseca 1994; Fonseca et al. 1994; Fonseca et al. 1998). Generally, planting is done with fast-growing, colonizing species (e.g., shoalgrass or wigeon grass) rather than slow-growing, long-lived species (e.g., turtle grass); however, plant species selection would depend on the project and site-specific conditions (Farrer 2010; Fonseca et al. 1994; Fonseca et al. 1998; Fonseca et al. 1987). All these factors should be considered during the planning phase of the project, and those criteria best suited for the project and the site selected should be used (Fonseca et al. 1998). These propagation and transplanting actions can be used separately or in combination to revegetate SAV beds (Fonseca et al. 1998; Paling et al. 2009).

Typically, a revetment system consisting of a stone dike is laid directly on the natural slope of the shoreline, or, where indentations occur, just offshore. The dikes are constructed using geotextile material as a base to prevent differential settling and to slow subsidence. The target elevation of the rock is approximately +3 feet NAVD88, with all sections having a 1:2 slope. Barges transport the rocks to the site, and flotation channels typically need to be excavated for barge use; such channels are refilled as part of project construction (NPS 2013).

Due to the complex physical environment and remoteness associated with implementing projects in some locations (e.g., Chandeleur Islands) (Fonseca et al. 1998; Short et al. 2002), an important step in developing SAV restoration projects is to establish scientifically based site-selection criteria and conduct a feasibility analysis. Expertise across a range of disciplines should be sought, including that of seagrass ecologists, coastal geologists, physical oceanographers, seagrass inventory and mapping specialists, wetland and shoreline specialists, and restoration specialists, including practitioners and resource economists.



### D.1.6.2 OPA Appropriateness Evaluation

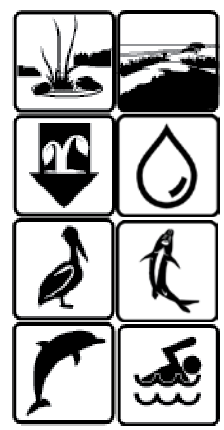
The restoration approach “Restore and enhance submerged aquatic vegetation” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by directly restoring or protecting SAV habitat and by providing habitat and foraging areas that can enhance production of water column resources including invertebrates and fish. It can also help compensate for the interim services losses to SAV, nearshore and water column resources, turtles, and marine mammals adversely affected by the DWH oil spill (Fonseca et al. 2000), by

supporting and enhancing the health and productivity of SAV beds and associated species and communities.

The techniques described above have been widely applied across the Gulf of Mexico (Farrer 2010; Fonseca 1994; Fonseca et al. 1998; Paling et al. 2009), including many NRDA cases and in Emergency Restoration and Early Restoration for the DWH oil spill. That history demonstrates that this approach is highly likely to succeed in long-term restoration applications relating to the DWH spill. Projects implemented pursuant to this restoration approach can be designed to avoid collateral injury to other natural resources. Projects that involve construction (e.g., backfilling scars with sediment and protecting SAV through the installation of wave attenuation structures) could have short-term, minor impacts on natural resources. The nature and severity of those impacts would depend highly on the type and location of the project, and any such impacts would be outweighed by the long-term benefits to SAV and associated species and communities that derive from the restoration actions. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



### D.1.7 Protect and Conserve Marine, Coastal, Estuarine, and Riparian Habitats



This restoration approach supports, protects, and restores a wide variety of marine, coastal, estuarine, and riparian habitats and the ecosystem services they provide, through the identification, protection, management, and restoration of important habitat areas or land parcels. This approach can provide habitat connectivity across habitat types or geographic areas, and minimize habitat loss by reducing or avoiding impacts from activities such as development. In addition, protecting habitats can provide public access for the use and enjoyment of the Gulf of Mexico's natural resources. Multiple restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Acquire lands for conservation.** Conserving and protecting land parcels via acquisition or conservation easements can protect wetlands and other significant coastal, estuarine, and riparian habitats; create connections between protected areas; remove direct threats of development; provide mechanisms for protected species management; provide nesting and foraging habitat for birds; protect critical freshwater inflows to estuaries; and improve coastal water quality. Identifying and prioritizing ecologically significant coastal, estuarine, and riverine habitats may be an important prerequisite to implementing conservation actions, particularly in areas where specific habitat resources have not been sufficiently evaluated. Habitat areas or land parcels would be identified based on their ability to complement and advance the goals of coastal management, habitat conservation, and other applicable plans. These land parcels could then be conserved and protected via a conservation easement, property use restrictions, or fee title acquisition.

- **Develop and implement management actions in conservation areas and/or restoration projects.** Developing and implementing management and restoration plans for existing and/or proposed conservation areas or for restoration projects can directly enhance habitats through activities such as debris removal, invasive species control, fire management, and vegetative plantings. Habitat management activities can also provide for the enhancement of nesting and foraging areas for various bird species across the Gulf. The Trustees would develop and implement habitat management plans to enhance habitat quality or ecosystem conditions. Such plans would identify system modifications that could enhance habitat quality or ecosystem condition and could consider how multiple, protected land parcels could be jointly managed to support multiple life stages of a species or improve the overall condition of a receiving water body.

- **Establish or expand protections for marine areas.** Similarly to acquiring land for conservation, establishing or expanding protections for marine areas can protect significant coastal and marine habitats. Marine protected areas (MPAs) are able to protect and manage threats from a variety of human activities in a given marine location for the benefit of natural resources. MPA protections are generally not completely prohibitive but are put in place to help maintain essential ecological processes, preserve genetic diversity, and ensure the sustainable use of species and ecosystems (Kelleher 1999). Federal, state, and local governments and nongovernmental organizations (NGOs) can be responsible for managing MPAs. Numerous marine sites have been designated by federal and state governments for some level of protection. Some federal statutes and mechanisms govern the use, management, protection, and conservation of marine areas and marine resources and allow federal agencies to designate and expand MPAs. Those statutes include, but are not limited to, the National Marine Sanctuaries Act (NMSA), Coastal Zone Management Act (CSMA), National Wildlife Refuge Administration Act, Magnuson-Stevens Fisheries Management and Conservation Act, Endangered Species Act (ESA), and the Marine Mammal Protection Act (MMPA). Additionally, state authorities and management approaches to coastal and marine management or planning areas exist for the protection of marine habitat areas, specific marine species, or other resources (Davis et al. 2004). For example, specific parcels within state-owned submerged lands can be leased or designated for conservation purposes. Additionally, state waters can be designated to protect their ecological values as state aquatic preserves (e.g., seagrass conservation areas or oyster reserves), outstanding resource waters, or estuarine research reserves (usually in a federal-state cooperative). State waters can also be protected by extending the boundaries of protected areas, such as wildlife management areas, coastal/wetland preserves, or scientific/research areas to include adjacent nearshore waters (Showalter & Schiavinato 2003). Although less familiar to the public than terrestrial land protection mechanisms, a range of mechanisms to protect biologically diverse and ecologically significant marine habitats are available, and the Gulf states have used these mechanisms to provide an additional framework for the implementation of this restoration technique (ELI 2011).

### D.1.7.1 Implementation Considerations

Areas may be identified for conservation based on their potential for loss or degradation, ability to protect or buffer wetlands or allow for habitat migration over time, contributions to restoring ecosystems and significant coastal habitats, ability to connect protected areas, and/or ability to reduce coastal water pollution. A number of implementation considerations are associated with this approach; key considerations are as follows:

- **Property acquisitions.** Land subject to a conservation easement may remain in private ownership, but a conservation easement would restrict development and certain uses on the property. Fee title acquisition is the purchase of a parcel that will be deeded to individual state, federal, or local governments; land trusts; or conservation NGOs for habitat protection and management. Under this approach, land would be purchased from willing sellers or participants only. Neighbors adjacent to land purchased to gain access to resources under this restoration plan would retain all their current rights to their land. The government agencies are required to pay fair market value for land purchased, which will be determined through established appraisal procedures. Successful negotiations would result in land acquisition by the appropriate state or federal land management agency, accredited land trust, land protection organization, or other qualified NGO. Similarly, the acquisition of lesser property interests such as conservation easements would be accomplished through the voluntary enactment of use restrictions. In addition to identifying the appropriate mechanism for conserving a parcel of land, these projects also need to factor in maintenance and management in order to ensure the desired benefits are achieved.

  Acquisition could also target areas important for specific species, such as beach mice or Gulf sturgeon. For example, protection and recovery plans for beach mice typically include monitoring plans to gauge, characterize, and manage populations. Monitoring would enable the effects of predators and predator controls to be monitored and managed as well. Conserving habitats is another approach commonly used by state and federal natural resource agencies, as well as a number of NGOs. Riverine habitats, such as the Bogue Chitto National Wildlife Refuge, have been conserved specifically for Gulf sturgeon use. Considerations regarding the conservation of Gulf sturgeon habitat areas include transaction and maintenance costs, project longevity, landowner willingness, regional support, flexibility in methods of acquiring target parcels, and an evaluation of site-specific threats that may be abated by different levels of land conservation.

- **Management measures.** The types of land for which plans would be developed include those that are managed by state and/or federal agencies; the Trustees will focus on addressing the key restoration needs for those lands. For example, the Trustees could develop and implement a habitat management plan to jointly manage multiple, protected land parcels to support multiple life stages of a species. The Trustees could also use habitat management plans to consider and implement activities that would improve the overall condition of a receiving water body. Coordination with existing management plans and agencies with management authority would enhance this restoration technique. Management plans could provide for habitat management or restoration activities in conservation areas in order to maintain or enhance habitat quality or

ecosystem condition; such plans could also include public access or amenities. Habitat management plans could also include allowances for compatible management by private landowners to conduct restoration or other habitat improvements, such as reducing nonpoint sources of water pollution. Management approaches could consist of virtually any other habitat-related restoration technique or combination of techniques identified in this restoration plan, including, but not limited to, altering land cover (including intertidal or submerged substrate or vegetation), altering hydrology, removing marine debris, or controlling invasive species. Specific management measures could include:

  - **Invasive species control.** Once invasive species become established and spread, controlling or eradicating them can be extraordinarily difficult and costly. In addition, invasive species removal is not always feasible, and new invasive species are likely to appear or expand their range. Control of predator species can involve nonlethal methods (e.g., habitat enhancement to protect the prey species, scare tactics, repellents, predator-proof fencing, cages/mesh over turtle nests, live traps, and immunocontraception methods) or lethal methods (e.g., trapping, shooting from aircraft or the ground, or poisons). Some of the lethal methods have strong public opposition because they are considered to be inhumane. If lethal predator control methods are proposed, government agencies will follow federal guidelines for public review and comment. Removal of non-native/invasive plants is less controversial and has been part of habitat restoration projects for decades.
  - **Debris removal.** Removal of structures that are hazards or impair habitat function on beaches, such as jetties, old seawalls, and riprap, could affect shoreline users. For example, these structures are sometimes used to access the shoreline for fishing. In these cases, stakeholder engagement would be needed to inform the public of the benefits and negative impacts. A good example of debris removal to improve beach and dune habitat is the Phase III Early Restoration Project, the Gulf Islands National Seashore Beach Enhancement Project, which involves removing asphalt and road-base material that is scattered widely over the Fort Pickens, Santa Rosa, and Perdido Key areas of the Gulf Islands National Seashore in Florida.

- **Establish or expand protections for marine areas.** In the marine environment, acquisition and protection projects can be complicated because marine areas are often already within the public trust but allow extractive activities (e.g., oil and gas production, commercial and recreational fishing, and/or recreational diving), some of which may significantly affect natural resources. MPAs are, therefore, put in place to manage these types of human activities in a given marine location for the benefit of natural resources. A knowledge of the threats to the resources being protected is integral to understanding the types of benefits likely to be obtained from a preventive restoration project. When determining the protections needed to prevent future injury to marine, coastal, estuarine, and riparian habitats, it is important to consider the potential threats to those resources. MPAs have had a positive effect on fish biomass (Edgar et al. 2011; Harborne et al. 2008) and abundance (Jeffrey et al. 2012), particularly in no-take reserves (Edgar et al. 2011; Kramer & Heck 2007). However, the resource benefits from MPAs may take time to develop (Molloy et al. 2009).

### D.1.7.2 OPA Appropriateness Evaluation

The restoration approach "Protect and conserve marine coastal, estuarine, and riparian habitats" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by minimizing or eliminating the potential for future loss or degradation of protected areas and/or enhancing the ecosystem services provided by protected areas over time relative to the future of those protected areas in the absence of the conservation action. It also can help compensate for interim services losses to 1) coastal and riparian buffer uplands; 2) coastal wetland, oyster, SAV, or beach/barrier island habitats; and 3) nearshore and offshore living coastal and marine resources such as fish and shellfish, birds, sea turtles, and marine mammals that were adversely affected by the DWH oil spill. This restoration approach may also compensate for interim services losses by increasing future ecosystem services provisioning from protected areas compared to levels that would be achieved without conservation actions.

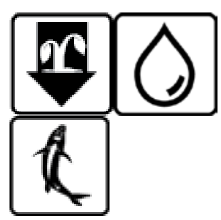
The techniques described above have been widely used to restore habitats and species across the Gulf of Mexico, including in many other NRDA cases and in Early Restoration for the DWH spill. Previous work demonstrates that this approach is highly likely to succeed in long-term restoration applications relating to the spill. Collateral injury to other natural resources is expected to be minimal or avoided entirely by the application of this approach. The nature and severity of those impacts would depend greatly on the management goals for the land and the location of the project, and any such impacts would likely be outweighed by the long-term benefits derived from the management actions. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



## D.2 Water Quality Restoration Approaches

1. Reduce nutrient loads to coastal watersheds
2. Reduce pollution and hydrologic degradation in coastal watersheds

### D.2.1 Reduce Nutrient Loads to Coastal Watersheds



This restoration approach would implement conservation practices in vulnerable areas to reduce nutrient pollution and provide ecosystem-scale benefits to Gulf Coast habitats and resources chronically threatened by nutrients and co-pollutants causing water quality degradation. Depending on site characteristics, conservation practices could include a combination of agricultural conservation practices, forestry conservation practices, and/or long-term conservation cover establishment, as discussed below.

- **Agricultural conservation practices.** Through voluntary conservation programs, farmers can improve nutrient application and management methods to decrease the amount of nutrients going into the watershed and ultimately discharging into coastal Gulf waters. These practices should be coordinated with existing state and federal conservation programs operated by the USDA-Natural Resources Conservation Service (NRCS) (e.g., Environmental Quality Incentives

Program [EQIP], Conservation Reserve Program [CRP], Wetlands Reserve Program [WRP], and Wildlife Habitat Incentives Program [WHIP]). These programs provide technical assistance to farmers and implement conservation practices that will improve nutrient and sediment management along the Gulf Coast. Depending on site characteristics, conservation practices could include a combination of structural conservation practices, annual conservation practices, and/or long-term conservation cover establishment. *Structural conservation practices* typically require engineering designs and surveys and a contractor to install them (as opposed to the farmer). These practices, once implemented, are generally considered permanent. Some examples include sediment basins to intercept runoff and retain pollutants and sediments on site or drainage water management to reduce leaching of pollutants through the ground water. *Annual conservation practices* are practices that a farmer or land manager implements as part of the crop production system each year. These practices are primarily designed to promote soil quality, reduce in-field erosion, and reduce the availability of sediment, nutrients, and pesticides for transport by wind or water. They include residue and tillage management, nutrient management practices, pesticide management practices, and cover crops. *Long-term conservation cover establishment* generally consists of using a conservation easement to protect and restore wetlands on marginal lands. Priority lands for this type of conservation typically provide a cost-effective opportunity to restore wetlands, which would also provide beneficial habitat for migratory birds and other wildlife. Vegetative plantings can also be used in this practice to restore riparian buffers and wetlands or create grassed waterways to promote nutrient uptake and reduce nutrient loadings to nearby streams. Wetland restoration can also be conducted on farms where the private landowner would convert marginal farmland soils back to their historical conditions. These types of projects provide multiple benefits, including reducing nutrient and sediment load to nearby water bodies, providing critical habitat for migratory and native bird populations, enhancing ground water recharge, and providing flood protection for watersheds. All or a combination of these practices could be implemented in coordination with farmers to reduce nutrient loadings to coastal watersheds across the Gulf Coast.

- **Forestry management practices.** Forested areas serve as a natural filter to surface flows, reducing nutrient loads into the Gulf of Mexico. However, forested areas are threatened by land use changes such as hydrologic modifications and timber production. A combination of actions could be used to restore forested areas and their nutrient sequestration properties. These actions generally include removal of invasive species, prescribed burnings, reforestation, hydrologic restoration, and road restoration and/or decommissioning. These types of projects provide multiple benefits including reducing nutrient and sediment load to nearby water bodies, enhancing ground water recharge, and providing flood protection for watersheds.

#### D.2.1.1 Implementation Considerations

Water quality restoration should target areas so as to benefit coastal watersheds with chronic water quality impairments that affect coastal and nearshore habitats and resources. Furthermore, the implementation of water quality improvement techniques should be coordinated within watershed boundaries and across other habitat and resource restoration techniques to provide ecosystem-scale

benefits to the nearshore Gulf Coast. As such, the Trustees should establish watershed selection and prioritization criteria to inform site and project selection prior to implementing restoration techniques.

This approach will target areas on public or private lands with the goal of reducing nutrient losses from the landscape and nutrient loads to streams and downstream receiving waters, thus providing benefits to coastal waters that have chronic water quality degradation (e.g., hypoxia and harmful algal blooms [HABs]). As such, this approach would require the voluntary cooperation and support of partners, which may include, but are not limited to, private landowners and farmers; timber management/logging operations; municipal and county governments; and appropriate local, state, and federal agencies. Where feasible, these projects should be coordinated within watershed boundaries to enhance nutrient reductions to coastal water bodies. Examples of past successful water quality restoration projects include regional watershed management plans, state Clean Water Act 319 programs, and USDA-NRCS conservation programs (e.g., EQIP, CRP, WRP, and WHIP). This funding will not be used to fund previous activities required under local, state, or federal law (e.g., pollution reduction actions required by a Clean Water Act permit), but instead could be used in coordination with existing mandates to enhance water quality benefits. Through a coordinated and integrated watershed approach to project implementation, expected benefits include reductions in nutrient losses from the landscape, reductions in nutrient loads to streams and downstream receiving waters, reduction in water quality impairments (e.g., hypoxia and HABs), and associated benefits to coastal waters, habitats, and resources.

These conservation practices should be implemented in vulnerable and high-yield subwatersheds; however, identification of project-specific sites would require coordination with project partners. In addition, the selection of nutrient management techniques should be coordinated with appropriate local, state, and federal agencies and the private landowner/farmer. The implementation and success of these nutrient management techniques is highly dependent on cooperation and maintenance by the landowner and/or farmer. Therefore, it is important to ensure that the partners are engaged throughout the process of selecting sites and nutrient management techniques, and to provide partners with education and technical assistance to ensure appropriate implementation and maintenance throughout the lifetime of the project.

USDA-NRCS conservation programs and EPA have funded the successful implementation of agriculture conservation practices throughout the nation, resulting in significant reductions in nutrient loadings to water bodies nationwide (SWCS & ED 2007). Recently, USDA's Conservation Effects Assessment Program (CEAP) evaluated the ecological impact of the agricultural conservation practices implemented in the Texas Gulf Basin (USDA & NRCS 2015). These practices combine structural practices for controlling water erosion with structural or tillage and residue management practices to reduce nutrient runoff throughout the Texas Gulf Basin. The combined use of these conservation practices has reduced sediment, nitrogen, and phosphorus loads delivered from cropland to rivers and streams by 60, 41, and 55 percent, respectively. Additionally, under Section 319 of the Clean Water Act, EPA provides grants to states who work with partners and stakeholders to control nonpoint source pollution. This program has documented numerous examples of the use of conservation systems to restore water quality.[3]

[3] http://water.epa.gov/polwaste/nps/success319/.

The Trustees will use these types of programs, which have proven success records, to implement nutrient reduction practices in Gulf coastal watersheds to mitigate nutrient threats to estuaries and nearshore coastal waters.

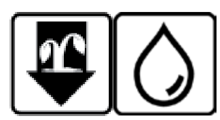
#### D.2.1.2 OPA Appropriateness Evaluation

The restoration approach "Reduce nutrient loads to coastal watersheds" meets the criteria for being appropriate under OPA. If implemented properly, as part of a package, it will enhance ecosystem services provided by restored habitats and resources and may return injured natural resources and services to baseline by 1) reducing nutrient loads to coastal watersheds, 2) improving water quality, 3) reducing the extent of eutrophication and occurrence of low dissolved oxygen (DO) and/or HABs, 4) reducing turbidity, and 5) increasing light penetration. Additionally, this approach can work to compensate for interim services losses to estuarine-dependent water column resources, oysters, SAV, and recreational uses adversely affected by the DWH oil spill. The restoration approach may compensate for lost ecosystem services by reducing nutrient runoff, which will improve water quality and mitigate chronic ecosystem threats (e.g., hypoxia, HABs, and impaired recreational use) to provide ecosystem benefits to injured resources and habitats.

The techniques described above are well studied, frequently implemented, and have been demonstrated to be effective in numerous studies by the USDA 's Conservation Effects Assessment Program (CEAP) and water quality restoration "Success Stories" for the EPA Section 319 Nonpoint Source Control Grant Program. Collateral injury to other natural resources is expected to be minimal, because the techniques will likely be implemented in areas that have high nutrient loading and other water quality impairments. Collateral injury could occur during project construction; these effects can be minimized during the design process. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR. § 990.54(a).



### D.2.2 Reduce Pollution and Hydrologic Degradation to Coastal Watersheds



This restoration approach focuses on restoring hydrology and reducing pollution in coastal watersheds to improve local water quality and provide benefits to nearshore Gulf Coast ecosystems. Development in coastal watersheds leads to hydrologic alterations that change the volume, timing, duration, and quality of freshwater inflow in the form of increased stormwater runoff and hydrologic restrictions. These alterations in freshwater inflows are also correlated to increased flooding and discharge of pollutants, including fecal bacteria and pathogens, to nearby coastal water bodies.

Stormwater runoff is the most common and ubiquitous source of nonpoint source pollution in the coastal landscape. Stormwater runoff is created when rainfall flows over natural landscape or impervious surfaces and does not percolate into the ground. Coastal development is associated with impervious surface cover (e.g., roads, rooftops, parking lots, and driveways), which increases the volume and rate of stormwater runoff (EPA 2003). Stormwater runoff accumulates debris, sediment, and pollutants (e.g., chemicals, fertilizers, herbicides, insecticides, salts, oil, and bacteria and solids from livestock, pets, and faulty septic systems) throughout the landscape and discharges them into nearby

coastal waters. This discharge can affect water quality in both local waterways and downstream coastal Gulf waters (EPA 2003). EPA and the states regulate and permit certain pollutant sources; however, strategic enhancements in pollution reduction techniques could reduce pollution of nearby coastal waters.

This restoration approach would implement a combination of stormwater control measures, erosion control practices, agriculture conservation practices, forestry management practices, hydrologic restoration, and coastal and riparian conservation techniques that are not previously mandated by the Clean Water Act. This restoration approach could implement, but is not limited to, the following techniques:

- **Low-impact development (LID) practices.** Existing stormwater infrastructure could be retrofitted with a combination of LID practices to create green infrastructure. Green infrastructure, specifically LID practices, uses a suite of techniques to disperse stormwater throughout a site to encourage infiltration and mimic predevelopment hydrology to retain stormwater on site. Some examples of LID practices include rain gardens, permeable pavement, green roofs, rainwater harvesting, and stormwater wetlands (NRC 2008). Rain gardens, also known as bioretention cells, are shallow, vegetated basins that collect and absorb runoff from roads, rooftops, and sidewalks. Rain gardens combine temporary detention with a soil medium and plants to promote stormwater retention and removal of pollutants through settling, filtration, plant uptake, and microbial decomposition and transformation. Permeable pavements are alternative paved surfaces that infiltrate, treat, and/or store rainwater where it falls. Permeable pavements may be constructed from pervious concrete, porous asphalt, permeable interlocking pavers, and several other materials. Green roofs consist of a layer of waterproofing material, growing media, and vegetation that enables rainfall infiltration and evapotranspiration of stored water. Rainwater harvesting systems collect and store rainfall for later use. Rainwater that falls on rooftops is collected and conveyed into an above- or belowground storage tank (also referred to as a cistern), where it can be used for nonpotable water uses. Stormwater wetlands, also called constructed wetlands, are shallow vegetated depressions that capture and treat stormwater using wetland plants. In addition to reducing the concentrations of pollutants in stormwater, these techniques would reduce the volume of stormwater flows, which would in turn reduce the occurrence of combined sewer overflows and related water quality degradation.

- **Traditional stormwater control measures (SCM).** Where stormwater management has not been previously mandated, and LID practices cannot be installed due to site constraints (e.g., high water table), traditional SCMs could be installed to intercept stormwater, prevent flooding, allow settling of pollutants, and reduce pollutant loadings to estuarine water bodies. Traditional SCMs typically fall into two main categories: 1) retention systems and 2) detention systems (SFWMD 2002). Retention systems rely on absorption of runoff to treat urban runoff discharges, whereas detention systems detain stormwater for a short period of time (e.g., 24 hours) and rely on settling to remove pollutants. Retention BMP systems include dry retention basins, exfiltration trenches, concrete vegetated filter strips, and grassed swales. Detention systems include wet and dry ponds.

- **Erosion and sediment control (ESC) practices.** A range of practices can be used to minimize erosion and the transport of sediment downstream. USDA-NRCS uses various techniques to reduce erosion and soil loss from farms (e.g., sediment basins, vegetative buffers, or terracing). For example, Florida's Stormwater Erosion and Sediment Control Inspector's Manual provides BMPs for other land uses and activities (FLDEP 2008). In certain regions of Florida, unpaved roads exposed to torrential rainfall can cause significant erosion and result in sediment loadings to nearshore water bodies. ESC practices for unpaved roads might entail paving the unpaved road from hill crest to hill crest, using less erosive aggregate material, raising the road profile, installing grade breaks, incorporating additional drainage outlets, or removing roadside ditches and replacing them with vegetated swales.

#### D.2.2.1 Implementation Considerations

Site-level water quality restoration has proven successful throughout the nation (Clausen et al. 2000; Holman-Dodds et al. 2003; Roseen et al. 2009). However, restoration of water quality at the watershed scale (and the scale of Gulf Coast estuaries) will require a coordinated, comprehensive watershed approach. As such, water quality restoration activities should target coastal watersheds that have degraded water quality affecting coastal and nearshore habitats and resources. Furthermore, the implementation of water quality improvement techniques should be coordinated at a watershed level and across other habitat and resource restoration techniques to provide ecosystem-scale benefits to the nearshore Gulf Coast. Consequently, watershed selection criteria should be established to inform site and project selection prior to implementing restoration approaches (Schueler & Kitchell 2005).

Some pollution is permitted and regulated by the federal Clean Water Act and/or under state authorities; those permitted activities could not be addressed through NRDA funding. Water reuse regulations may also prevent the option for water reuse projects in certain locations.

Stormwater management is an increasingly common practice in watershed districts. For example, the city of Tampa, Florida, which has focused on improving Tampa Bay water quality since before 1965 (Johansson 1991), has established a Stormwater Division. This department is responsible for designing, constructing, and maintaining SCMs. To date, the SCMs include more than 600 miles of stormwater pipe, more than 250 miles of ditches and culverts, and more than 100 treatment ponds, as well as the cleanup of curbed streets to reduce contaminants and flooding. Stormwater management in Tampa Bay, in concert with nitrogen controls from wastewater treatment facilities, power plants, and fertilizer manufacturers, is credited with the recovery of seagrass populations in Tampa Bay (Greening et al. 2011). Although the main focus for Tampa Bay is nutrient management, the diversity of water quality management strategies, including stormwater management, has resulted in ecosystem benefits (e.g., increased water quality, seagrass bed expansion, and increased recreational use).

#### D.2.2.2 OPA Appropriateness Evaluation

The restoration approach "Reduce pollution and hydrologic degradation in coastal watersheds" meets the criteria for being appropriate under OPA. If implemented properly, it can return injured natural resources and services to baseline by 1) reducing pollutant, nutrient, and pathogen loads to coastal watersheds; 2) improving water quality; and 3) improving recreational use. This approach can also help compensate for interim services losses to estuarine-dependent water column resources, oysters, SAV, and recreational uses adversely affected by the DWH oil spill. Through reducing nonpoint source

pollution (e.g., pollutants, nutrients, and pathogens), it will improve water quality and mitigate chronic ecosystem threats (e.g., hypoxia, HABs, habitat degradation, and impacts to recreational use) to provide ecosystem benefits to injured resources and habitats.

The techniques described above are well studied, frequently implemented, and effective and have demonstrated success and promise through numerous research studies, EPA and state regulations, and watershed management plans. Collateral injury to other natural resources is expected to be minimal, because the techniques will likely be implemented in areas that have observed damages associated with water quality degradation. Collateral injury could occur during project construction, but this potential would be minimized and mitigated during the design process. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR. § 990.54(a).

## D.3 Fish Restoration Approaches

1. Reduce impacts of ghost fishing through gear conversion and/or removal of derelict fishing gear
2. Reduce mortality among Highly Migratory Species and other oceanic fishes
3. Voluntary reduction in Gulf menhaden harvest
4. Incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship
5. Voluntary fisheries-related management actions to increase fish biomass
6. Reduce post-release mortality of red snapper and other reef fishes in the Gulf of Mexico recreational fishery using fish descender devices
7. Restore sturgeon spawning habitat
8. Reduce Gulf of Mexico commercial red snapper or other reef fish discards through IFQ allocation subsidy program



### D.3.1 Reduce Impacts of Ghost Fishing Through Gear Conversion and/or Removal of Derelict Fishing Gear

This restoration approach focuses on reducing the amount of ghost fishing by derelict fishing gear. Marine debris is one of the most widespread pollution problems facing ocean and coastal environments worldwide (IMDCC 2014; NAS 2009). In the United States, the U.S. Congress defines marine debris as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned in the marine environment or Great Lakes (33 USC § 1951 *et seq*., as amended). One of the most persistent and damaging types of marine debris is lost or derelict fishing gear (Macfadyen et al. 2009), which continues to catch organisms after the gear is lost, a phenomenon known as "ghost fishing." Ghost fishing from derelict fishing gear is a potentially significant source of mortality for fish and other organisms (Arthur et al. 2014; Macfadyen

et al. 2009). Derelict blue crab traps are a potential target for restoration, because they are present in high numbers in the Gulf, are documented to catch estuarine-dependent finfish and invertebrate species, and are relatively easy to find in both intertidal and subtidal waters. Research indicates that traps 1) are lost due to many factors, some of which are preventable; 2) persist in the environment for several years; and 3) nondiscriminately catch target and nontarget species (Arthur et al. 2014; Bilkovic et al. 2014; Clark et al. 2012; Guillory 1993; Havens et al. 2008). Multiple restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Implement contract and volunteer removal programs to collect existing derelict fishing gear.** Removal programs collect existing derelict fishing gear to reduce the number of invertebrates (such as blue crabs) and finfish that are killed annually by derelict gear. Several options exist for implementing a program to remove derelict fishing gear from estuarine and marine waters in the Gulf. Fixed-price or performance-based contracts may be used to engage fishers in subtidal removal events, while intertidal removal events may be coordinated based on volunteer participation. Alternately, this technique could expand the capacity of existing removal programs. This technique can draw on experience from existing derelict gear removal programs and regulations for ghost fishing (e.g., Florida's Spiny Lobster, Stone Crab and Blue Crab Trap Retrieval Program and Derelict Trap and Trap Debris Removal Program, as well as Texas' Abandoned Crab Trap Removal Program) to determine effective implementation options (FWC 2015; TPWD 2015).
- **Conduct voluntary gear conversion programs.** Voluntary gear conversion programs support efforts to integrate degradable components in actively fished traps to limit ghost fishing if the traps become derelict. Such programs could target areas where no regulations for degradable components currently exist. Gear would be provided to fishers along with a financial incentive to add degradable components to their gear. In addition, technical assistance could be provided to instruct fishers on the correct installation and placement of the degradable components. Several options for degradable components in fishing gear are available. For example, in the blue crab fishery, options for degradable components include 1) cotton cord (known as "rot cord") covering an escape panel or spring-loaded lid opening, 2) degradable panels made of wood, 3) degradable cull rings made of a naturally occurring group of polymers called polyhydroxyalkanoates (PHAs), and 4) degradable hog rings.

#### D.3.1.1 Implementation Considerations

Implementing these techniques would allow fishers to modify their gear during mandatory, short-term fishery closures for derelict trap removal events, thereby receiving an incentive fee during a period when they would not be allowed to fish. Outreach to the fishing community and volunteers will be an important component of this restoration approach. This includes engaging and cooperating with local fishers to inform implementation. These factors are essential in building sustained and successful gear removal and modification programs. Similarly, this approach would benefit from establishing strong ties with state conservation agencies, fishers, Sea Grant extension agents and scientists, and other local organizations during project development, which would increase the likelihood of project success on the local level. Since this approach is voluntary and incentivized, working with stakeholders would help to

create the appropriate incentives for encouraging participation in fishing gear removal and gear conversion events. The techniques described above are reasonable and well-established. The volunteer gear modification program, which would target commercial fishers in Louisiana, Mississippi, and Alabama, is modeled after existing regulatory requirements for degradable trap components that are promulgated in Florida, Texas, and elsewhere (Bilkovic et al. 2012; Florida Department of State 2007). The proposed gear modification and removal programs may leverage existing programs such as those in Florida to ensure additive benefits by expanding the capacity, timeframe, and/or engagement of local and state stakeholders.

#### D.3.1.2 OPA Appropriateness Evaluation

The restoration approach "Reduce impacts of ghost fishing through gear conversion and/or removal of derelict fishing gear" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by reducing ghost fishing-related mortality of blue crab and nontargeted finfish by integrating degradable components into fishing gear and removing derelict gear from nearshore and offshore waters. Additionally, this approach can help compensate for interim services losses to estuarine fishery resources adversely affected by the DWH oil spill. Habitat improvement resulting from derelict gear removal can benefit multiple fishery resources as well as benthos; reduce entanglement hazards for marine mammals, sea turtles, and seabirds; and create incentives for participating fishers (e.g., Arthur et al. 2014).

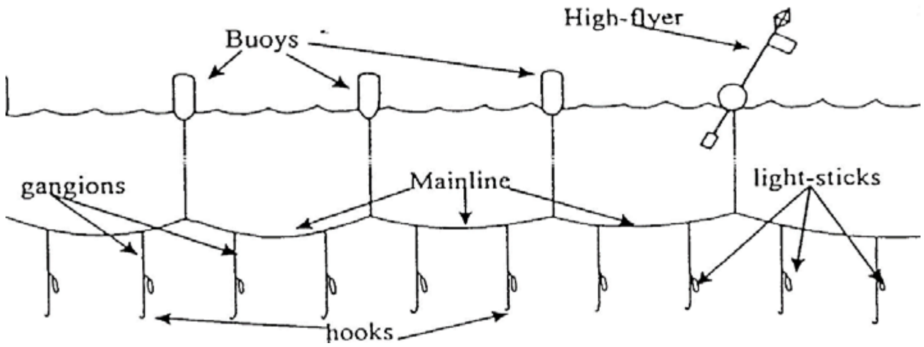
Derelict trap removal programs in the Gulf of Mexico have previously been implemented, and they have included volunteer efforts to remove derelict traps from intertidal waters as well as contract-driven fisher efforts to remove derelict traps from subtidal waters (e.g., Anderson & Alford 2014; Ocean Conservancy 2009). Collateral injury to other natural resources is expected to be minimal, given that both techniques decrease the amount of ghost fishing in derelict traps. The gear conversion technique is expected to decrease collateral injury to other natural resources during normal fishing operations, and the gear removal technique is expected to follow BMPs (e.g., those outlined in NOAA 2013b) to ensure minimum habitat damage to benthic substrate, adverse water quality impacts, and interactions with other natural resources. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



### D.3.2 Reduce Mortality Among Highly Migratory Species and Other Oceanic Fishes

Highly migratory species and other oceanic fishes, including tunas, billfishes, sharks, and swordfish, transit large expanses of the world's oceans in search of desirable habitat, such as foraging or spawning grounds. In doing so, they move between jurisdictional boundaries. These species are threatened by the substantial mortality associated with bycatch (catch of nontarget species) within the commercial pelagic longline (PLL) fishery and post-release mortality in recreational rod and reel (RR) fisheries. The PLL fishery in the Atlantic (which includes the Gulf of Mexico and Caribbean) primarily targets yellowfin tuna, bigeye tuna, and swordfish. Incidentally caught species include bluefin tuna,

billfish, and sharks (see Figure 5.D-16). Regulations, fishing practices, and bycatch mortality vary substantially by country and geography.




*Source: Arocha (1997).*

**Figure 5.D-16.** Typical pelagic longline (PLL) fishing gear. The PLL fishery uses gear with a mainline of monofilament with long, branch or "gangion" lines suspended from the mainline, each with a hook (e.g., circle or J) and bait specific to the targeted fishery.

This restoration approach aims to reduce bycatch-related mortality to highly migratory species (HMS) and other oceanic fish by encouraging fishers to convert to fishing gear that can exclude, or reduce harm to, nontarget species, including those considered undersized (i.e., not retained because of regulatory limits). Multiple restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Promote gear conversion to circle hooks and weak hooks.** Circle hooks cause less severe injuries to HMS when they are caught; as a result, fish released after being caught with circle hooks have a higher survival rate than those caught on traditional J hooks (Cooke & Suski 2004; Serafy et al. 2012a; Serafy et al. 2012b; Walter et al. 2012). Circle hooks point into and are perpendicular to the hook shank, forming a circle (in contrast to J hook points that are parallel with the hook shank) (see Figure 5.D-17 and Figure 5.D-18). The circle hook reduces gut hooking and is more likely to hook a fish in the corner of the mouth than a J hook, reducing injury and increasing post-release survival for some species (e.g., see Cooke & Suski 2004; Horodysky & Graves 2005; Kerstetter & Graves 2006; Serafy et al. 2012b). A "weak hook" is a standard circle hook composed of finer gauge wire that is designed to straighten with less force than a standard hook, releasing larger nontarget species (Bigelow et al. 2012). Weak circle hooks have been shown to reduce incidental catch of large bluefin tuna without affecting the catch of target species (Foster & Bergmann 2012). Large circle hooks or other bycatch reduction devices (BRDs) also benefit sea turtles, marine mammals, sharks, and seabirds.

*Source: NOAA (2013a).*

**Figure 5.D-17.** J hook (left) and circle hook (right).

5.D Restoration Approaches and OPA Evaluation

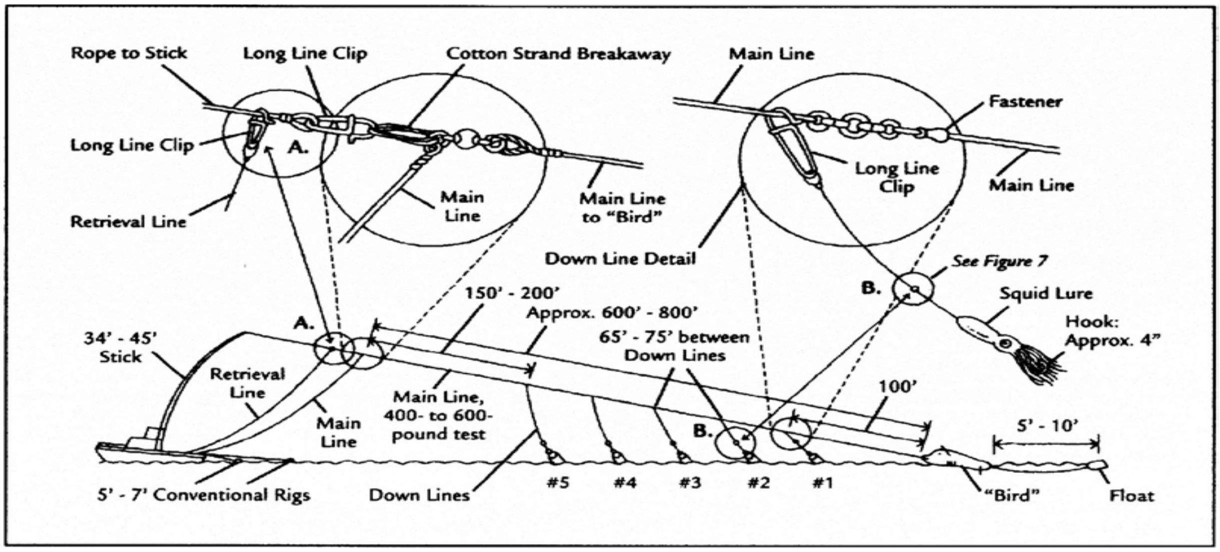
Longline landings by U.S. fleets are small, averaging only 5 percent of total Atlantic longline landings for 2004 through 2013 (ICCAT 2014). Therefore, expanding the use of circle and weak circle hooks beyond the United States provides an opportunity to reduce catch, bycatch, and discard or release mortality in species that migrate long distances. For example, compensating Mexican fishers to voluntarily replace circle hooks with weak circle hooks in the Mexican PLL fishery, which already uses circle hooks, could reduce incidental catch of bluefin tuna and related injury and mortality.

***Source:*** *NMFS (2015b).*

**Figure 5.D-18.** Standard circle hooks (top) and weak circle hooks (bottom) after bluefin tuna experiments.

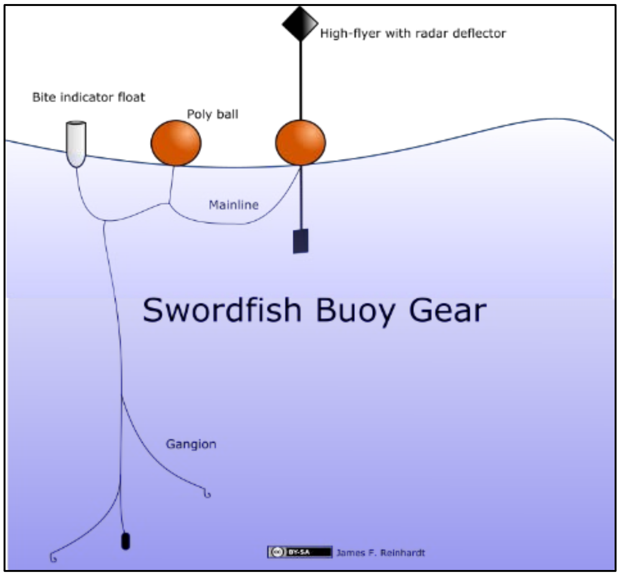
- **Promote gear conversion to greenstick and buoy gear.** Greenstick gear (Figure 5.D-19) is used to target yellowfin and bigeye tuna, and buoy gear (Figure 5.D-20) is used to target swordfish. Both types of gear are used in some regions of the Atlantic HMS fishery, but are used much less frequently than PLL gear; preliminary data have shown significantly lower bycatch rates for greenstick and buoy gear than for PLL gear (Kerstetter et al. 2014; Kerstetter & Bayse 2009). Greenstick gear is defined at 50 CFR § 635.2 as "an actively trolled mainline attached to a vessel and elevated or suspended above the surface of the water with no more than 10 hooks or gangions attached to the mainline." It has neither the soak time nor the depth associated with PLL. Buoy gear consists of one or more flotation devices supporting a single mainline to which no more than two hooks or gangions are attached, and is typically used at night. No more than 35 flotation devices may be possessed or deployed, and no more than 35 individual buoy gears are allowed per vessel. Buoy gear hooks and/or gangions are attached to the vertical portion of the mainline. All deployed buoy gears are required to have monitoring equipment. Bycatch mortality is less with this gear than with typical PLL gear, because a fewer number of hooks are fished, and the gear is more frequently tended, which increases the likelihood that bycatch would be released alive.

- **Implement incentive-based annual time closure (repose period).** Time closures in the Atlantic and Gulf U.S. fisheries have been successful at reducing bycatch in the PLL and other fisheries (Wilson et al. 2007). When done in combination with gear conversions (e.g., greenstick and buoy gear), fishers utilizing the alternate gear can continue to fish during the repose because bycatch of pelagic fish is still being reduced. One goal of providing the alternative gear and compensation during a repose period is to reduce adverse financial impact on fishers and help maintain local economies.




***Source:*** *Wescott (1996).*

**Figure 5.D-19**. Greenstick fishing rig.




***Source:*** *James F. Reinhardt.*

**Figure 5.D-20.** Buoy gear with four flotation devices attached.

### D.3.2.1 Implementation Considerations

This restoration approach could include combinations of techniques in multiple geographies. For example, circle hooks could be exchanged for J hooks in the Caribbean recreational pelagic fishery and international commercial PLL fishery to reduce mortality among HMS that are caught as part of catch-and-release fisheries or discarded due to regulatory or value constraints. Projects could be implemented with incentives such as no-cost hooks and monetary payment. All combinations of methods for implementing this approach require nuanced implementation considerations; the considerations below are some examples.

Challenges to project implementation of the recreational fishery hook exchange include the large number of recreational vessels in the United States and the Caribbean. In the United States, it is difficult to track the large number of recreational vessels that have acquired permits (i.e., 25,238 angling category and 4,173 charter boat permits). Overall, the fishery is not geographically confined, and recreational fishing reporting requirements are less stringent than those for commercial vessels (e.g., no observer coverage in the recreational fishery). Furthermore, noncompliance or limited compliance with reporting requirements is a significant problem throughout the fishery (NMFS 2014a).

This approach could also be used to exchange hooks for weak circle hooks in fisheries that catch spawning bluefin tuna, such as the Mexican commercial PLL fishery. Such a hook exchange would reduce the catch of large bluefin tuna, which are heavy enough to bend the hook and escape, and could be implemented using an incentive-based program such as no-cost hooks and monetary payment. Exchanging hooks for weak circle hooks with Mexican fishers would require coordination and contracts with vessels, but the Mexican PLL fishery is relatively small and limited in its distribution. Among non-U.S. PLL vessels with whom an exchange of J hooks for circle hooks or weak circle hooks is desired, vessel owners would need to be contacted and workable contracts for hook exchanges developed. Implementing monitoring for non-U.S. vessels would also require coordination with government entities.

This approach depends on voluntary participation of stakeholders and the adoption of identified bycatch reduction strategies to ensure reduced bycatch. The reliance on voluntary participation inherently introduces uncertainty regarding how much progress can be made toward restoration outcomes. Providing incentives, establishing agreements, and providing education and outreach can reduce these uncertainties. This approach could also benefit from coordination with sea turtle and marine mammal restoration approaches that have similar uncertainties and potential mechanisms for reducing them.

This approach could also compensate fishers for refraining from fishing during an annual repose period (e.g., bluefin tuna spawning period) and/or provide alternative gear types or allow the use of techniques that reduce bycatch during the repose for continued fishing. Incentives could also include replacing existing vessels with vessels that could fish with alternatives gears more effectively. Doing so would enhance the long-term utilization of alternative gear technology. As part of a fishing repose and alternative gear provisioning project, technical extension services would be provided to participants to educate users and refine alternative gear to maximize its effectiveness. These services would include research, outreach, and training on the use of the alternative gear types. Under existing U.S. regulations, vessels that do not possess PLL gear on board may fish inside the PLL gear-restricted areas. The Trustees would provide technical extension services related to rigging and fishing with greenstick and buoy gear to help fishers learn to use the alternative gear. Fishers that become proficient with the use of greenstick and buoy gear might continue to use these gears to some extent during times outside the PLL repose period. To the extent these types of gear replace PLL gear, increased benefits for fish stocks may accrue through additional reductions in dead discards.



#### D.3.2.2 OPA Appropriateness Evaluation

The restoration approach “Reduce mortality among HMS and other oceanic fishes” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by reducing fishing mortality to HMS and other oceanic fishes by increasing the use

of fishing gear that reduces hooking injury and/or increases gear selectivity to targeted species. It can also benefit other bycatch species such as sea turtles. Additionally, this approach can help compensate fishers for interim services losses to fishery resources, which were adversely affected by the DWH oil spill. It would do this by altering the catch and/or the post-release mortality rates of a targeted or bycaught species, resulting in increases in biomass of fish species injured by the spill.

The techniques described above decrease mortality to pelagic species, by 1) decreasing directed fishing mortality, 2) increasing post-release survival, and/or 3) reducing bycatch through gear exchange programs and a voluntary fishing repose. A number of studies have demonstrated decreased rates of bycatch and mortality rates of bycaught species and regulatory discards due to the use of alternative gear types (e.g., see Cooke & Suski 2004; Curran & Bigelow 2011; Horodysky & Graves 2005; Kerstetter et al. 2014; Serafy et al. 2012b). This has resulted in regulatory adoption of alternative gear types in some areas (i.e., the requirement to use weak hooks in the Gulf PLL fishery). Additionally, reducing fishing effort through the use of closed areas and/or seasonal fishing closures is a widely accepted practice in fisheries management to reduce bycatch and rebuild and sustain fish stocks. Collateral injury to other natural resources is expected to be minimal because this approach will not increase the level of fishing effort, and the use of alternative gear proposed in the gear exchange program (circle hooks and weak hooks) should result in a net reduction in fishing mortality to discarded species (Bayse & Kerstetter 2010; Foster & Bergmann 2012). Circle hook use may increase catch rates of some species; however, since many of these are targeted species, this technique could result in more efficient fisheries. Impacts to all species will need to be monitored to ensure that the project results in the anticipated benefits. In addition, in some cases, quota transfer is permitted among ICCAT nations; therefore, projects must be monitored to ensure that benefits achieved in one area are not offset by adverse impacts on resources elsewhere. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



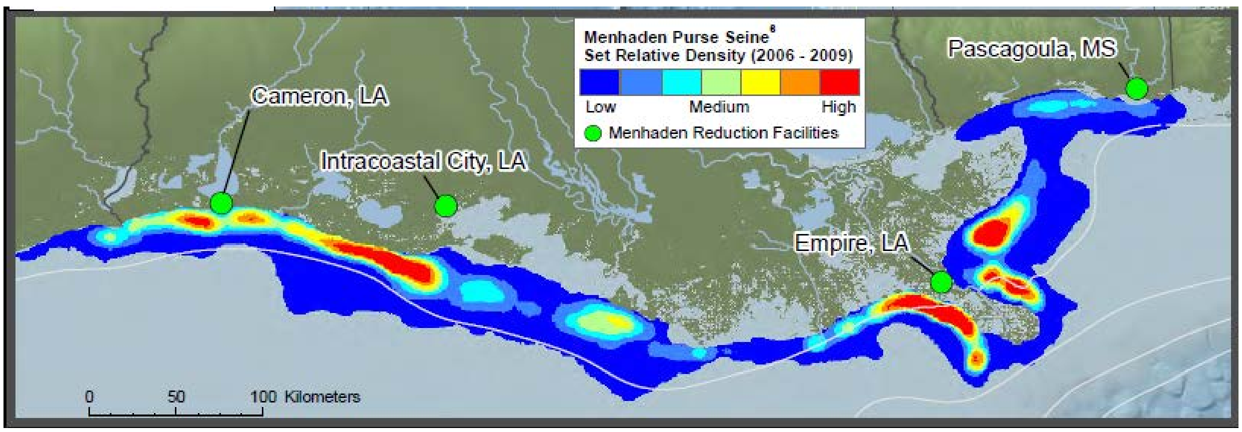
### D.3.3 Voluntary Reduction in Gulf Menhaden Harvest

This restoration approach focuses on a voluntary reduction in menhaden harvest by the two companies operating in the Gulf of Mexico. Gulf menhaden (*Brevoortia patronus*) is an estuarine-dependent species that is one of the primary prey items for coastal and pelagic fishes, marine mammals, and seabirds (Deegan 1993). Studies have documented Gulf menhaden consumption by at least 35 species, including ecologically and recreationally important finfish (Akin & Winemiller 2006; Scharf & Schlicht 2000), sharks (Barry et al. 2008; Bethea et al. 2004), seabirds (Withers & Brooks 2004), and marine mammals (Barros & Wells 1998; Fertl & Wursig 1995; Leatherwood 1975). Thus, reducing the menhaden harvest may have broad effects on the northern Gulf of Mexico ecosystem (Geers 2012; Geers et al. 2014).

The Gulf of Mexico menhaden fishery is one of the largest in the United States by weight, landing 497.5 metric tons of fish in 2013 and 391.9 metric tons in 2014 (NMFS 2015a). Consolidation of the fishery has occurred to the point that only two companies (Omega Protein, Inc., and Daybrook Fisheries, Inc.) currently harvest and process fish. These companies are vertically integrated, owning all the fishing

vessels and processing facilities. The major products of this fishery are fish meal, fish oil, and fish solubles, which are then traded on the commodities market.

Purse seines are the primary means of menhaden harvest in the Gulf. The fishery operates mostly in state waters and is focused in Louisiana waters (see Figure 5.D-21). A small bait fishery for menhaden also exists, but it is much smaller and not considered within this restoration approach. The menhaden fishery is managed by state agencies coordinated by the Gulf States Marine Fisheries Commission, an advisory committee that consists of state, federal, and industry representatives. The only relevant Gulf-wide management measures include a seasonal closure that prevents harvest from November 1 through the third Monday in April. Texas is the only state that sets an annual harvest quota for menhaden in the Gulf.




***Source:*** *Love et al. (2013).*

**Figure 5.D-21.** Menhaden fishing effort in the Gulf of Mexico from 2006-2009. Note: the Cameron, Louisiana, facility has closed since the creation of this map.

This restoration approach would establish voluntary, company-specific quotas that would ensure that catches remain at the targeted level and allow the industry maximum flexibility.

### D.3.3.1 Implementation Considerations

This restoration approach entails establishing voluntary, company-specific quotas that would ensure that catches remain at the targeted level. This technique allows the industry the flexibility to maximize their efficiency by determining when and where they fish. Menhaden processing companies would be compensated for their participation in the reduced catch program based on a valuation of the projected decrease in menhaden landings resulting from project participation. Specific agreements or contracts would be developed with each company specifying the agreed-on quota, timing, and other considerations. The primary implementation challenge with this technique may be gaining industry buy-in. The amount of the final harvest reduction, duration of the project, and the size of the fair market value compensations would be subject to negotiation with the participating entities. Socioeconomic impacts on the labor force and fishing communities would also need to be analyzed prior to implementation. The scale of the biomass removed by the fishery, consolidation of participants, and the ecological role of menhaden as prey for numerous species creates a unique opportunity to restore large quantities of biomass lost from the DWH oil spill. Reducing the menhaden harvest for a period of time will allow the biomass of menhaden, bycaught species, and menhaden predators to increase. Other

conditions of the contract would include1) limiting reinvestment in the fishery in order to reduce the potential for this project to increase harvest once the contract is over, and 2) restricting contracting parties from reallocating fishing effort to other fisheries or geographic regions.

#### D.3.3.2 OPA Appropriateness Evaluation

The restoration approach "Voluntary reduction in Gulf menhaden harvest" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by reducing menhaden harvests and enhancing the benefits menhaden provide within the Gulf food web. Conversely, the detrimental effects of increased menhaden would also need to be considered; for instance, higher abundance of menhaden may lead to adverse effects on other fish through complex foodweb interactions. Additionally, this approach can help compensate for interim services losses to fishery resources adversely affected by the DWH oil spill by reducing fishing pressure on menhaden, an important forage fish in the Gulf of Mexico. Reducing menhaden harvest may also result in increases in finfish resources, including the biomass of menhaden, menhaden predators, and bycaught species.

The approach described above is designed to increase the amount of menhaden and other species remaining in the ecosystem. Harvest reductions are proven to increase fish populations. Decreasing fishing pressure can cause quick and positive response among fish stock, especially for species with short generation times (Beare et al. 2010; NMFS 2009). Collateral injury to other natural resources is expected to be minimal, but this approach may cause increases in international fishery landings in order to absorb the demand for fish products. This effect will need to be assessed periodically. In addition to increasing forage fish availability in the food web, a reduction in harvest effort would also reduce the potential for sea turtle and marine mammal interactions with fishing operations. Further modeling may be necessary to ensure that the maximum benefit is obtained. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



### D.3.4 Incentivize Gulf of Mexico Commercial Shrimp Fishers to Increase Gear Selectivity and Environmental Stewardship

This restoration approach focuses on the inshore and offshore shrimp fisheries operating in the northern Gulf of Mexico to reduce the capture and mortality of bycatch associated with this fishery. Otter and skimmer trawls, the two most common gear types employed in the Gulf shrimp fishery, are nonselective fishing gear that typically retrieve large amounts of finfish, crustacean, and invertebrate bycatch in addition to commercially targeted brown and white shrimp (*Farfantepenaeus aztecus* and *Litopenaeus setiferus*, respectively) (Scott-Denton et al. 2012; Steele et al. 2002). Discarded bycatch in the commercial shrimp fishery affects finfish species integral to Gulf food webs and also key commercial and/or recreational fisheries resources (Crowder & Murawski 1998; Harrington et al. 2005). For example, the offshore shrimp trawl fishery is a significant source of mortality for the juvenile red snapper (*Lutjanus campechanus*) (SEDAR 2013), and Gulf menhaden (*Brevoortia patronus*) is a frequent bycatch product in the inshore fishery (Burrage 2004; Warner et al. 2004). The magnitude of bycatch captured by trawl fisheries is large. As a whole, shrimp trawling in U.S. federal

waters of the Gulf generated approximately 229 million pounds of bycatch in 2010, which exceeded shrimp landings by a factor of 1.76 (approximately 129 million pounds of shrimp landed) (NMFS 2013c). Federal and state management regulations require that many nontarget species be discarded. Due to the intensity and duration of fishing operations, mortality of bycatch is assumed to be 100 percent. A variety of restoration techniques are available for use, individually or in combination, to reduce bycatch in the Gulf shrimp fisheries. This restoration approach could employ, but is not limited to, the following techniques:

- **Promote gear conversion to more efficient BRDs.** Federal regulations currently mandate the use of BRDs on all shrimp trawl nets used in offshore federal waters. Regulations regarding the use of BRDs for the shrimp fishery in nearshore state waters vary among the states. Consistent with federal regulations, Florida and Texas require that shrimp trawlers have BRDs installed on nets rigged for fishing, while Alabama, Mississippi, and Louisiana do not require BRDs (ALDCNR 2012; LDWF 2014; MDMR 2011). The offshore fishery uses otter trawl gear almost exclusively (NMFS 2013a), and most federally permitted fishers (80 percent) use the Gulf fisheye BRD (Scott-Denton et al. 2012). Both otter trawl and skimmer trawl gears are commonly used in the nearshore shrimp fishery. Skimmer trawls are used primarily in shallow waters (e.g., less than 10 meters). This technique would create incentives for using more efficient BRDs where they are already required, or using any BRDs where they are not currently required. For example, in the offshore fishery, voluntary participants could fish with nets rigged with an upgraded BRD (e.g., composite panel over the fisheye) for an agreed-on length of time. In the nearshore fishery, participants could agree to use a BRD if their nets are not currently equipped with one, or an upgraded BRD if one is currently used.

- **Promote gear conversion to a hopper post-catch sorting system.** Hopper sorting systems alleviate common stresses associated with traditional sorting techniques, such as extended air exposure of finfish during the catch sorting process (Broadhurst et al. 2008; Ferguson & Tufts 1992; Gingerich et al. 2007). Installing hoppers on Gulf shrimp trawl vessels may reduce mortality associated with bycatch by an average of 16 percent based on number of individuals surviving (Dell et al. 2003). This would represent a substantial reduction in total mortality for this high volume shrimp fishery. Voluntary, incentivized gear conversion could include the gear and installation costs associated with building the system and retrofitting the vessel deck. Many fishers in the Queensland, Australia, East Coast prawn trawl fishery use "hopper" post-catch sorting systems, in which the catch is transferred to a tank of fresh seawater rather than onto a dry sorting-tray. Commercial product and bycatch is lifted from the hopper and transferred onto a moving conveyor belt where targeted shrimp catch is removed and bycatch is allowed to continue on the belt over the side of the vessel via a discard chute (Dell et al. 2003). With this type of catch sorting system, bycatch is discarded immediately at the time of sorting, rather than being left on the sorting table until all commercially important species have been collected.



#### D.3.4.1 Implementation Considerations

Each of the two techniques could be considered separately or in combination. There are some overarching considerations that are important for restoration implementation: 1) there are differences in federal and state shrimp fishery management regulations, 2) there are differences in management

and policies among the states, 3) gaining voluntary participation depends on carefully planned outreach and coordination, 4) benefits and likelihood of success depend on season and geography; 5) developing appropriate incentives for fisher participation would require input from gear modification and fisher experts, and 6) there are differences in implementation costs.

As stated above, federally permitted vessels must have a BRD installed on trawl nets. Regulations requiring the use of BRDs in state waters vary across the Gulf. The states of Florida and Texas require BRDs on all nets, while Alabama, Mississippi, and Louisiana do not. The differences between federal and state regulations are important considerations when developing an implementation plan. Fishers that currently use BRDs may be more likely to participate; however, a greater biomass benefit may be achieved by adding BRDs to trawl gear not currently rigged with a BRD. Shrimp trawlers need proper incentives and training to use new gear types and alter their established fishing practices. Also, any aspect of the project conducted in state waters would require coordination with state fisheries managers.

Gear modification and shrimp fishery experts should be relied on for assistance in developing several important aspects related to project implementation. Shrimp trawl and gear experts have built longstanding relationships with fishers, and their assistance may be required to identify and engage with potential participants. Outreach should be conducted on a vessel-by-vessel basis and implemented in off-peak seasons to minimize disturbance to fishers. The Trustees would identify geographic areas of the Gulf that could produce the desired benefit to a species or group of species. They would also identify potential participants that would be expected to fish in the desired locations at the optimal times of year.

This approach depends on voluntary participation of stakeholders and the adoption of identified bycatch reducing strategies. The reliance on voluntary participation inherently introduces uncertainty regarding how much progress can be made toward restoration outcomes. Providing incentives, establishing agreements, and providing education and outreach can reduce these uncertainties. This approach could also benefit from coordination with sea turtle and marine mammal restoration approaches that have similar uncertainties and potential mechanisms for reducing them.

The cost of BRDs ranges from $50 to several hundred dollars, while the total cost of a hopper system would range from tens of thousands to hundreds of thousands of dollars depending on the size of the vessel, costs of materials, and installation costs. Despite the high costs associated with installing a hopper sorting system, the Trustees believe long-term use and large-scale adaptation of these devices throughout the Gulf could occur. The Australian commercial fishery introduced hopper sorting systems to produce a higher quality prawn product, which could command a higher market price.

Several studies have evaluated the effectiveness of various BRD technologies in the Gulf shrimp trawl fishery and have indicated that finfish bycatch is reduced when BRDs are used. For example, using inshore otter trawl gear in Tampa Bay, Florida, Steele et al. (2002) noted that finfish catch per unit effort (CPUE) was always less when nets equipped with either the Florida fisheye or the extended mesh funnel BRD were used, compared with nets without a BRD. Shrimp biomass and numbers were also reduced, but the differences were not significantly different relative to control nets. Similarly, Burrage (2004) evaluated the performance of Gulf fisheye BRDs on otter trawl gear in the inshore fisheries of Louisiana

and Mississippi and determined that the BRD produced a substantial reduction in finfish bycatch (up to 42 percent) with no shrimp loss in three of the four evaluations. Using skimmer trawls equipped with a Gulf fisheye BRD in Apalachicola Bay, Florida, Warner et al. (2004) observed a 20 percent and 50 percent decrease in finfish bycatch in spring and fall seasons, respectively, with no reduction in shrimp landings. Although the Gulf fisheye is the most commonly used device, others have been shown to be more effective. For example, the composite panel BRD provides a reduction in bycatch of approximately 50 percent with a mean shrimp loss of only 1 percent.

#### D.3.4.2 OPA Appropriateness Evaluation

The restoration approach “Incentivize Gulf of Mexico commercial shrimp fishers to increase gear selectivity and environmental stewardship” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by creating incentives for the use of more effective bycatch reduction devices and post-catch sorting systems in shrimp trawl practices. Additionally, this approach can help compensate for interim services losses to fishery resources adversely affected by the DWH oil spill by reducing both total bycatch biomass retrieved and mortality of landed nontarget species common in the commercial shrimp trawl fishery.

The techniques described above are proven to reduce bycatch and subsequent mortality of finfish in the commercial shrimp fishery in both U.S. and international trawl fisheries (Burrage 2004; Dell et al. 2003; Steele et al. 2002; Warner et al. 2004). They also provide benefits to species or groups of species affected by the spill, which may include red snapper, Atlantic croaker, Gulf menhaden, and others (Scott-Denton et al. 2012). Collateral injury to other natural resources is expected to be minimal because the Trustees do not anticipate that this approach will change current commercial shrimp trawl fishing behavior. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



### D.3.5 Voluntary Fisheries-Related Actions to Increase Fish Biomass

This approach would restore both target and bycatch species of Gulf of Mexico fisheries through influencing the type, amount, and specificity of fishing mortality. Fisheries, fishing pressure, and fishing technologies will evolve over time and new opportunities for increasing fish biomass through voluntary efforts could emerge. Actions to reduce fishing mortality will be implemented in partnership with the fishing community as mutually beneficial agreements between fishing operations and the Trustees. Knowing that bycatch remains a large concern in Atlantic (including Gulf) fisheries, this approach includes examples of the types of emerging issues which could be addressed through restoration:

- **Emerging fishing technologies.** New technologies could develop over time as fisheries evolve, which could represent opportunities to use new gear or technology to implement other bycatch reduction efforts. This could include supporting programs that develop or assist in the development of technological solutions that reduce bycatch of fish species injured during the DWH oil spill. Funds provided for technological innovation will help accelerate the pace of development of technologies that can ameliorate fishing impacts and create efficiencies for the

fishing industry. For technologies that have already shown promise in small-scale design studies, this approach can help provide necessary resources to scale up the technology to increase benefits to fish species injured during the DWH oil spill. This approach could include workshops to establish goals and objectives for improvements in bycatch reduction technologies and technology transfer as it relates to injured resources. Funding mechanisms to support bycatch reducing technology and the transfer of these technologies on a large scale to the fishery could also be established.

- **Illegal, unregulated, unreported (IUU) fishing.** Illegal fishing refers to fishing activities that violate applicable laws and regulations, including those laws and regulations that are used to sustainably manage U.S. fisheries in federal and state waters. Unreported fishing refers to those fishing activities that are not reported, or are misreported, to relevant authorities in violation of national laws and regulations or reporting procedures of relevant Regional Fishery Management Organizations. Finally, unregulated fishing occurs in areas or for fish stocks for which there are no applicable conservation or management measures, and where such fishing activities are conducted in a manner inconsistent with state responsibilities for the conservation of living marine resources under international law. In the Gulf of Mexico, documented IUU fishing undermines sustainable fishery management and directly impacts fishes that were injured during the DWH oil spill. Small unenclosed vessels with outboard motors, which originate from Mexico and are called "lanchas," have been identified fishing in the U.S. exclusive economic zone (EEZ). This problem is particularly pertinent in an area off the southern Texas coast. For example, in FY2015, the U.S. Coast Guard (USCG) detected 184 foreign vessels fishing in U.S. waters and had 28 interdictions (Moore & Schlaht 2015). The USCG has documented a wide range of fishes being caught by lanchas, including snappers, groupers, and sharks. This approach could support efforts to cooperatively identify new mechanisms for preventing illegal fishing that impact injured species in the Gulf of Mexico, which can help reduce the amount of fish illegally caught in U.S. waters. Coordinating with existing working groups in the region would further the development of concepts that will ultimately help prevent the illegal catching of fish. One product could be a set of communications and coordination tools to provide enforcement with more information about when and where illegal fishing is occurring. Development, validation, and implementation of models that help improve interdiction methodologies could improve enforcement efficiency, which would lead to fewer illegal fishing operations. Education and outreach plans and materials also could be developed to raise awareness with U.S. industries and the public on the adverse impacts of importing illegally caught fish.



#### D.3.5.1 Implementation Considerations

This restoration approach would rely on close coordination with stakeholders, including fishers, as well as state and federal fishery managers. There are multiple options for engaging and coordinating on implementation. For example, workshops could be used to establish goals and objectives for improvements in bycatch reduction technologies and technology transfer, as it relates to injured resources. It will also be important to develop appropriate incentives to support bycatch reducing technologies and the transfer of these technologies on a large scale to the fishery. Incentives and voluntary participation will be coordinated with federal, state, and international management agencies to achieve objectives.

This approach depends on voluntary participation of by stakeholders and the adoption of identified bycatch reduction strategies. The reliance on voluntary participation inherently introduces uncertainty regarding how much progress can be made toward restoration outcomes. Providing incentives, establishing agreements, and providing education and outreach can reduce these uncertainties. Incentives could include replacing existing vessels with vessels that could fish with bycatch reducing technology more effectively. This approach could also benefit from coordination with sea turtle and marine mammal restoration approaches that have similar uncertainties and potential mechanisms for reducing them.

#### D.3.5.2 OPA Appropriateness Evaluation

The restoration approach “Voluntary fisheries-related actions to increase fish biomass” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by supporting the development of methods and technologies, which will result in increasing biomass of injured fish species. Additionally, this approach can help compensate for the interim services losses to fishery resources, including species that are bycatch or illegally caught in Atlantic (including Gulf of Mexico) fisheries that were adversely affected by the DWH oil spill. The restoration approach may also provide a useful mechanism for coordinating and supporting emerging fishery management actions and developing new technologies and applying them to applicable fisheries.

This restoration approach would rely on lessons learned from implementing similar approaches that, when tested and used properly in various fisheries, are known to effectively increase biomass by decreasing bycatch and dead discard rates, and from implementing similar approaches that prevent and deter illegal fishing activities in other areas. For example, the weak hook, which is now used throughout the Gulf PLL fishery, is known to minimize bycatch of bluefin tuna and was developed through an experimental fishery with the assistance of funds from a National Marine Fisheries Service (NMFS)-funded cooperative agreement (NMFS 2014a). In recognition of this fact, NOAA Fisheries funds projects designed to engineer new solutions to bycatch problems (NOAA 2013a). Collateral injury to other natural resources is expected to be minimal because new methodologies and technologies will only affect those species targeted and/or caught as bycatch in the proposed fisheries or in IUU fishing activities that are part of the project. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



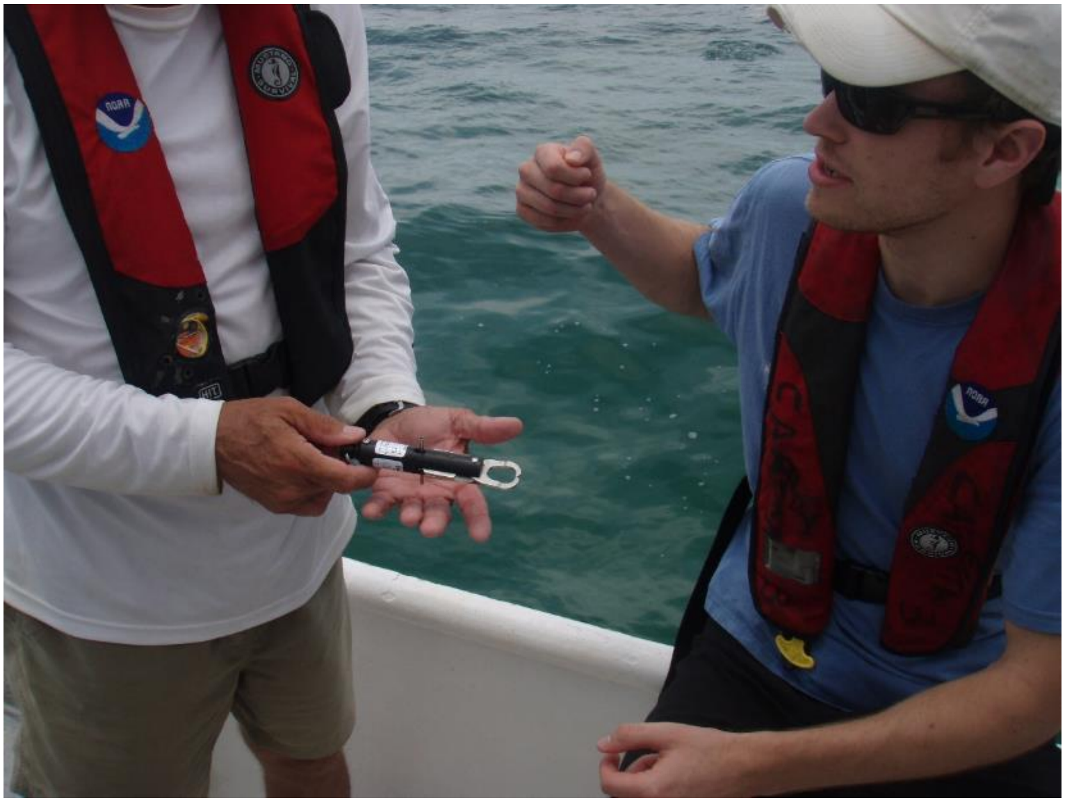
### D.3.6 Reduce Post-Release Mortality of Red Snapper and Other Reef Fishes in the Gulf of Mexico Recreational Fishery Using Fish Descender Devices

This restoration approach would reduce the post-release mortality of recreationally caught red snapper *(Lutjanus campechanus)* and other reef fish, such as gag *(Mycteroperca microlepis)*, red grouper *(Epinephelus morio),* and vermilion snapper *(Rhomboplites aurorubens),* in the Gulf of Mexico. This approach promotes the use of fish descender devices (e.g., weighted release devices) among recreational private boat, charter boat, and headboat anglers and provides education so that fishers can effectively use these devices and reduce angler handling time. The reef fish fishery in the Gulf supports

an economically important recreational fishery, which, in 2011, consisted of over three million recreational anglers taking 23 million trips (NMFS 2012). Among the most important targets in the recreational fishery are snappers, groupers, tilefish, jacks, triggerfishes, and wrasses. Recreational vessels of all sizes target reef fish, ranging from small, 12-foot private boats to 85-foot headboats that may carry up to 100 individuals (Moran 1988; Sauls et al. 2014).

Currently, many managed reef fish have minimum size and daily bag limits, resulting in a significant number of reef fish being discarded following capture. Released individuals may not survive due to injuries sustained during capture. Fish rapidly brought to the surface from depth (e.g., by hook and line) may suffer a variety of injuries collectively known as barotrauma (Wilde 2009). As fish are brought to the surface, pressure decreases and gases expand, causing trauma to various tissues, including distension of the esophagus, gut, and eyes; internal bleeding; and physiological stress (Brown et al. 2010; Rummer & Bennett 2005). In addition to these symptoms, an animal's buoyancy may be impaired, preventing it from returning to depth and exposing it to a variety of stressors at the surface, including high water temperatures (Davis 2002) and increased predation (Diamond et al. 2011). In an effort to reduce discard mortality, the Gulf of Mexico Fishery Management Council implemented a regulation in 2008 requiring all reef fish fishers to possess and use a venting tool (e.g., a hypodermic needle) (73 FR 5117). A venting tool is used to puncture the swim bladder, allowing it to deflate (Wilde 2009) and increasing the fish's ability to submerge and return to the appropriate depth. Although some believe venting is an effective method to increase post-release survival (e.g., Collins et al. 1999; Drumhiller et al. 2014; Patzig & Weeks 2007), others indicate that it is either not effective (Burns 2009), or harmful (Wilde 2009). Some have suggested that a lack of training and education on venting techniques may have limited the overall effectiveness in preventing post-release mortality (Wilde 2009). Largely due to the inflexibility of this regulation to allow alternative release methods that may also increase survival (e.g., shotlines or weighted release tools), that rule was repealed in 2013 (Sauls et al. 2014).

Recent research has supported the use of rapid recompression techniques (i.e., methods that quickly return fish to depth after capture) as an alternative to venting to increase post-release survival of red snapper and other reef fishes (see Figure 5.D-22). In experiments using hyperbaric chambers to simulate rapid decompression from depth, Drumhiller et al. (2014) found that red snapper survival increased if the fish were rapidly recompressed compared to those left untreated. When researchers simulated capture at 30 meters, red snapper survival was 100 percent, versus 67 percent survival for those left untreated. When researchers then simulated capture from 60 meters, 83 percent of the rapidly recompressed fish survived, compared to 17 percent that survived without treatment. Along with reduced handling time, studies have shown that rapid recompression or deep water release is an effective tool to increase post-release survival of physoclistous fishes (those with swim bladders) in other locations as well, including Australia (e.g., Lenanton et al. 2009; Rummer & Bennett 2005; Sumpton et al. 2010) and the U.S. West Coast (Hochhalter & Reed 2011). To our knowledge, no studies have shown that using rapid recompression devices decreased survival.



*Source: James F. Reinhardt.*

**Figure 5.D-22**. NOAA scientists discuss the use of the Seaquilizer, used to release fish at specified depths (e.g., 50, 100, or 150 feet).

### D.3.6.1 Implementation Considerations

This restoration approach would provide recreational fishers of reef fishes with fish descender devices and the training to use them. Fishers, captains, and owners in the private charter and headboat sectors would be provided incentives for using the devices, reporting their use, and participating in training and educational components of the project. A training program would be implemented to instruct fishers, captains, and owners in the correct techniques and appropriate conditions for using the devices. The training program would also emphasize proper fish-handling techniques to maximize post-release survival and minimize handling time. Headboat operators who agree to participate may also be compensated to employ additional crew necessary to utilize weighted-release devices in a high-volume context. A variety of devices have been used to release fish at depth, including cages and/or barbless hooks attached to heavy weights or specialized release hooks and pressure activated lip grips (e.g., the Seaquilizer; Figure 5.D-22) that release fish at specified depths.

Due to the difficulty in obtaining large enough sample sizes to draw definitive conclusions, studies have provided only minimal evidence that fish descender devices are effective in preventing mortality among Gulf fishes (see Diamond et al. 2011). Descender devices, however, have been shown to increase survival in fish species located outside the Gulf (e.g., Jarvis & Lowe 2008). Furthermore, their use in Gulf fisheries has been endorsed by researchers and managers (Drumhiller et al. 2014). The restoration approach would likely be initially focused within a specific geography and sector (e.g., charter boat fleet

out of Panama City, Florida) in order to identify the best implementation process. The geographic scale and scope of the project would expand in successive years. A phased expansion would allow for adaptive implementation of the project to incorporate information gained during early implementation (increasing information from scientific partners) and the evolution of weighted-release technology.

This restoration approach targets the Gulf of Mexico recreational reef fish fishery, but this technique could be implemented in the commercial fishery as well. Outreach will be necessary for this project and may include presentations to recreational fishing associations or clubs (e.g., Florida Sport Fishing Association and Mississippi Charter Boat Captains Association). After introducing this program to the recreational fishing community, training sessions could be offered. In addition, an educational video on the appropriate use and benefits of weighted-release tools could be developed. To encourage participation in the program, this video could be shown at events aimed at recruiting fishers, as well as on board charter boat and headboat vessels during the ride to fishing grounds.

#### D.3.6.2 OPA Appropriateness Evaluation

The restoration approach “Reduce post-release mortality of red snapper and other reef fishes in the Gulf of Mexico recreational fishery using fish descender devices” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by decreasing post-release mortality of reef fish that are caught but not retained due to regulatory or other reasons. Additionally, this approach can help compensate for interim services losses to fishery resources adversely affected by the DWH oil spill. It would do so by reducing the mortality of targeted fish species discarded for regulatory reasons and as bycatch by increasing the use of devices that return fish to the bottom of the water column upon release. This can reverse some of the effects of barotrauma (e.g., by deflating swim bladders) and increase the survival rates of fish. Additionally, outreach explaining these techniques may help reduce handling time by fishers, which can also reduce the post-release mortality of reef fish.

The restoration approach described above is expected to result in increased biomass of reef fish species. Post-release mortality is an issue in reef fish fisheries, and barotrauma mitigation measures can reduce this mortality (Drumhiller et al. 2014; Hochhalter & Reed 2011; Sumpton et al. 2010). The technique would first be implemented in a limited geographic area and sector of the fishery, which would allow data to confirm the predicted benefits of the project prior to widespread implementation. Collateral injury to other natural resources is expected to be minimal because the method only affects animals that are likely to have died without the measures implemented by the project. Therefore, this project should not have any direct impact on the level of effort in the fishery. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



### D.3.7 Restore Sturgeon Spawning Habitat

Gulf sturgeon migrate from marine waters to spawn (lay and fertilize their eggs) in fresh water in the large river systems of the Gulf of Mexico. Gulf sturgeon typically spawn near limestone outcroppings, cobble, gravel, or other hardbottom habitats (Scollan & Parauka 2008), which are relatively uncommon features in southern U.S. rivers. Gulf sturgeon make long migrations year after

year to the same location to take advantage of this spawning habitat. Improving the conditions in these rivers will increase the Gulf sturgeon's ability to spawn and reproduce. A variety of restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Erosion and sediment control or abatement.** Whereas overfishing may have been the historical cause of declining Gulf sturgeon stocks, pesticides, metals, and other contaminants have also been identified as possible contributors to Gulf sturgeon population decline and/or slow recovery to appropriate population numbers (FWS & GSMFC 1995). This technique would improve Gulf sturgeon spawning habitat by identifying spawning areas and reducing streambank erosion and sediment discharges into those areas. Specifically, this technique would stabilize stream banks and modify culverts and gabions to reduce sediment discharge. This technique could also include establishing field borders, riparian forest buffers, filter strips, grass waterways, drainage water management, vegetative barriers, constructed wetlands, and other measures commonly applied to restore water quality in streams.
- **In-stream barrier removal or construction of fish passage.** In some streams that host Gulf sturgeon spawning migrations, barriers may be reducing access to preferred spawning habitat (Ahrens & Pine 2014). Frequently, for Gulf sturgeon, it may be more appropriate to remove the barriers, such as dams and sills, as part of this technique. Where applicable, these barriers would be either removed or bypassed so that adult and juvenile Gulf sturgeon could migrate up- and downstream. Fish passage methods include, but are not limited to, fish ladders, side channels, spillways, and manual transport. New methods would be considered as they become available.

### D.3.7.1 Implementation Considerations

The act of removing a barrier to instream migration is an endeavor that invariably requires careful planning. Although one type of barrier may be as natural and temporary as a log jam, another may be a dam that has been in place for many years. In addition to acting as a barrier to Gulf sturgeon, such barriers affect many other resources found in a river, such as sediment dynamics (in some cases, where sediments may be contaminated), water levels, flow, temperature levels, oxygen levels, and human movement. The amount of study and preparation required may be significant and expensive and take several years to complete. Although instream barrier removal may be complicated, it is generally considered desirable when feasible because of the potential for achieving substantial restoration benefits. As a secondary consideration, creating passages around instream barriers (e.g., fish ladders and weirs) is a viable and common technique used by fisheries managers when removal is not an option.

### D.3.7.2 OPA Appropriateness Evaluation

The restoration approach "Restore sturgeon spawning habitat" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by enhancing the reproduction of Gulf sturgeon. Additionally, this approach can help compensate for interim services losses to Gulf sturgeon adversely affected by the DWH oil spill in the same manner.

The techniques described above are well-known and are frequently applied by fisheries managers as restoration projects. In fact, each technique is currently included as a recovery strategy in the Gulf sturgeon recovery plan (FWS & GSMFC 1995). Collateral injury to other natural resources is not expected or is considered minimal. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.3.8 Reduce Gulf of Mexico Commercial Red Snapper or other Reef Fish Discards Through IFQ Allocation Subsidy Program

This restoration approach focuses on subsidizing fishers in the Gulf of Mexico to use individual fishing quota (IFQ) allocations rather than discard catch in the Gulf reef fish fishery. Some fishers in the eastern Gulf discard a high percentage of red snapper catch. The high discard rate is likely due to insufficient quotas, which reduce the profitability of landing red snapper that are caught. Discarded red snapper have a high rate of post-release mortality. This approach would establish a mechanism to subsidize the transfer of quota allocations in order to reduce the number of discarded reef fish and promote healthy fishing practices. The total amount of quota transferred to participants would be implemented in coordination with fishery managers. Successful implementation of this project would reduce the amount of reef fish, including red snapper, discards and ass0ociated mortality in the Gulf reef fish fishery.

The bottom longline gear is commonly used to target red grouper *(Epinephelus morio)* and catches red snapper *(Lutjanus campechanus)* as bycatch. When fishers lack sufficient IFQ, fish are discarded, often dead. Discarded red snapper are not credited towards the annual quota (but are considered for stock assessments and in setting annual catch limits), and so represent wasted catch. Vertical line (handline and bandit reel) gears, used in the waters of the Florida Panhandle, target red snapper, but exhibit a high discard rate as well. In recent years the vertical line fishers off the Florida coast have seen an increase in both the catch and discard rates of red snapper. The higher discard rates seen by the eastern Gulf vertical line fishers may be due, in part, to insufficient quota currently allocated to those fishers.

The Red Snapper IFQ (RS-IFQ) program is a single-species, single-share category program. Eastern Gulf commercial fishers received only a small percentage of the red snapper market share in the early stage of the RS-IFQ program, because initial share distribution was based on landings during the years prior to fall 2006, a period in which red snapper stocks were depleted in the eastern Gulf. Since 2007, the total number of vessels harvesting red snapper and landings at Florida facilities have increased, which may be attributed to a rebound in the red snapper population in the eastern Gulf (NMFS 2013b; O'Hop & Sauls 2012).

A status and trends analysis of the Gulf of Mexico IFQ programs suggests that the red snapper market is stabilizing (NMFS 2013b). A stabilizing market may have other consequences; namely, that vertical and bottom longline fishers of the Florida Panhandle and Peninsula who were not initially allotted an RS-IFQ market share may find that purchasing allocation is not cost-effective. Thus, this restoration approach seeks to increase the cost-effectiveness of allocation purchases for fishers wishing to use red snapper

IFQ but who have not traditionally had easy access to IFQ. The approach thereby aims to decrease discarded red snapper bycatch and improve the health of the reef fish fishery.

#### D.3.8.1 Implementation Considerations

This restoration approach would utilize a quota bank, or similar mechanism, in which quota is purchased and leased to fishers at a reasonably subsidized price to ensure retention of captured red snapper and other reef fish, and to promote environmental stewardship. Such quota banks have been successful at promoting favorable fishing techniques; however, the transfer of commercial quota may unintentionally change fishing behavior. For example, without the same access to red snapper quota, other fishers may switch to catching other species of reef fish, which then may result in greater pressure on other fish populations in the northern and western Gulf. Additional purchasers of allocation or quota may also drive up prices, so a rigorous economic analysis would be undertaken prior to implementation to evaluate the potential for unintended economic consequences. This project would be closely coordinated with fishery managers. When implementing this restoration activity, the Trustees need to consider existing, pending, and proposed regulations. Restoration approaches are intended to work in concert with existing regulations to create resource benefits beyond those that regulations can achieve, but without creating undue burden on the fishing community.

#### D.3.8.2 OPA Appropriateness Evaluation

The restoration approach and supporting technique "Reduce Gulf of Mexico commercial red snapper or other reef fish discards through IFQ allocation subsidy program" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline and compensate for interim losses by reducing reef fish discards (and overall reef fish fishing-related mortality) through the purchase and lease of allocation to fishers in the eastern Gulf of Mexico at a subsidized rate.

The approach described above is designed to reduce the number of reef fish discarded by commercial fishers. Collateral injury to other natural resources is expected to be minimal because the Trustees do not anticipate a change in current commercial fishing behavior. The Trustees also do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

## D.4 Sea Turtle Restoration Approaches

1. Reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures
2. Reduce sea turtle bycatch in commercial fisheries through enhanced training and outreach to the fishing community
3. Enhance sea turtle hatchling productivity and restore and conserve nesting beach habitat
4. Reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures

5. Reduce sea turtle bycatch in commercial fisheries through enhanced state enforcement effort to improve compliance with existing requirements
6. Increase sea turtle survival through enhanced mortality investigation and early detection of and response to anthropogenic threats and emergency events
7. Reduce injury and mortality of sea turtles from vessel strikes

### D.4.1 Reduce Sea Turtle Bycatch in Commercial Fisheries Through Identification and Implementation of Conservation Measures

This restoration approach focuses on reducing the bycatch and mortality of sea turtles in Gulf of Mexico commercial fisheries by identifying, developing, and implementing sea turtle bycatch reduction measures. Sea turtles are known to interact with several gear types including bottom longline (BLL), pelagic longline (PLL), trawls, gillnets, and pots/traps (NMFS & FWS 2008; NMFS et al. 2011). Sea turtles that are captured in these gear types are often unable to reach the surface to breathe, struggle to escape, and suffer physiological changes that can compromise their health and lead to death. Requirements to reduce sea turtle bycatch are in place for some of these fisheries (e.g., turtle excluder devices [TEDs] in the otter trawl segment of the Gulf shrimp fishery) (see Figure 5.D-23). This approach would reduce sea turtle bycatch in commercial fisheries operating in the Gulf.

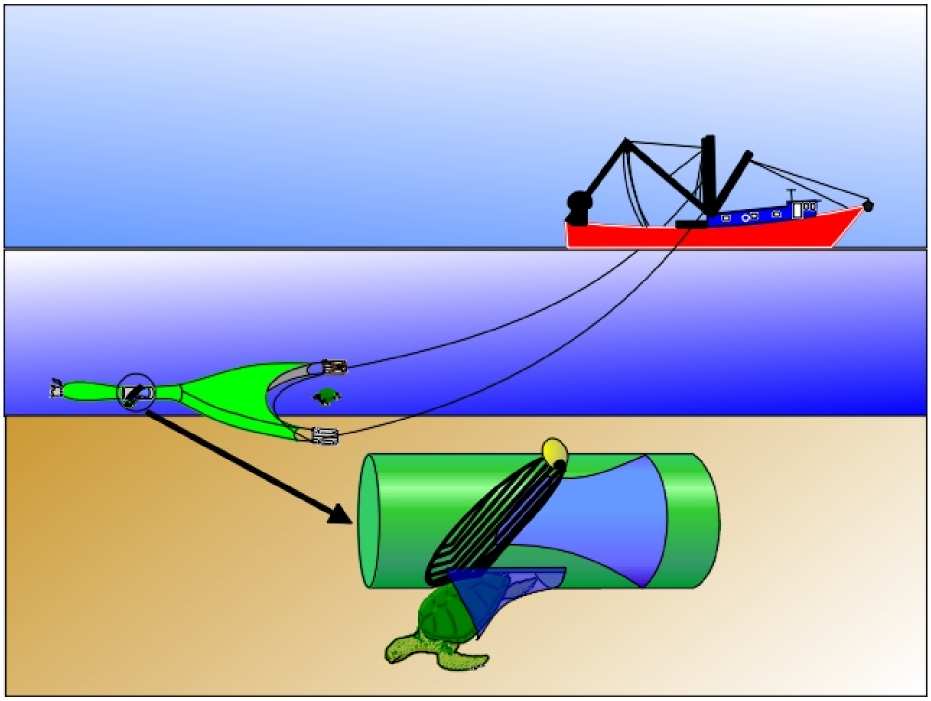
This restoration approach would identify potential new measures, such as gear modifications (e.g., hook size and type), changes in fishing practices (e.g., reduced soak times), and/or temporal and spatial fishery management to reduce sea turtle bycatch in Gulf commercial fisheries. Reducing sea turtle bycatch in commercial fisheries is a high-priority recovery action in the loggerhead and Kemp's ridley recovery plans (NMFS & FWS 2008; NMFS et al. 2011).

#### D.4.1.1 Implementation Considerations

This approach would be implemented using a multiphased approach. Initial efforts would focus on assessing existing fishery-specific sea turtle bycatch information and gathering additional information as necessary. Development of potential bycatch reduction measures/techniques would follow, along with testing to evaluate sea turtle bycatch reduction and target catch retention. Lastly, effective bycatch reduction strategies could be implemented on a voluntary basis or through requirements under ESA or other appropriate regulatory mechanisms. The reliance on voluntary participation inherently introduces uncertainty regarding how much progress can be made toward restoration outcomes. Providing incentives, establishing agreements, and providing education and outreach can reduce these uncertainties. This approach could also benefit from coordination with marine mammal and fish restoration approaches that have similar uncertainties and potential mechanisms for reducing them.

Potential challenges could include soliciting vessels for pre-implementation studies. In addition, bycatch rates can vary among years, based on factors such as water temperature, species abundance, and fishing effort distribution. Monitoring programs would need to be structured to ensure statistical robustness. These types of sea turtle conservation measures have precedents in the Gulf, including, for example, the reef fish BLL fishery, where changes in fishing methods and time/area closures have been implemented; and the U.S. PLL fishery, where changes in fishing techniques, including hook-and-bait

combinations, have been implemented. The techniques described in this approach have been successfully used to develop sea turtle bycatch reduction measures for certain fisheries.



*Source: NOAA-NMFS, Southeast Fisheries Science Center.*

**Figure 5.D-23.** Drawing depicting the placement of a TED in a trawl net.

#### D.4.1.2 OPA Appropriateness Evaluation

The restoration approach "Reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by characterizing the nature of bycatch in commercial fisheries and developing and implementing bycatch reduction measures. Additionally, this approach may work to compensate for the interim services losses to sea turtles, primarily adult and juvenile Kemp's ridley and loggerhead turtles adversely affected by the DWH oil spill.

The techniques described above are reasonable and effective ways to address the sea turtle bycatch problem. This approach will first focus on understanding where and when bycatch is occurring, the magnitude of that bycatch, and the factors influencing bycatch. Next, techniques/methods to reduce sea turtle bycatch will be tested prior to implementation. This approach has been proven successful in addressing the bycatch problem in various fisheries (e.g., development of hook-and-bait measures to reduce bycatch in the PLL fishery). Collateral injury to other natural resources is expected to be minimal; if any collateral injury is identified during implementation, mitigation methods will be considered. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting

projects based on a project-specific evaluation of the OPA evaluation standards found at 15CFR § 990.54(a).

### D.4.2 Reduce Sea Turtle Bycatch in Commercial Fisheries Through Enhanced Training and Outreach to the Fishing Community

This restoration approach would increase training and outreach to the fishing community to improve compliance with sea turtle bycatch reduction requirements. Although significant efforts to reduce sea turtle bycatch in Gulf fisheries are ongoing, achieving high rates of participation in relevant programs and/or compliance with existing regulations remains a challenge. Improved compliance with existing bycatch reduction measures, such as the use of TEDs in the shrimp otter trawl fishery, is critical for achieving necessary reductions in sea turtle bycatch mortality (see Figure 5.D-25). When outreach and training are provided to the fishing community, regulatory compliance improves (NMFS 2014b). However, existing capacity for training and outreach within NOAA and the states is insufficient to address existing needs and to consistently sustain these efforts.

This restoration approach could expand the successful NOAA Gear Monitoring Team (GMT) program, which operates in the Gulf states out of the NMFS Southeast Fisheries Science Center's Pascagoula Lab. This expansion would allow similar programs to be implemented at the state level. The approach could also add a new NOAA GMT in the southeastern U.S. Atlantic. Broadening the existing program and integrating federal and state efforts into an effective partnership would maximize the likelihood of success. The primary goal of an expanded GMT program is to provide a greater capacity for outreach, education, and training to the principal fishing sectors that interact with sea turtles (i.e., shrimp trawl [otter and skimmer], PLL, BLL, gillnet, and hook-and-line fisheries).



An expanded GMT program would enhance coordination between and among state and federal agencies, enhance communication with the fishing community, and result in improved compliance with sea turtle bycatch reduction measures. The program would improve compliance with sea turtle bycatch reduction measures by 1) working closely with sea turtle bycatch reduction device manufacturers and shops to assist and ensure that all such devices are properly built and installed to required standards; 2) working directly with fishers to improve their expertise to use and maintain bycatch reduction tools and devices via workshops and hands-on capacity building; and 3) conducting courtesy dockside and at-sea boardings to provide assistance for troubleshooting gear problems, rectifying deficiencies, and building capacity to improve compliance.

#### D.4.2.1 Implementation Considerations

The GMT program already exists within NOAA in the Gulf, but this program has spatial and temporal coverage gaps. Implementation would require close coordination with state marine resource agencies. This approach has been successfully used to enhance training and outreach regarding certain bycatch reduction measures in some areas of the Gulf of Mexico. Enhancing outreach and training to reduce sea turtle bycatch in commercial fisheries is a high-priority recovery action in the loggerhead and Kemp's ridley recovery plans (NMFS & FWS 2008; NMFS et al. 2011).

#### D.4.2.2 OPA Appropriateness Evaluation

The restoration approach "Reduce sea turtle bycatch in commercial fisheries through enhanced training and outreach to the fishing community" meets the criteria for being appropriate under OPA. If

implemented properly, it can help return injured natural resources and services to baseline and compensate for interim losses by improving compliance with existing sea turtle bycatch reduction requirements to reduce sea turtle mortality.

The technique described above has been proven successful. For example, compliance with federal TED regulations in the shrimp otter trawl fishery has increased since a similar training and outreach program was initiated (NMFS 2014b). Collateral injury to other natural resources is expected to be minimal. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.4.3 Enhance Sea Turtle Hatchling Productivity and Restore and Conserve Nesting Beach Habitat

This restoration approach focuses on improving and maintaining the suitability of nesting beach habitat for sea turtles. Loggerheads, Kemp's ridleys, and green turtles nest on suitable beaches in the Gulf of Mexico, almost exclusively in Florida, Alabama, and Texas, with occasional or rare nesting in Mississippi and Louisiana. In general, projects in Florida and Alabama would benefit nesting loggerhead and green turtles, while projects in Texas would benefit Kemp's ridley turtles. While on land, sea turtles face a variety of threats. This restoration approach involves reducing some of these threats, creating an opportunity to improve sea turtle reproductive success. A variety of restoration techniques are available for use, individually or in combination, as potential restoration projects. Not all restoration techniques are suitable for all locations. This restoration approach could employ, but is not limited to, the following techniques:

- **Reduce beachfront lighting on nesting beaches.** Anthropogenic light sources along beaches and coasts can have negative impacts on the nocturnal behaviors of both nesting sea turtles and hatchlings (Witherington & Martin 2003). Lighting can affect nest site selection, disorient nesting turtles returning to the sea, and interfere with the ability of hatchlings to find the ocean. The emergence from the nest and crawl to the sea is one of the most vulnerable periods of a sea turtle's life. Hatchlings disoriented by artificial light are more exposed to ghost crabs, birds, and other predators; may become dehydrated; and may die before reaching the water. Turtle-friendly lighting projects would reduce light pollution, thereby reducing hatchling disorientation and increasing the number of hatchlings reaching the water. Specifically, property owners and other entities that own or maintain lighting near nesting beaches would be encouraged, through education and/or financial assistance, to 1) keep outdoor lighting to a minimum and use low wattage, shielded bulbs; 2) turn off lights when not in use; 3) label switches that control lights that may affect sea turtles; and 4) use low-profile, low-intensity lights with long wavelengths. Reducing beachfront lighting is consistent with the species' recovery plans; light pollution has been identified as one of the most significant threats to recovery of loggerheads (NMFS & FWS 2008). Lighting management is also a high-priority conservation action needed for green turtle recovery (NMFS & FWS 1991).

- **Enhance protection of nests.** Nest protection measures can include identifying, marking, protecting, and monitoring nests. Once nests are identified and marked, some may be physically protected (e.g., by placing cages and/or mesh wire over the nests), which reduces predation (Engeman et al. 2006; Kurz et al. 2011) (see Figure 5.D-24). Identifying and marking nests also protects nest sites from human activities that could otherwise harm or destroy nests (e.g., use of beach umbrellas and beach driving). Nest relocation may be needed if threats cannot be effectively reduced using nonmanipulative measures. Predator removal programs have typically targeted raccoons, coyotes, and feral pigs; such programs can greatly improve turtle nest success (Engeman & Smith 2007). Nest protection measures are consistent with the species' recovery plans; predation by native and exotic species has been identified as a significant threat to loggerheads (NMFS & FWS 2008). Nest success is one key to population recovery; protection of nests and subsequent improved nest success contributed significantly to the pre-2010 rapid population growth of the Kemp's ridley (NMFS et al. 2011), and likely is contributing to the ongoing recovery of the green turtle in the southeast U.S. (NMFS & FWS 1991).


***Source:*** *Kelly Sloan, Sanibel-Captiva Conservation Foundation.*

**Figure 5.D-24.** Loggerhead nest marked and protected with a flat screen that allows hatchlings to emerge naturally.

- **Acquire lands for conservation of nesting beach habitat.** Many nesting beaches are threatened by development. Nesting beaches could be protected and conserved by purchasing beachfront

properties outright or ensuring long-term protections on private property through conservation easements. As sea levels rise, suitable nesting beach habitat will disappear where coastal armoring and/or upland development interfere with natural beach processes (Steinitz et al. 1998). Of particular concern is coastal armoring (Mosier 1998), which creates an immovable, permanent barrier and can significantly interfere with or prevent successful nesting (see Figure 5.D-25). Land purchases or the acquisition of conservation easements could reduce the amount of coastal armoring and restore natural beach/dune system processes, including landward migration in response to erosion and sea level rise (Fletcher et al. 1997). Maintaining the current length and quality of protected nesting beaches, as well as acquiring and protecting additional properties on key nesting beaches, are Priority 1 actions in the loggerhead recovery plan (NMFS & FWS 2008). Similarly, reinforcing habitat protection efforts on nesting beaches is a high priority for Kemp's ridley and green turtle recovery (NMFS & FWS 1991; NMFS et al. 2011).

***Source:*** *Wilma Katz, Coastal Wildlife Club.*

**Figure 5.D-25.** An unsuccessful attempt by a loggerhead trying to find a suitable nesting site in front of rock revetment.

- **Beach user outreach and education.** Targeted education and outreach efforts could be implemented to inform those using nesting beaches about human threats to sea turtles and how their activities may affect sea turtles. Signage, brochures, and staff to serve as interpreters at nesting beaches are some possible outreach mechanisms. Outreach topics would include development of BMPs for sea turtle nesting beaches, such as removing obstacles to nesting females and hatchlings (e.g., beach furniture and recreational equipment), removing anthropogenic debris, and properly managing garbage disposal (important for minimizing predator attraction) (Choi & Eckert 2009; Witherington 1999). Other outreach and education techniques that would reduce harm to nesting sea turtles could also be implemented with property owners, rental managers, and nearby businesses and schools. The Kemp's ridley recovery strategy emphasizes the importance of public outreach and education and the development of community partnerships (NMFS et al. 2011) (see Figure 5.D-26). The loggerhead recovery strategy similarly recognizes the importance of facilitating recovery through public awareness, education, and information transfer (NMFS & FWS 2008).

*Source:* *National Park Service.*

**Figure 5.D-26.** Kemp's ridley sea turtle nesting at Padre Island National Seashore.

### D.4.3.1 Implementation Considerations

To maximize program success, each technique will be applied in areas where the particular threat or problem is ongoing. Not all techniques are appropriate for all sea turtle species, nor are all techniques appropriate for all locations. Predator control measures will be most effective when employed at locations where predation levels are impeding recovery. Reducing beachfront lighting will be most effective on nesting beaches where lighting conditions have been documented to cause disorientation of hatchlings or nesting females.

Expanding nest monitoring activities could also improve nest protection efforts and, thus, would improve nest success. Nesting beach surveys are the most widely implemented monitoring tool used by the global sea turtle community to assess and monitor the status of sea turtle populations (Schroeder & Murphy 1999). Monitoring trends on nesting beaches is a high-priority recovery action in the loggerhead, Kemp's ridley, and green turtle recovery plans (NMFS & FWS 1991, 2008; NMFS et al. 2011).

If predator control is included, appropriate humane measures would be taken to minimize the potential for collateral effects. For example, if poison baits were used, their dispersion would be minimized through proper use and adherence to any required permits. In addition, the potential for indirect adverse ecological effects (e.g., encouraging nontargeted, potentially undesirable predators to move in) would be considered and weighed as part of the program design and siting.

Another key consideration in ensuring project success is public outreach and engagement, particularly because many of these projects will require voluntary participation by the public. Access to private property would be required in some areas for nest identification, predator control, and monitoring.

Property owner willingness is necessary for implementing retrofits of beachfront lighting, acquiring property, and participating in conservation easement programs. The techniques described in this approach are well-known and frequently applied. Each technique is included as part of the recovery strategy in the green turtle, loggerhead, and Kemp's ridley species recovery plans (NMFS & FWS 1991, 2008; NMFS et al. 2011).

#### D.4.3.2 OPA Appropriateness Evaluation

The restoration approach "Enhance sea turtle hatchling productivity and restore and conserve nesting beach habitat" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline and compensate for interim losses by increasing successful sea turtle nesting, emergence of turtle hatchlings from the nest, and their successful transit of the beach to the water.

The techniques described above are well-known and frequently used. Each technique is included as part of the recovery strategy in species recovery plans (NMFS & FWS 1991, 2008; NMFS et al. 2011). Collateral injury to other natural resources is expected to be minimal, although predator control programs may result in minor effects, including elimination of the targeted predators. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



### D.4.4 Reduce Sea Turtle Bycatch in Recreational Fisheries Through Development and Implementation of Conservation Measures

This restoration approach focuses on reducing and minimizing the bycatch of sea turtles from recreational fisheries. Initially, the Trustees would focus on piers and similar fixed structures (e.g., jetties, bridges, and breakwaters) in the nearshore, shallow water habitats of the Gulf of Mexico, which are important sea turtle feeding and migratory areas. Sea turtles are frequently caught and/or entangled in recreational hook-and-line gear and can be injured or killed. In recent years, hundreds of sea turtles, especially Kemp's ridleys, have been caught on recreational hook-and-line gear in the northern Gulf (NOAA & NMFS 2015). Reducing sea turtle bycatch in hook-and-line fisheries is a high-priority recovery action identified in the loggerhead and Kemp's ridley recovery plans (NMFS & FWS 2008; NMFS et al. 2011).

This approach would first focus on improving understanding of bycatch in recreational fisheries in the Gulf of Mexico. For example, it could develop a comprehensive characterization of sea turtle bycatch on hook-and-line gear at piers and similar fixed structures in the Gulf. This effort would likely include deploying observers or implementing a survey program to document and characterize bycatch at piers and similar fixed structures. The data collected would be used to develop and test a range of potential bycatch reduction measures or techniques. Once identified, potential bycatch reduction measures could be experimentally implemented to determine their effectiveness. For example, hook-and-line fishing from piers and other fixed structures threatens sea turtles due to incidental hooking and entanglement during active fishing or with discarded lines and other debris around piers. Sea turtles may be attracted to fishing piers and similar fixed structures by bait, fish, and fish parts discarded from cleaning stations or by fishing practices. Piers and similar fixed structures are located in or near sea turtle habitat, which

increases the risk that sea turtles will interact with hook-and-line gear. When a turtle is caught by an actively fished line, the turtle may break the line or the fisher will cut the line to release the turtle. Under both scenarios, the turtle will swim away with a hook and some amount of line (see Figure 5.D-27). This may lead to the death of the turtle, depending on where and how the turtle is hooked and/or entangled. The amount of sea turtle bycatch from piers and similar fixed structures depends on factors such as habitat type, pier size, and number of anglers (Rudloe & Rudloe 2005). Other factors may also play a role, such as season, time of day, depth, hook type, and/or bait type.

***Source:*** *Houston Zoo/NOAA.*

**Figure 5.D-27**. X-ray of a juvenile Kemp's ridley sea turtle showing a recreational fishing hook in the esophagus.

These initial efforts would analyze existing data and collect and analyze new data on pier and fixed structure characteristics (e.g., location, operating hours, water depth, and lighting) and amount and type (species and size) of sea turtle bycatch at these structures. These data will improve understanding of the geographic and temporal scope and scale of sea turtle bycatch by species and life stage, which will be needed to effectively design and implement bycatch reduction measures.

Additionally, these efforts would help shape the development, testing, and implementation of other techniques, such as using artificial bait, eliminating fish-cleaning stations, or restricting fishing times or areas, depending on the results of the analyses described above. This approach could include developing and implementing a comprehensive educational effort to inform the recreational fishing community how to avoid catching sea turtles and what to do if a turtle is caught. The education program could highlight preliminary ways to reduce bycatch of sea turtles in recreational fisheries. Its scope could then be expanded after the initial data collection and analysis period. Education and outreach efforts could include, for example, placing signs with stranding responder contact information, monofilament line recycling bins, and receptacles for unused bait on or near fishing piers, marinas, boat launches, and other locations used by recreational fishers (see Figure 5.D-28). The approach would likely include close collaboration with municipalities and states to develop and implement outreach programs and alternative practices to reduce sea turtle bycatch in recreational fisheries.


***Source:*** *NOAA.*

**Figure 5.D-28.** Example of an educational sign for recreational fishers.



### D.4.4.1 Implementation Considerations

Implementation of this restoration approach would require coordination among NOAA, USFWS, the Gulf of Mexico Sea Turtle Stranding and Salvage Network (STSSN) state coordinators, local communities, and stranding network responders. This restoration approach could be implemented within the Gulf of Mexico in each of the five states. This approach depends on voluntary participation of stakeholders and the adoption of identified bycatch reduction strategies to ensure reduced interactions of sea turtles with fishing gear. The reliance on voluntary participation inherently introduces uncertainty regarding how much progress can be made toward restoration outcomes. Providing incentives, establishing agreements, and providing education and outreach can reduce these uncertainties. This approach could

also benefit from coordination with marine mammal and fish restoration approaches that have similar uncertainties and potential mechanisms for reducing them.

For example, efforts to reduce sea turtle bycatch from fishing piers and similar fixed structures are in their infancy. Educational signage has proven effective in increasing reporting of captured sea turtles. The implementation of increased education and outreach will require enhanced STSSN capacity to accommodate response to additional reports of sea turtles caught in recreational fisheries. Characterization of the factors that may contribute to sea turtle bycatch, as envisioned in this technique, is a model successfully used for reducing bycatch in other fisheries (e.g., the U.S. PLL fishery). Successful implementation of this technique would require close coordination among federal, state, and local entities.

#### D.4.4.2 OPA Appropriateness Evaluation

The restoration approach "Reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by reducing and minimizing the bycatch of sea turtles in recreational fisheries in the Gulf. Additionally, this approach can help compensate for interim services losses primarily to juvenile Kemp's ridley, loggerhead, and green turtles adversely affected by the DWH oil spill. It would do so by reducing sea turtle bycatch in recreational hook-and-line fisheries through first identifying factors influencing bycatch, then developing and testing the effectiveness of bycatch reduction measures, and, finally, implementing the successful measures.

The techniques described above are reasonable and established. Educational signage has proven effective in increasing reporting of captured sea turtles. Characterization of the factors that may contribute to sea turtle bycatch, as envisioned in this approach, is a model successfully used for reducing bycatch in other fisheries (e.g., the U.S. PLL fishery). Collateral injury to other natural resources is expected to be minimal. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.4.5 Reduce Sea Turtle Bycatch in Commercial Fisheries Through Enhanced State Enforcement Effort to Improve Compliance with Existing Requirements

This restoration approach would enhance state enforcement, in state waters, of sea turtle bycatch reduction requirements by increasing training of and outreach to relevant state enforcement personnel and by increasing state fisheries enforcement effort. Training will help improve staff expertise and ensure their understanding of and ability to enforce existing regulations (see Figure 5.D-29). Such training and outreach could include developing and implementing a state-led Gulf-wide training program to increase consistency and enhance collaboration among state marine resource enforcement agencies. Even with adequate training and outreach, many state enforcement agencies are understaffed and underequipped, leaving them unable to provide the necessary effort to help ensure compliance

with required sea turtle bycatch reduction measures. Additional funding for enforcement personnel and equipment (e.g., patrol vessels) would alleviate resource constraints and help expand education, training, and enforcement efforts. Enhanced enforcement of required sea turtle bycatch reduction measures is a high-priority recovery action identified in the loggerhead and Kemp's ridley recovery plans (NMFS & FWS 2008; NMFS et al. 2011).

***Source:*** *NOAA.*

**Figure 5.D-29.** NOAA gear specialists demonstrate TED requirements and inspection procedures.

#### D.4.5.1 Implementation Considerations

This approach could include two primary techniques: providing training for and outreach to state fishery enforcement personnel and increasing state fishery enforcement resources (additional personnel and necessary equipment and vessels). The training and outreach technique would require available resources at NMFS to provide personnel and facilities and/or travel for training events at multiple locations in Gulf states. It will be necessary to provide initial training to state fishery enforcement agencies followed by periodic refresher training and outreach events. Differences in how the various state enforcement agencies operate will need to be considered. Facilitating coordination among the states would help ensure consistency in how enforcement activities are conducted throughout the Gulf of Mexico. NOAA's Office of Law Enforcement and GMT would lead the development and implementation of the training and outreach program.

Increasing state fishery enforcement capabilities for sea turtle bycatch reduction would also require providing resources to the states for hiring additional enforcement personnel and purchasing necessary equipment, such as patrol vessels and associated items. This approach would require engaging with state agencies to better understand their current enforcement capacities and needs. This approach also would need to factor in accountability mechanisms so that funds are focused on sea turtle bycatch reduction compliance and are not shifted to other enforcement needs.

#### D.4.5.2 OPA Appropriateness Evaluation

The restoration approach "Reduce sea turtle bycatch in commercial fisheries through enhanced state enforcement effort to improve compliance with existing requirements" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by addressing some of the limitations in state agencies' ability to adequately enforce sea turtle bycatch requirements for fisheries in state waters. Additionally, this approach can help compensate for the interim services losses to ESA-listed sea turtle species adversely affected by the DWH oil spill. It can do so through reducing overall sea turtle bycatch, injury (number and severity), and mortality from fisheries operating in state waters. Ancillary benefits could also occur through the reduction in bycatch of marine mammals and other nontarget species that have also been affected by the spill.

The approach would enhance existing state fishery enforcement programs by increasing expertise, personnel, and equipment resources. The state fishery enforcement programs currently work to help ensure compliance with fishery regulations designed to protect sea turtles, but the programs are currently resource-limited. No collateral injury to other natural resources is expected. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.4.6 Increase Sea Turtle Survival Through Enhanced Mortality Investigation and Early Detection of and Response to Anthropogenic Threats and Emergency Events

This restoration approach involves enhancing the infrastructure and capacity of the Gulf of Mexico STSSN. This restoration approach could include 1) enhanced network response and coordination, 2) enhanced preparedness and response capacity for emergency events, 3) enhanced investigation of mortality sources, 4) enhanced data access and analysis, 5) enhanced rehabilitation capability where necessary, and 6) improved coordination and communication among and between rehabilitation facilities, state coordinators, USFWS, and NOAA. The STSSN was formally established in 1980 to collect information on and document strandings of sea turtles along the U.S. Gulf of Mexico and Atlantic coasts. The STSSN was established in response to a need to better understand the threats sea turtles face in the marine environment and to investigate mortality events. Enhancement of the STSSN will improve the network's ability to aid live stranded sea turtles and to recover and necropsy dead stranded sea turtles to better understand mortality sources in the marine environment (see Figure 5.D-30). Sea turtle strandings are defined as animals that wash ashore or are found floating either in a weakened condition or dead. Stranded turtles are documented on a standardized STSSN form. Depending on species, size,

location, and carcass condition, dead turtles are necropsied in the field or laboratory, buried on the beach, or transported to freezer storage for later necropsy and sample collection. Some areas of the northern Gulf of Mexico have had relatively low stranding coverage, thus, historical data are limited for these areas.

NMFS and USFWS share federal jurisdiction for the conservation and recovery of sea turtles. In accordance with the 1977 Memorandum of Understanding, USFWS has lead responsibility for nesting beaches and NMFS has lead responsibility in the marine environment. Sea turtle stranding response and rehabilitation operate with a shared jurisdictional responsibility between the two agencies. NMFS acts as the primary data coordinator, ensuring that data are collected in a standardized manner suitable for management, monitoring, and research purposes and facilitating their use in meeting recovery objectives. USFWS provides oversight for all rehabilitation activities that occur within the STSSN. Each state has an STSSN coordinator, who coordinates stranding response within that state. The agencies that host the state coordinator for each state are the National Park Service (NPS) for the Texas STSSN, Louisiana Department of Wildlife and Fisheries for the Louisiana STSSN, NOAA for the Mississippi STSSN, USFWS for the Alabama STSSN, and Florida Fish and Wildlife Conservation Commission (FWC) for the Florida STSSN.

Enhanced mortality investigation and stranding response can provide information needed to inform the development of management actions to reduce threats in the marine environment. Reduction of anthropogenic threats in the marine environment is critical to the recovery of sea turtles (NMFS & FWS 1991, 2008; NMFS et al. 2011).


***Source:*** *FWC.*

**Figure 5.D-30.** Necropsy of a loggerhead turtle recovered after stranding in the Gulf of Mexico.

### D.4.6.1 Implementation Considerations

Implementation of this restoration approach would require coordination among NOAA, USFWS, the Gulf of Mexico STSSN State Coordinators, local communities, and stranding network responders. This restoration approach could be implemented within the Gulf of Mexico in each of the five states, in both coastal and marine environments, including state and federal waters. Key considerations for implementation include developing project-specific details that are complementary to the Phase IV Early Restoration project.

### D.4.6.2 OPA Appropriateness Evaluation

The restoration approach "Increase sea turtle survival through enhanced mortality investigation and early detection of and response to anthropogenic threats and emergency events" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by improving response capabilities and identifying mortality sources, which could then be addressed through conservation measures. Additionally, this approach can help compensate for interim services losses to juvenile and adult Kemp's ridley, loggerhead, green, and hawksbill sea turtles adversely affected by the DWH oil spill. It would do so through improving network capacity for response and aid to stranded sea turtles and identifying factors that contribute to sea turtle mortality, which will allow conservation strategies for reducing sea turtle mortality to be developed.

The technique described above is reasonable and established—it expands an existing program that has a proven role in identifying mortality sources. Collateral injury to other natural resources is expected to be minimal or nonexistent. The approach would use existing ESA permits and authorities. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

## D.4.7 Reduce Injury and Mortality of Sea Turtles from Vessel Strikes

This restoration approach focuses on reducing harmful impacts to sea turtles from vessel strikes. Propeller and hull collision injuries from recreational and commercial vessels are commonly documented in sea turtles found stranded (dead or injured) in the Gulf of Mexico (NOAA & NMFS 2015). For example, in Florida, along the Gulf of Mexico coastline 70 to 213 turtles with vessel strike injuries have been documented annually since 2005; the average is approximately 130 turtles per year (see Figure 5.D-31).

The prevalence of sea turtle strandings with boat-related injuries coincides with areas of high vessel activity (FFWCC 2015; NMFS & FWS 2008). Threats assessment analyses in ESA recovery plans have identified vessel strikes as a significant mortality factor for Kemp's ridley and loggerhead turtles. Average annual mortality from vessel strikes was estimated at 101 to 1,000 juvenile loggerheads, 101 to 1,000 adult loggerheads, 101 to 1,000 juvenile Kemp's ridleys, and 11 to 100 adult Kemp's ridleys in the Gulf of Mexico and U.S. Atlantic (NMFS & FWS 2008; NMFS et al. 2011). Green turtles are also susceptible to mortality and injury as a result of vessel strikes (NMFS & FWS 1991). Developing and implementing solutions to reduce vessel strikes is a high-priority action required for the species' recovery (NMFS & FWS 2008).

*Source: Brittany Workman, Clearwater Marine Aquarium.*

**Figure 5.D-31.** Loggerhead turtle stranded along the Gulf coast of Florida with propeller injuries to the carapace.

This approach could reduce injuries to sea turtles from vessel strikes in the Gulf of Mexico through 1) public outreach and education, 2) enhanced understanding of the temporal and spatial distribution of vessel strikes, 3) enhanced understanding of additional cofactors that may influence the frequency of vessel strikes (e.g., water depth, vessel speed, and vessel size), and 4) development of potential mechanisms to reduce the frequency of vessel strikes (e.g., voluntary speed restrictions or vessel exclusion areas in highest risk locations).

#### D.4.7.1 Implementation Considerations

Implementation of this restoration approach would require coordination among NOAA, USFWS, the Gulf of Mexico STSSN State Coordinators, local communities, and stranding network responders. Successfully reducing harmful impacts from vessel strikes requires changing human behavior, which can be quite challenging. Reducing this threat requires raising awareness among various user groups (e.g., recreational boaters, commercial fishers, marina owners, and commercial shipping entities) about how their activities may harm sea turtles and what steps they can take to minimize the risk of a vessel strike.

This restoration approach could be implemented within the Gulf of Mexico in each of the five states, or in specific geographic locations, based on data analysis described above. The development of potential mechanisms to reduce the frequency of vessel strikes will be informed by and dependent on information generated from review and analyses of data on temporal and spatial distribution of vessel strikes and other cofactors that may influence the probability of vessel strikes.

#### D.4.7.2 OPA Appropriateness Evaluation

The restoration approach “Reduce injury and mortality of sea turtles from vessel strikes” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline and compensate for interim losses, primarily to adult and juvenile Kemp’s ridley, loggerhead, and green sea turtles, by reducing injury and mortality from vessel strikes.

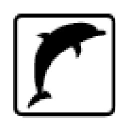
The techniques described above are reasonable and effective ways to address the sea turtle injury and mortality from vessel strikes. This approach will first focus on understanding the temporal and spatial distribution of vessel strikes and any cofactors that may influence the frequency of vessel strikes. Then the approach would focus on developing potential mechanisms to reduce the frequency of vessel strikes. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

## D.5 Marine Mammal Restoration Approaches

1. Reduce commercial fishery bycatch through collaborative partnerships
2. Reduce injury and mortality of bottlenose dolphins from hook-and-line fishing gear
3. 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
4. Measure noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals
5. Reduce injury, harm, and mortality to bottlenose dolphins by reducing illegal feeding and harassment activities
6. Reduce marine mammal takes through enhanced state enforcement related to the Marine Mammal Protection Act
7. Reduce injury and mortality of marine mammals from vessel collisions



### D.5.1 Reduce Commercial Fishery Bycatch Through Collaborative Partnerships



This restoration approach focuses on reducing direct interactions between common bottlenose dolphins (*Tursiops truncatus*) and fisheries through collaborative partnerships to identify, test, and implement solutions. Bycatch in fishing gear is a leading source of mortality among marine mammals and one of the main threats identified for bottlenose dolphins in the Gulf of Mexico (Phillips & Rosel 2014; Read et al. 2006). The most frequently documented bycatch events within the Gulf of Mexico involve bottlenose dolphins in commercial fisheries, such as the shrimp trawl, menhaden purse seine, and trap/pot fisheries, although bycatch in other fisheries does occur (79 FR 77919, December 29, 2014; Soldevilla et al. 2015; Waring et al. 2015) (see Figure 5.D-32). The following are the known bycatch events for these fisheries:

- In the Gulf portion of the shrimp otter trawl fishery, the 5-year average annual estimated serious injury and mortality of dolphins from 2007 to 2011 was 279.7 (Soldevilla et al. 2015).
- Fishers reported 13 dolphins caught in the menhaden fishery from 2000 to 2013, with an additional three observed bycatch events during a pilot observer program in 2011 (Waring et al. 2015).
- Strandings data document 16 dolphins entangled in gear consistent with trap/pots from 2002 to 2013 (NOAA 2014a; Waring et al. 2015).

Because only a portion of dead animals strand and are detected and recovered, the trap/pot gear strandings may be up to be three times higher (Peltier et al. 2012; Wells et al. 2015; Williams et al. 2011). This level of documented bycatch may be of conservation concern for some stocks of bottlenose dolphins. Therefore, identifying opportunities and strategies to reduce and prevent these direct impacts from fishing gear through mitigation measures can be an effective means of compensating for injuries to marine mammals incurred as a result of the DWH oil spill.

***Source:*** *NOAA.*

**Figure 5.D-32.** Bottlenose dolphins in Mississippi Sound feeding on and around a shrimp trawl.

In this approach, collaborative partnerships would be developed to characterize the nature of fishery interactions and identify, test, and implement strategies to reduce bottlenose dolphin bycatch in shrimp trawl, menhaden, and trap/pot fishing gear. Collaborative partnerships would be developed among commercial fishers and industry, gear experts, observer programs, academic institutions and researchers, and state and federal agencies. Partnerships would be facilitated by convening technical workshop(s). The goal of the workshop(s) would be to determine actions that would help reduce bycatch in each fishery or for specific gear types. These actions could include, but are not limited to, conducting research regarding potential gear modifications, developing gear and fishery practice modifications, developing best fishing practices, and/or implementing outreach programs to promote

strategies. All these actions have been previously implemented and recommended for bycatch reduction (50 CFR 229; Barco et al. 2010; Haymans 2005; McFee et al. 2006; McFee et al. 2007; Noke & Odell 2002; Powell 2009; Read et al. 2004; Read & Waples 2010; Werner et al. 2006; Zollett & Read 2006). The collaborative process described here is an effective way to obtain stakeholder input, develop creative solutions, and ensure buy-in for strategies that will reduce bycatch while maintaining fisheries. Because each fishery has different gear and fishery practices, separate but similar processes could be implemented for each of them. Solutions would then be tested as needed, implemented, and evaluated.

This approach could also directly monitor and adaptively manage bycatch reduction solutions by expanding and enhancing both the fishery observer and marine mammal stranding network (MMSN) programs. Observer coverage of fisheries provides critical information and data for monitoring and evaluating marine mammal bycatch (NMFS 2011). This information includes data to quantify the magnitude of serious injury and mortality, characterize patterns between marine mammal interactions and spatiotemporal fishery distribution and gear type usage, and quantify effectiveness of bycatch reduction measures. To expand the observer program, this approach could include funding additional observers, providing training, making observer trips, characterizing dolphin behavior around fishing gear, and analyzing data. It could also include developing and implementing innovative monitoring efforts (e.g., electronic logbooks or on-net video monitoring) to improve the characterization of spatiotemporal fishery effort and interaction with marine mammals.

When observer coverage is minimal or nonexistent, marine mammal strandings data are used as an indicator of fishery bycatch or to supplement observer coverage. Strandings data provide minimum rates of fishery interactions and baseline knowledge of the spatial extent of interactions (79 FR 21701, April 17, 2014; 80 FR 6925; Byrd et al. 2014; Byrd et al. 2008; Friedlaender et al. 2001; Horstman et al. 2011). The data can also be used to detect real-time increases in fishery interactions and further direct observer coverage monitoring and management efforts (Byrd et al. 2008).

#### D.5.1.1 Implementation Considerations

Implementation of this restoration approach will require coordination, mechanisms to reduce uncertainties, and performance monitoring to maximize benefits. Collaborative efforts will require that the Trustees coordinate with various stakeholders and state resource coordinators and managers. This coordination will help identify, develop, implement, and evaluate effective solutions for reducing fishery interactions and bycatch, which cause marine mammal injury and mortality. This approach depends on voluntary participation of stakeholders and the adoption of identified bycatch reduction strategies to ensure reduced marine mammal interactions with fishing gear. The reliance on voluntary participation inherently introduces uncertainty regarding how much progress can be made toward restoration outcomes. Providing incentives, establishing agreements, and providing education and outreach can reduce these uncertainties. This approach could also benefit from coordination with sea turtle and fish restoration approaches that have similar uncertainties and potential mechanisms for reducing them.

This restoration approach has precedence in the Gulf; the techniques are routinely used as part of existing management activities to help conserve, protect, and recover marine mammal stocks. Implementing this approach may also help identify solutions requiring cooperative research between academics and fishing industry members, for which MMPA permits could be required.

### D.5.1.2 OPA Appropriateness Evaluation

The restoration approach "Reduce commercial fishery bycatch through collaborative partnerships" meets the criteria for being appropriate restoration under OPA. If implemented properly, it can help return injured natural resources and services to baseline and compensate for interim services losses by reducing and mitigating direct and indirect injury and mortality of bottlenose dolphins in the shrimp trawl, menhaden purse seine, and trap/pot fisheries in the Gulf of Mexico.

The techniques described above are well-established and widely used to help reduce and mitigate marine mammal bycatch in commercial fishing gear. Collaborative partnerships have demonstrated success in developing and implementing bycatch reduction measures and ways to monitor and evaluate such reductions (79 FR 21701, April 17, 2014; 80 FR 6925, February 9, 2015; 69 FR 65127, November 10, 2004; and 71 FR 24776, April 26, 2006; Read et al. 2006). Some innovative gear technologies or modifications that have not previously been researched or are not in widespread use may first require collaborative research to evaluate feasibility and effectiveness. Collateral injury to other natural resources is expected to be minimal and is not expected beyond that occurring during routine hauling and deploying of fishing gear under normal fishery practices. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

## D.5.2 Reduce Injury and Mortality of Bottlenose Dolphins from Hook-and-Line Fishing Gear

This restoration approach focuses on reducing the harmful impacts of hook-and-line fishing gear on bottlenose dolphins. To reduce these impacts, this restoration approach could include the following: 1) conducting systematic surveys of fishers and evaluating stranding data to understand the scale, scope, and frequency of hook-and-line fishing interactions with dolphins; 2) developing collaborative partnerships and convening workshops with stakeholders to identify, test, and implement ways to reduce interactions; and 3) systematically repeating surveys and stranding data evaluations to measure success.

Fishing interactions between hook-and-line (rod and reel) anglers and bottlenose dolphins occur throughout the southeastern United States, including the Gulf, and are increasing (Powell & Wells 2011; Shippee et al. 2011). Hook-and-line gear is used by either recreational anglers or for-hire fishing vessels (e.g., charter boats and headboats). These interactions cause lethal injuries to dolphins from fishing gear entanglements and ingestions and related mortalities (e.g., fisher retaliation by shooting). Interactions may be affecting the long-term sustainability of some bottlenose dolphin stocks in the Gulf of Mexico. In the Gulf, 81 bottlenose dolphins stranded with hook-and-line gear attached from 2002 to 2013 (see Figure 5.D-33) and an additional 17 stranded with evidence of gunshot wounds (NOAA 2014a; Waring et al. 2015). Known stranding numbers may be up to three times higher, because only a portion of dead animals strand and are detected and recovered (Peltier et al. 2012; Wells et al. 2015; Williams et al. 2011).

Dolphin interactions with hook-and-line gear largely result from dolphins taking the bait or catching it directly off a fish hook (e.g., depredation) or eating discarded fish (e.g., scavenging) (Powell & Wells

2011; Read 2008; Zollett & Read 2006), as well as from illegal feeding that causes dolphins to associate anglers with food (see Figure 5.D-34). These interactions will likely persist and increase due to a combination of factors. These factors include the decline of prey populations due to environmental events or overfishing by commercial and recreational fisheries, cultural transmission of depredation and scavenging behaviors throughout dolphin populations, and continued illegal feeding of wild dolphins by humans (Coleman et al. 2004; Cunningham-Smith et al. 2006; Gannon et al. 2009; Mann & Sargeant 2003; Nowacek 1999; Peddemors 2001; Powell & Wells 2011; Read 2008; Wells 2003; Whitehead et al. 2004).


***Source:*** *NOAA.*

**Figure 5.D-33.** Dead bottlenose dolphin with fishing line embedded in its mouth.

***Source:*** *Sarasota Dolphin Research Program.*

**Figure 5.D-34.** After being illegally fed, this bottlenose dolphin patrols a fishing pier for opportunities to take bait and/or catch directly off fishing hooks.

Interactions are problematic for both anglers and dolphins. For anglers, interactions may cause 1) decreased catch and damage to gear and 2) increased regulatory discard mortality rate (Burns et al. 2004; Parker 1985; Zollett & Read 2006). For dolphins, interactions may result in 1) harmful retaliation (e.g., shooting or other types of bodily harm) from frustrated fishers (DOJ 2006, 2007; NMFS 1994; Read 2008; Waring et al. 2015; Zollett & Read 2006); 2) increased risk of injury and death from gear entanglement or ingestion (Barco et al. 2010; Read 2008; Stolen et al. 2012; Stolen et al. 2013; Wells et al. 2008; Wells et al. 1998); and 3) changes to activity patterns, such as decreases in natural foraging (Powell & Wells 2011). All these interactions have potential implications for population sustainability. For example, in Sarasota Bay during 2006, hook-and-line fishing gear interactions caused a 2 percent decline in the dolphin population (Powell & Wells 2011).

Injury and mortality to dolphins from these fishery interactions pose complex management and conservation issues in the Gulf of Mexico. Therefore, this restoration approach would focus on reducing direct and indirect injuries and mortalities associated with hook-and-line fishery interactions. The process would be iterative to ensure that opportunities for creative solutions and collaborations with stakeholders are maximized and effective at reducing interactions and related mortalities. This approach could include activities such as conducting qualitative focus groups and quantitative surveys of hook-and-line anglers to help determine 1) anglers' attitudes toward dolphins and fishing gear interactions with dolphins, 2) the frequency and geographic extent of those interactions, 3) anglers' likelihood to take various actions (both retaliatory and preventive), and 4) anglers' responses to various outreach

messages. This restoration approach could also include collaborative partnerships to identify, test, implement, and evaluate effective actions for reducing dolphin interactions with hook-and-line gear and related mortalities from retaliation. These actions could include, but are not limited to, conducting research regarding potential gear modifications, developing gear and fishery practice modifications, developing best fishing practices, developing and researching safe and effective deterrence techniques, and/or implementing outreach programs to promote strategies. To measure success, the Trustees could also use systematic social science surveys and evaluate marine mammal stranding data before and after actions are implemented.

### D.5.2.1 Implementation Considerations

This restoration approach will require coordination, mechanisms to reduce uncertainties, and performance monitoring to maximize benefits. Collaboration efforts will require that the Trustees coordinate with various stakeholders and state resource coordinators and managers. This coordination will help identify, develop, and implement effective solutions for reducing hook-and-line gear interactions causing marine mammal injury and mortality. This approach depends on voluntary participation of stakeholders in workshops, and completion of social science surveys. It also relies on voluntary adoption of identified strategies to reduce hook-and-line gear interactions and related harm to dolphins. Voluntary participation inherently introduces uncertainty regarding how much progress can be made toward restoration outcomes. Providing incentives, establishing agreements, and providing education and outreach can reduce these uncertainties. For example, education and outreach efforts could include placing signs with MMSN contact information, monofilament line recycling bins, and receptacles for unused bait on or near fishing piers. This approach could also benefit from coordination with sea turtle and fish restoration approaches that have similar uncertainties and potential mechanisms for reducing them.

This restoration approach has precedence; the techniques are routinely used as part of existing management activities to help conserve, protect, and recover marine mammal stocks. This approach could also identify solutions, including those requiring cooperative research between academics and fishing industry members or those identified by conducting social science studies such as surveys, focus groups, or interviews.

### D.5.2.2 OPA Appropriateness Evaluation

The restoration approach "Reduce injury and mortality of bottlenose dolphins from hook-and-line fishing gear" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by reducing injury and mortality to bottlenose dolphins from interactions with hook-and-line fishing gear and retaliation by fishers. Additionally, this approach can help compensate for interim services losses to estuarine, coastal, and shelf stocks of bottlenose dolphins adversely affected by the DWH oil spill.

The techniques described above are well-established and routinely conducted within the Gulf of Mexico and nationally for natural resource management and conservation needs, including those for marine mammals. These techniques have been effective in collecting data to enhance knowledge and understanding, developing and implementing potential solutions to reduce fishing gear interactions, and providing ways to evaluate the effectiveness of such solutions. In addition, researchers have recommended the use of targeted outreach and shown that it can reduce human interactions with

dolphins, which further reduces the risk of harm or mortality from interacting with hook-and-line fishing gear (Barco et al. 2010; Powell 2009; Wells et al. 1998). Some innovative gear technologies and/or deterrence techniques that have not previously been researched or are not in widespread use, however, may first require collaborative research to evaluate potential feasibility and effectiveness.

Collateral injury to other natural resources is not expected beyond that occurring during routine hauling and deploying of fishing gear under normal fishery practices. In fact, collateral benefits are more likely, as outreach to fishers may prevent hook-and-line fishing gear from becoming derelict. This can avert harmful entanglements of bottlenose dolphins and other protected species, such as sea turtles. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

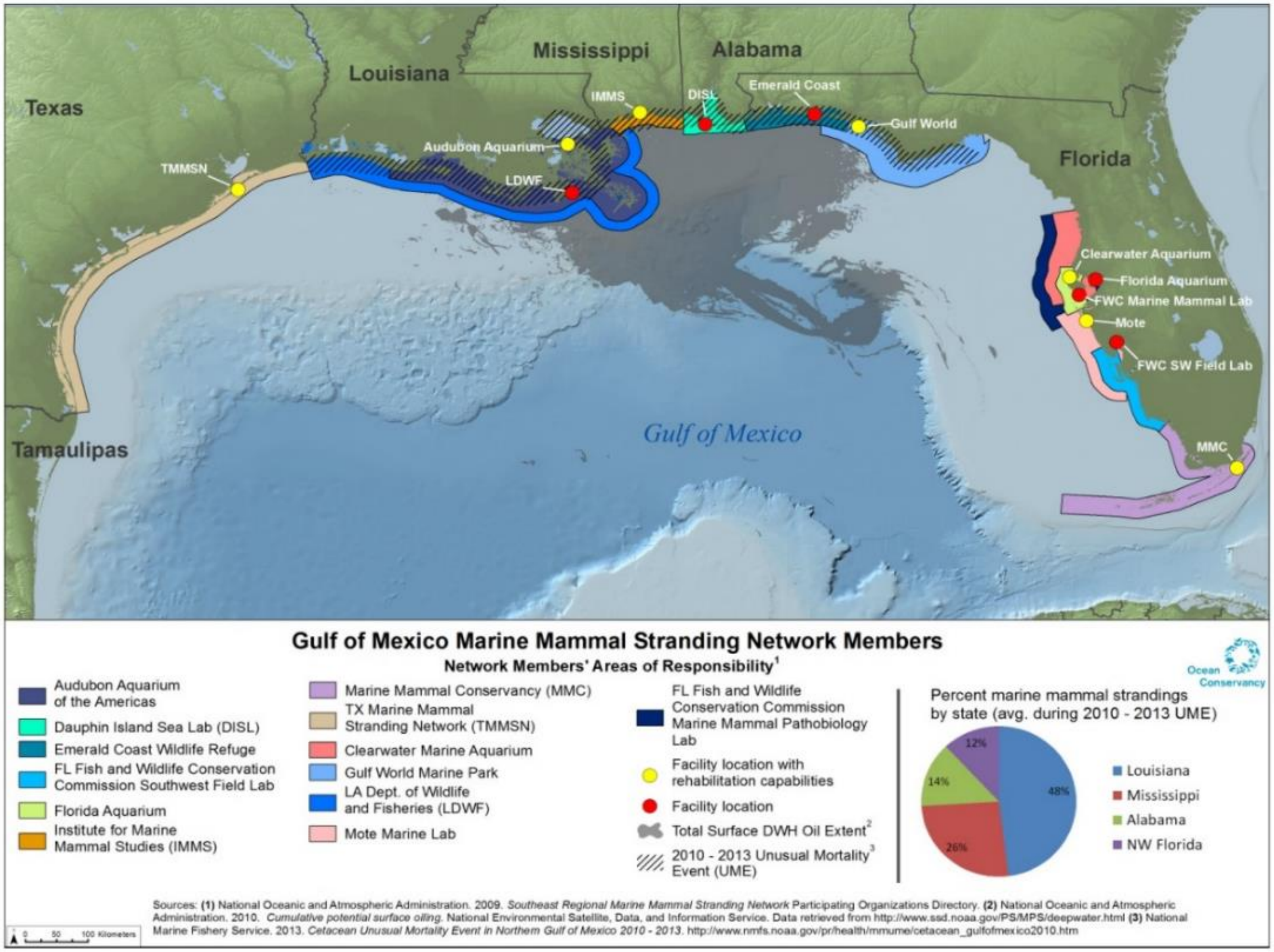
### D.5.3 Increase Marine Mammal Survival Through Better Understanding of Causes of Illness and Death as well as Early Detection and Intervention for Anthropogenic and Natural Threats

This restoration approach focuses on increasing marine mammal survival through improving understanding of key causes of morbidity and mortality, and also on the early detection and mitigation of anthropogenic or natural threats. This approach is anticipated to have positive impacts on the survival of many marine mammal species in the Gulf of Mexico, but in particular on BSE and coastal stocks of bottlenose dolphins. Other offshore species that are subject to mass strandings or die-offs may also benefit, such as short-finned pilot whales (*Globicephala macrorhynchus*) and rough-toothed dolphins (*Steno bredanensis*). A variety of restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Expand the MMSN's capabilities along the coast of the Gulf of Mexico.** This technique expands the MMSN's ability to detect, respond to, recover, and necropsy dead stranded marine mammals and triage, treat, and humanely euthanize or rehabilitate and release live stranded marine mammals. The information collected can be helpful for informing restoration and management efforts. The MMSN was formalized by the 1992 Amendments to the MMPA, and volunteer MMSNs exist throughout all coastal states to respond to marine mammal strandings. These MMSNs are coordinated either by NOAA's NMFS (cetaceans, seals, and sea lions) or USFWS (manatees, sea otters, polar bears, and walruses). In the Southeast Region along the U.S. Gulf Coast, 10 organizations/facilities currently hold stranding agreements with NMFS and are authorized to respond to live or dead stranded marine mammals (Figure 5.D-35). Seven of these organizations are also authorized to rehabilitate stranded marine mammals. This technique could increase existing capacity and expand networks to additional areas to respond to marine mammal species that are found stranded along the Gulf Coast. This technique could also enhance detection of live and dead stranded, injured, or entangled marine mammals by improving methods commonly used to detect stranded animals (e.g., boat surveys), as well as

developing alternate surveillance strategies (e.g., innovative technologies, public awareness campaigns, active surveillance, and dedicated boat surveys).

Enhance capabilities to rapidly diagnose causes of marine mammal morbidity and mortality to identify threats and mitigate impacts (conservation medicine). Enhancing the tools available to diagnose live stranded animals could increase survival at the stranding site and during rehabilitation, potentially increasing the numbers of animals returned to the wild. This technique could also enhance understanding of common causes of mortality in dead stranded marine mammals through 1) training stranding staff to perform necropsies (animal autopsies) and collect samples for additional analyses, 2) standardizing and enhancing data collection, and 3) providing funding for diagnostic tests on samples collected from stranded animals to determine cause of illness or death. The technique could also include archiving of tissues to understand long-term trends in marine mammal health and developing and maintaining databases to manage marine mammal health data. These data could be used to provide a better long-term understanding of the causes of marine mammal illness and death in the Gulf of Mexico. This technique could also be used to develop and implement interventional medicine to reduce harm to marine mammals, such as vaccines, entanglement response, sedatives, or antibiotics. Currently, a vaccine (for canine distemper virus) has been used in marine mammals and could be evaluated for use in BSE bottlenose dolphins to protect the dolphins from cetacean morbillivirus (CMV), which has been identified as a potential high risk to cetaceans. In the United States, CMV outbreaks occurring in the mid-Atlantic from 1987 to 1988 and 2013 to 2015 killed bottlenose dolphins (Lipscomb et al. 1994; NOAA 2015), as did those occurring in the Gulf in 1992 and 1994 (Kraftt et al. 1995; Lipscomb et al. 1996). The Trustees may need to evaluate the risk of infection, the safety and efficacy of the vaccine, and the effectiveness of either prophylactic vaccination prior to a disease outbreak or vaccination in response to an outbreak; however, modeling will determine if vaccination during an outbreak is likely to work to protect the populations.




***Source:*** *Ocean Conservancy.*

**Figure 5.D-35.** Spatial coverage of the MMSN in the Gulf of Mexico. Note that Texas MMSN includes two rehabilitation facilities (one in Galveston and one at Texas State Aquarium in Corpus Christie). Also note that MMC has changed its name to Dolphin's Plus Oceanside Marine Mammal Responders (DPO MMR) and no longer operates a rehabilitation facility.

- **Improve the ability to detect and rescue free-swimming dolphins that are entangled, entrapped, or out of habitat.** Marine mammals can become entangled with gear from commercial and recreational fishing, as well as from marine debris. In the absence of intervention, untreated wounds resulting from such entanglements can lead to serious injuries including massive blood loss, infections, impaired mobility, and death (Wells et al. 2008). Fishing hooks embedded in the throat, goosebeak, or esophagus, or line wrapped around the goosebeak, generally lead to death (Wells et al. 2008). Constrictive wraps of line or other objects (e.g., packing straps, motor belts [Figure 5.D-36], Aerobie frisbees, swimsuits) around the body and at the insertions of the fins/flukes, particularly for young animals that are still growing, can lead to deep lacerations (NOAA 2014a). These wraps may eventually reach bones or sever appendages, causing death. Animals entrapped (e.g., due to levee construction), out of habitat, or displaced by severe weather or oceanographic events (e.g., hurricanes) are also candidates for intervention, if they cannot return to suitable habitat on their own and/or when their health is compromised.


***Source:*** *K. Sparks, Georgia Department of Natural and Environmental Resources.*

**Figure 5.D-36.** Example of a bottlenose dolphin wrapped around the head by the belt from a motor.

This technique would provide additional funding to the MMSN to support personnel, equipment, training, and travel to better assist marine mammals that are entangled, entrapped, or out of habitat (e.g., a program similar to the one developed for the Large Whale Entanglement Response Network, *http://alaskafisheries.noaa.gov/protectedresources/entanglement/whales.htm*). This support may include executing contracts with experienced, NMFS-approved dolphin catchers and dolphin capture leads and veterinarians, as well as purchasing essential capture equipment (e.g., seine net and health assessment equipment), to be stationed in strategic locations throughout the Gulf. In addition, support would be needed for the MMSN or others to conduct pre-capture monitoring of the animals (using photo identification) to ensure that they can be relocated for the intervention. Tagging equipment and tracking support would also be needed to conduct post-release monitoring of the animals to evaluate post-intervention success. Currently, few MMSN participants are trained or have experience in cetacean interventions, thus developing volunteer rescue teams of cetacean handlers should be encouraged. This could be done through supporting training activities during planned dolphin health assessments or other activities that involve handling wild dolphins (Wells et al. 2013). In addition, developing new tools and

methods for boat-based disentanglements, and providing related training, could improve the safety and success of these interventions.

- **Develop and increase the technical and infrastructure capabilities to respond to major stranding events or disasters.** Rapid and effective intervention is critical for responding to major stranding events or disasters, such as mass strandings, disease outbreaks, oil spills, extreme weather events, and hurricanes. This intervention may include photographic assessment, tagging, remote biopsy, or live capture techniques. The current capabilities of the Gulf MMSN to respond to such events are limited. This technique would increase the technical and infrastructure capabilities of the Gulf MMSN to respond to major stranding events or disasters (natural and anthropogenic) through multiple mechanisms. These could include 1) providing funding for a marine mammal disaster response coordinator, 2) providing funding for training, 3) developing equipment caches such as marine mammal disaster response trailers, and 4) building multiprong rapid-response teams to assist local MMSN organizations during major stranding events or disasters. All of these actions can reduce the morbidity and mortality associated with mass strandings or disasters.

#### D.5.3.1 Implementation Considerations

To make measureable assessments of group health, researchers must identify causes of morbidity, disease, and mortality and understand the physiology and life history of stranded animals (Hart et al. 2013). The MMSN provides the existing framework for these activities. This approach will require compliance with the MMPA and ESA. MMSN partners in the Gulf of Mexico are currently authorized under either their Section 112c or 109h authority to respond to and/or rehabilitate stranded marine mammals. Response to endangered marine mammals is authorized under an NMFS-held Scientific Research and Enhancement Permit. Enhancements to the MMSN (e.g., enhancements to existing rehabilitation facilities) should take into account guidelines in NMFS' Policies and Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release (*http://www.nmfs.noaa.gov/pr/pdfs/health/eis_appendixc.pdf*) and the terms of their stranding agreement.

In addition to understanding causes of marine mammal mortality and morbidity, researchers can use data collected from marine mammal strandings to foster development of actions that can prevent or mitigate marine mammal threats and stressors, thereby increasing survival of marine mammals and allowing populations to recover. For example, while detecting and responding to entangled marine mammals, researchers could collect data that could help 1) identify the origin of fishing and other material removed from entangled and stranded marine mammals, 2) enhance our understanding of the nature of fishery interactions, 3) provide minimum interaction rates, and 4) facilitate development of measures to reduce them. Another example of where stranding data can be useful is in detecting viral diseases such as CMV and identifying areas where vaccination programs should be developed. Some diagnostic and interventional medicine techniques described in this restoration approach that have the greatest potential for recovery of affected marine mammal populations may not currently be feasible given the current state of research. Therefore, the Trustees recommend a phased approach to implementation after risks to populations are assessed, which will allow for evolving information to be incorporated into effective restoration activities.

Diagnostic techniques are currently used to understand causes of marine mammal morbidity and mortality. However, some diagnostic and interventional medicine techniques described in this restoration approach are not yet in wide use (e.g., a CMV vaccine and delivery method for bottlenose dolphin populations does not currently exist, although active research into developing a vaccine for cetaceans is ongoing). These may first require additional research and small-scale design studies to examine feasibility.

Although federal resources are devoted each year to marine mammal stock assessments (e.g., through line transect surveys and observations of marine mammal bycatch in various sectors of the fishing industry), far fewer, and less consistent, federal resources are available to support the study of stranded marine mammals. Moreover, the capabilities of individual MMSN facilities and response coverage in different areas vary greatly. The quality of diagnostic examination of stranded marine mammals depends substantially on the resources and expertise of the responding stranding network and the state of decomposition of the subject at the time of examination (Moore et al. 2013). Enhancing the MMSN will target the most important needs for each network or geographic area. For example, this information can help document changes to the populations of highly affected areas (e.g., Barataria Bay) and inform restoration and management efforts. Using this approach will help expand coverage to more areas, with greater consistency in the networks' ability to use information collected and respond to marine mammal threats.

#### D.5.3.2 OPA Appropriateness Evaluation

The restoration approach "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" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline and compensate for the interim services losses to marine mammal species, particularly BSE and coastal stocks of bottlenose dolphins that were adversely affected by the DWH oil spill.

The techniques described above are reasonable and established. Stranding networks currently exist in all coastal states, and rehabilitation, disentanglement, and rescues already occur for marine mammals throughout the United States. Collateral injury to other natural resources is expected to be minimal or nonexistent. Burial and equipment use may have a negligible impact on erosion, and/or minor adverse effects may occur due to use of temporary pools for rehabilitation (e.g., through the release of wastes and pathogens). However, rehabilitation facilities would have necessary permits for wastewater discharges. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.5.4 Measure Noise to Improve Knowledge and Reduce Impacts of Anthropogenic Noise on Marine Mammals

This restoration approach focuses on using passive acoustics and other technologies to 1) characterize the spatial overlap between noise and marine mammal stocks, 2) characterize the dominant anthropogenic noise sources, and 3) prioritize noise reduction of those sources in areas where

noise and high densities of marine mammals overlap. Noise from anthropogenic sources, including commercial shipping, oil and gas exploration and extraction, and military activities, can have short- and long-term impacts on marine life. Measurements of cumulative noise would serve as a predictor variable (among others) that could be used to assess possible correlations with broad-scale and long-term marine mammal movement patterns, and provide data necessary to ground-truth models built to predict noise patterns in the Gulf. Outcomes from these efforts can help inform management actions for marine mammal restoration.

This approach could include the following:

- Collecting and using data from calibrated passive acoustic and complementary marine mammal survey techniques to characterize the spectral, temporal, and spatial qualities of noise throughout the Gulf of Mexico and determine areas of overlap between high noise levels and marine mammal stocks.
- Prioritizing noise reduction in areas where high noise levels and high densities of marine mammals overlap.
- Developing collaborative partnerships to identify, test, and implement strategies and technologies to reduce noise impacts on marine mammals using outcomes from the characterization and prioritization steps.

Experts broadly agree that more information on Gulf sources of anthropogenic sound and the associated impact on marine mammals is needed (Frisk et al. 2003; NRC 2005). Human activities, including navigation and transportation, oil and gas exploration and acquisition, offshore construction, research, and military activities intentionally and unintentionally introduce sound into the marine environment. Marine mammals rely heavily on acoustic sensory capabilities to detect and interpret acoustic communication and environmental cues to select mates, find food, maintain group structure and relationships, avoid predators, navigate, and perform other critical life 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 through acute, chronic, and cumulative effects (Francis & Barber 2013). These impacts cover a range of adverse physical and behavioral effects including death, hearing loss, stress, behavioral changes, reduced foraging success, reduced reproductive success, masking of communication and environmental cues, and habitat displacement (Francis & Barber 2013). Many studies show these impacts are relevant both for marine mammals (e.g. Aguilar Soto et al. 2006; Azzara et al. 2013; Cox et al. 2006; Croll et al. 2001; Hatch et al. 2012; Nowacek et al. 2007; Rolland et al. 2012; Tyack et al. 2011; Weilgart 2007) and their prey sources (e.g. Mooney et al. 2012; Popper et al. 2003; Radford et al. 2014).

The acute, chronic, and cumulative impacts of these anthropogenic noise sources on most marine mammal species in this region have not been well documented, and, in general, long-term, population-level impacts of noise on cetaceans are not well studied. To better evaluate the impacts of anthropogenic noise on cetacean species, NOAA convened the Cetaceans and Sound Mapping (CetSound) working group and developed geospatial tools to understand wide-ranging, long-term underwater noise contributions from multiple human activities throughout U.S. waters

(*http://cetsound.noaa.gov*). Results of this modeling project, which included noise from commercial shipping, passenger vessels, oil and gas service vessels, and oil and gas seismic surveys, indicate the Gulf of Mexico has the highest densities of ambient noise sources of all U.S. marine ecosystems, with predicted annual average ambient noise levels in some areas potentially approaching the noise threshold for behavioral harassment takes from nonimpulsive noise sources (NOAA 2005). These models are informative for highlighting that noise is a chronic stressor in the Gulf of Mexico and suggest the need for prioritizing noise reduction in the Gulf. However, modeling results need to be validated with in situ ocean noise measurements over broad spatial and temporal scales to identify large contributors to the noise budget and allow for targeted restoration. This approach could include the following:

- **Characterize spatial and temporal distributions and density of marine mammals in the Gulf.** A range of survey techniques and modeling methods exist for both measuring and predicting density and distribution of marine mammals, as well as understanding the behavioral context of specific patterns of habitat use. This information is critical and will be used for characterizing and quantifying noise and other impacts, as well as developing and implementing mitigation approaches (e.g., ship-quieting technologies) for marine mammals. In the Gulf of Mexico, data are generally lacking on marine mammal distributions and densities at the spatial and temporal scales needed to support assessments of noise impacts. This approach may involve collecting data on the seasonal and spatial occurrence of marine mammals using complementary survey techniques, developing analytical models of habitat preference and spatial distribution, and implementing spatial planning and decision-support tools. The data collection efforts will extend from the shoreline to the U.S. Exclusive Economic Zone, reflecting the ranges of the coastal, continental shelf, and oceanic stocks of marine mammals in these habitats. The multiyear data collection will include 1) large vessel visual and passive acoustic line transect surveys of oceanic waters, 2) seasonal aerial surveys over the continental shelf, 3) year-round deployment of long-term passive acoustic monitoring units, 4) satellite tagging of marine mammals to better understand behavior and habitat use, and 5) oceanographic data collection, including hydrographic structure and indicators of water column productivity from survey platforms and remote-sensing products. This combination of information on marine mammals and their habitats will be incorporated into empirical models of seasonal spatial distribution and abundance and into spatial planning tools for use in environmental impact assessment, operational planning, and permitting by federal agencies.

- **Characterize ocean noise throughout the Gulf.** In this approach, long-term passive acoustic data could be collected throughout shelf, slope, and deep-ocean waters for both marine mammal presence and noise characterization. A combination of calibrated low- and high-frequency passive acoustic monitoring buoys will be used to ensure evaluation of a broad frequency range. Characterizations will include average and steady-state ambient noise and identifiable sounds, including seismic surveying sources, sonars, shipping, and explosive noise. These characterizations will then be compared with modeled noise conditions to improve predictive modeling of noise conditions in the Gulf and the evaluation of long-term noise trends. Efforts to measure ocean noise may be targeted toward important marine mammal habitats but will also cover the broad spatial scale of the Gulf to provide a complete picture of the acoustic environment in important marine mammal ecosystems throughout the Gulf. These

spatiotemporal ambient noise and sound source characterizations will be evaluated with spatiotemporal marine mammal density and distribution products to determine the overlap between ocean noise and marine mammals.

- **Develop collaborative partnerships to identify and implement noise reduction measures.** In this approach, collaborative partnerships could be developed to identify, test, and implement strategies to reduce noise impacts from sources such as military, shipping, and seismic surveys in areas with high densities of marine mammals. Collaborative partnerships would be developed among industry, noise experts, academic institutions and researchers, and state and federal agencies. Partnerships would be facilitated by convening technical workshop(s). The goal of the workshop(s) would be to determine actions that would help reduce noise impacts from specific sources on marine mammals. These actions could include, but are not limited to, conducting research regarding noise reduction techniques; developing, testing, and implementing quieting technologies; developing best practices; and/or implementing outreach programs to promote strategies. For example, voluntary noise reduction guidelines for the shipping industry have been developed through similar workshops that identify computational models for determining effective quieting measures; provide guidance for designing quieter ships and for reducing noise from existing ships, especially from propeller cavitation; and advise owners and operators on how to minimize noise through ship operations and maintenance, such as by polishing ship propellers to remove fouling and surface roughness (IMO 2014). As these guidelines are voluntary, effort could be invested in the Gulf to ensure adoption and implementation of the measures developed.

#### D.5.4.1 Implementation Considerations

This approach uses passive acoustics and other technologies to evaluate and address noise impacts on marine mammals. A range of survey techniques and modeling methods exist for both measuring and predicting density and distribution, as well as understanding the behavioral context of specific patterns of habitat use. This approach will further benefit from considering recommendations from NOAA's Ocean Noise Strategy. Overall, this suite of information is critical for characterizing and quantifying noise and other impacts on marine mammals, understanding how these effects overlap with marine mammal density and distribution, and mitigating impacts on marine mammals. This approach may also support research on developing quieter technologies and identifying what opportunities may exist to further develop technologies. This type of research is underway in areas outside the Gulf and would greatly inform similar work in the Gulf.

Extensive federal and state coordination is required, and challenges may occur in implementation based on the need to coordinate among multiple jurisdictions, depending on the types of solutions and geographic areas identified to reduce noise impacts. For example, any potential changes in shipping activities to reduce noise in particular areas would require coordination with the U.S. Coast Guard and/or the International Maritime Organization, both of which have jurisdiction over shipping. Finally, because noise also occurs Gulf-wide and outside the U.S. Exclusive Economic Zone, implementing this restoration approach or identified solutions both within and outside the U.S. portion of the Gulf of Mexico could help achieve the greatest benefit for marine mammals.

### D.5.4.2 OPA Appropriateness Evaluation

The restoration approach "Measure noise to improve knowledge and reduce impacts of anthropogenic noise on marine mammals" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by reducing injury to, mortality to, or harassment of marine mammals. Additionally, this approach can help compensate for interim services losses to oceanic, shelf, coastal, and estuarine marine mammals adversely affected by the DWH oil spill.

The techniques described above are well-established. Similar studies have been undertaken in the past to support assessments and mitigation of the chronic level of exposure to marine mammal populations from anthropogenic activities. Collateral injury to other natural resources is expected to be minimal to nonexistent. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

## D.5.5 Reduce Injury, Harm, and Mortality to Bottlenose Dolphins by Reducing Illegal Feeding and Harassment Activities

This restoration approach focuses on reducing harmful impacts on marine mammals from illegal feeding and harassment activities by people. People feeding, attempting to feed, and harassing dolphins are rampant activities, which are increasing throughout the Gulf of Mexico despite being illegal under the MMPA. This technique will reduce lethal and harmful impacts on estuarine and coastal bottlenose dolphins from illegal feeding and harassment activities throughout the Gulf of Mexico. Reducing these illegal activities requires raising awareness among various user groups (e.g., eco-tour operators, residents, visitors, recreational boaters, and marina or pier business owners) about how their activities may harm dolphins.

The harmful effects of people feeding and harassing bottlenose dolphins in the wild are well documented. Feeding wild bottlenose dolphins alters their natural behavior. It reduces their natural wariness of people and boats, which increases their risk of getting hit by a propeller and/or entangled in fishing gear, harms them by providing contaminated or inappropriate food and nonfood items, and poses a significant safety risk to humans (Cunningham-Smith et al. 2006; Donaldson et al. 2012; Donaldson et al. 2010; Finn et al. 2008; Mann & Kemps 2003; NMFS 1994; Orams 2002; Perrtree et al. 2014; Samuels & Bejder 2004). Short-term behavioral changes from harassment may further lead to long-term displacement or newly established residency in less-suitable habitats (Allen & Read 2000; Bejder et al. 2006; La Manna et al. 2010; Lusseau 2005; Samuels & Bejder 2004).

Implementing innovative and targeted outreach and education tools for resource user groups is crucial for effectively changing human behaviors and reducing associated negative impacts on dolphins. This approach could use social science studies such as surveys, focus groups, and interviews to identify and characterize the attitudes, knowledge, perceptions, and motivations of user groups interacting with dolphins to design targeted outreach tools. This information is an important first step to designing and implementing effective outreach to change human behavior, similar to how advertising campaigns study their audiences prior to developing effective messaging. This approach could use outreach techniques

such as public service announcements, targeted social media campaigns, audience-targeted print products and ads, and other types of educational campaigns (see Figure 5.D-37). This approach could also include partnering with stakeholders to widely distribute and communicate tools to effectively reach targeted user groups throughout the Gulf of Mexico. Social science studies could be used before and after outreach efforts to measure success.


***Sources:*** *NOAA, Texas Marine Mammal Stranding Network, and* www.dontfeedwilddolphins.org.

**Figure 5.D-37.** Examples of outreach tools and communication strategies: educational billboards, signs, and public service announcements.

### D.5.5.1 Implementation Considerations

Successfully reducing harmful impacts in this approach requires changing human behavior, which can be quite challenging. This restoration approach will require coordination, mechanisms to reduce uncertainties, and performance monitoring to maximize benefits. Collaboration efforts will require that the Trustees coordinate with various stakeholders and state resource coordinators and managers. This approach also depends on voluntary public participation in social science research, and its effectiveness will depend on the public's receptiveness to communication strategies and outreach messages. This dependence on public participation and receptivity inherently introduces uncertainty regarding the potential for this approach to achieve progress toward restoration outcomes. Uncertainties can be reduced in several ways: 1) providing incentives for voluntary participation in social science studies, 2) using social science study results to identify communication strategies, 3) employing tools that match each target audience's motivations and needs while cost-effectively maximizing outreach impact over time, 4) enhancing enforcement of existing regulations by building capacity and training for state agencies, and 5) capitalizing on benefits from coordination with sea turtle and other protected resource enforcement and outreach-related restoration approaches.

This type of restoration approach and its techniques have precedence; all aspects of this restoration approach are routinely conducted to reduce impacts on dolphins from illegal feeding and harassment activities by people. Because these illegal activities are rampant across the southeastern United States and because tourism is increasing in the Gulf, the Trustees may need to implement this restoration approach outside the Gulf of Mexico to achieve the greatest benefit for marine mammals. Conducting social science studies such as surveys, focus groups, and interviews would require adherence to Paperwork Reduction Act and Information Quality Act requirements.

### D.5.5.2 OPA Appropriateness Evaluation

The restoration approach "Reduce injury, harm, and mortality to bottlenose dolphins by reducing illegal feeding and harassment activities" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by reducing direct and indirect injury, harm, and mortality to bottlenose dolphins from illegal feeding and harassment activities throughout the Gulf of Mexico. This approach is also expected to benefit other protected species such as sea turtles. Additionally, this approach can help compensate for the interim services losses to estuarine and coastal bottlenose dolphins adversely affected by the DWH oil spill.

The approach described above is well-established and widely used in the Gulf of Mexico and nationally for natural resource management and conservation efforts. In addition, targeted outreach has been recommended and shown to reduce human interactions with dolphins, which further reduces the risk of harm or mortality from interacting with hook-and-line fishing gear (Barco et al. 2010; Powell 2009; Wells et al. 1998). Collateral injury to other natural resources is expected to be minimal. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources, because implementing identified communication tools and strategies would create a general awareness of safe and responsible use of marine waters. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



## D.5.6 Reduce Marine Mammal Takes Through Enhanced State Enforcement Related to the Marine Mammal Protection Act

This restoration approach builds capacity and training for state enforcement agencies to implement the MMPA in their state waters (see Figure 5.D-38). Enforcement is an important tool for reducing illegal activities known to cause harm to marine mammals. MMPA provisions prohibit the illegal feeding, harassment, intentional harm (e.g., shooting), or other illegal "take" of marine mammals. This approach could include working with Gulf states individually to identify training needs and the most appropriate venue and format for the delivery of MMPA-related training. This approach could also include developing and distributing outreach products or techniques targeted specifically to enforcement officers. Examples could include fact sheets or stickers that summarize key MMPA provisions and describe why enforcing these provisions is important to a state's resources and marine mammals. In addition, this approach could provide increased funding to state enforcement agencies to increase the percentage of time that officers and equipment (e.g., vessels) are dedicated to MMPA enforcement activities.

*Source: FWC.*

**Figure 5.D-38.** FWC law enforcement disentangling a live dolphin from a crab pot as part of their enforcement activities.

The harmful effects of people feeding and harassing bottlenose dolphins in the wild are well documented. Feeding wild dolphins alters their natural behavior; reduces their natural wariness of people and boats, which increases their risk of getting hit by a propeller or being entangled in or ingesting fishing gear; harms them by providing contaminated or inappropriate food and nonfood items; and poses a significant safety risk to humans (Cunningham-Smith et al. 2006; Donaldson et al. 2012; Donaldson et al. 2010; Finn et al. 2008; Mann & Kemps 2003; NMFS 1994; Orams 2002; Perrtree et al. 2014; Samuels & Bejder 2004). Feeding, attempting to feed, and harassing dolphins are prevalent activities throughout the Gulf Coast. Direct intentional harm or retaliatory acts by people, such as shooting dolphins with bullets or arrows or using pipe bombs or other devices, also occurs Gulf wide (see Figure 5.D-39) (DOJ 2006, 2007, 2013, 2015). Continued and consistent enforcement is an important tool for reducing harmful and illegal activities (Kovacs & Cox 2014; McHugh et al. 2011; Perrtree et al. 2014). Increased enforcement would result in increased compliance with the MMPA and reduce the number of dolphins that are injured, killed, or harassed by illegal activities.

***Source:*** *Alabama state law enforcement.*

**Figure 5.D-39.** Stranded bottlenose dolphin that died from a puncture wound made by a screwdriver. Alabama state law enforcement assisted in the investigation of this illegal take.

### D.5.6.1 Implementation Considerations

This restoration approach will require coordination and communication, regular training and related resources, and development of performance metrics to maximize benefits. Differences in how the various state enforcement agencies operate and their priorities may present challenges, as well as competing demands. High turnover of enforcement field staff and leadership may also pose a challenge. Reducing these challenges would require 1) coordinating with NOAA's Office of Law Enforcement to ensure consistency in how enforcement activities are conducted and determine agency priorities, and 2) conducting regular training and communication with the states to ensure steady, consistent training opportunities for state officers, as well as sustaining knowledge and awareness of MMPA take prohibitions. This approach would also help identify the current training locations and frequency with which training for state officers is currently conducted and whether MMPA-related training can be included to reduce competing demands on officers' time.

The approach would require available resources at NMFS and staff time for training activities and facilitating coordination with the states. Conducting training would also require travel to various locations in coastal states across the Gulf. The Trustees could also coordinate this approach with other efforts to enhance state enforcement of protected species.

### D.5.6.2 OPA Appropriateness Evaluation

The restoration approach "Enhance state enforcement capabilities and training related to the MMPA" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline and compensate for interim losses by reducing illegal and harmful activities and increasing compliance with the MMPA, thereby reducing mortality and harm to marine mammal populations.

The approach described above is known to reduce harmful and illegal activities. For example, McHugh et al. (2011) found significant reductions in illegal feeding rates and number of items fed to a begging

dolphin in Sarasota, Florida, when a marked enforcement boat was patrolling the area. In addition, results of two scientific studies in Georgia found that enforcement activities aimed at shrimp trawl fishers combined with education for those fishers were the likeliest factors in reducing dolphin begging behavior (Kovacs & Cox 2014; Perrtree et al. 2014). Collateral injury to other natural resources is expected to be minimal to nonexistent. Enforcement activities are ongoing, and no past data suggest impacts on biological resources have occurred. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.5.7 Reduce Injury and Mortality of Marine Mammals from Vessel Collisions

This restoration approach focuses on reducing vessel collisions with marine mammal species in the Gulf of Mexico by developing and implementing a comprehensive mitigation strategy. This strategy may include techniques such as time/area-sensitive changes to vessel routes and speeds, mariner training, and mariner and recreational boater outreach and education. Passive acoustics, tagging, and predictive modeling are additional useful tools that help inform effective mitigation to reduce vessel collisions with marine mammals (cetaceans) in the Gulf of Mexico. 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) (Figure 5.D-40). The severity of injuries can include bone fractures, organ damage, and/or internal hemorrhaging and is dependent on the species, the individual, location of the cut, and the depth of penetration (Andersen et al. 2008). Factors affecting collision mortality risks are the likelihood of a collision (i.e., overlapping spatial distribution of major shipping lanes and high species densities) and the severity of the trauma (higher speeds and/or larger vessels) (Andersen et al. 2008; Constantine et al. 2015; Jensen & Silber 2004; Laist et al. 2001; Vanderlaan & Taggart 2007). Species that spend a greater proportion of their time near the surface of the water are at greater risk of ship strikes (Constantine et al. 2015) than those that predominantly inhabit lower depths. Stranding records and public reports may underrepresent vessel collisions, as many go undetected or unreported when they occur in remote areas or when carcasses drift out to sea and are undiscovered (Jensen & Silber 2004; Peltier et al. 2012; Williams et al. 2011).



Bryde's whales are the third most commonly reported whale species (after right whales and humpback whales) to be struck by vessels in the southern hemisphere (vanWaerbeck & Leaper 2008). In the northern Gulf of Mexico, there is a very small population of Bryde's whales with markedly low genetic diversity. In 2009, a documented vessel collision occurred when a Bryde's whale was struck and carried into Tampa Bay on the hull of a ship (Rosel & Wilcox 2014; Waring et al. 2015). A documented vessel strike of a sperm whale also occurred in 1990 (Waring et al. 2013). Vessel strikes with small cetaceans such as bottlenose dolphins also occur. Between 2002 and 2013 in the Gulf of Mexico, there were 47 bottlenose dolphin strandings with evidence of boat strike (NOAA 2014a).

***Source:*** *Clearwater Marine Aquarium.*

**Figure 5.D-40.** Bottlenose dolphin severely injured by a boat propeller strike.

The Gulf of Mexico is extremely busy in terms of number of vessels and vessel capacity. In 2009, the Gulf Coast region contained 13 of the nation's 20 leading ports for tonnage (USACE 2010). The risk of collision mortality is likely to increase in the future due to increased vessel traffic following the expansion of the Panama Canal and technological advancements resulting in larger ships.

Several actions could be considered as part of a comprehensive mitigation strategy to reduce the potential for vessel collisions. First, changes to vessel routing could reduce the risk of marine mammal and vessel collisions (Carrillo & Ritter 2010; NMFS 2008; Vanderlaan et al. 2008). Locations in the Gulf of Mexico that are known to contain higher densities of marine mammals, or are biologically important areas, can be avoided either spatially, temporally, or both through voluntary vessel rerouting. This technique has been previously implemented successfully, resulting in reduced right whale vessel collisions (NMFS 2008; Vanderlaan et al. 2008). Mechanisms such as voluntary seasonal Areas to Be Avoided (ATBA) could be employed; this is another effective tool used to reroute traffic around critical right whale feeding grounds in the Great South Channel from April 1 to July 31. A Traffic Separation Scheme (TSS) was established and then later amended to narrow the North-South shipping lanes in Boston, Massachusetts (Bettridge & Silber 2008). NMFS has also recommended shipping routes to help reduce the likelihood of collisions in waters off Florida, Georgia, and Massachusetts (NMFS 2008). Although marine mammals are broadly distributed throughout the Gulf of Mexico, techniques used to avoid vessel interactions with right whales can be applied in this area using knowledge of marine mammal distribution, ranging patterns, and biologically important areas.

Voluntary speed restrictions would help reduce the probability of vessel collisions and has successfully reduced large whale ship strikes (Constantine et al. 2015; Laist et al. 2014; van der Hoop et al. 2015). The lethality of collisions increases with ship speed (Silber et al. 2010; van der Hoop et al. 2015; Vanderlaan & Taggart 2007; Wiley et al. 2010). Studies showed that the probability of a lethal strike increased from 20 percent to 100 percent with speeds ranging between 9 and 20 knots (Pace III & Silber

2005; Wiley et al. 2010). Below the threshold of 10 knots, the risk of death from a ship's speed and hydrodynamic draw is considerably reduced (Silber et al. 2010). In a mortality risk model, vessel speed restrictions were found to reduce 80 percent to 90 percent of ship strike mortality risk for North Atlantic right whales (Conn & Silber 2013). The technique of reducing vessel speed is a powerful tool for reducing vessel collisions with marine mammals. Similar to the technique of changing vessel routes, this technique can be voluntary.

Another option to reduce the likelihood of collisions could be to increase mariner and recreational boater education and awareness (Silber et al. 2012). Mariners may not know which marine mammal species inhabit the Gulf of Mexico, the relative location of those species, the time of year they occupy the area, or ways to reduce risk of collision. When given this knowledge, mariners may offer solutions to help reduce the probability of ship strike. Outreach and education may also prompt mariners to voluntarily adopt techniques such as vessel routing and speed restrictions.

#### D.5.7.1 Implementation Considerations

All the techniques in this approach are regularly implemented and have proven successful throughout the United States and worldwide in reducing collisions between marine mammals and vessels. However, extensive coordination among multiple local, national, and international organizations is critical (e.g., ports, states, the U.S. Coast Guard, and the International Maritime Organization). This approach depends on voluntary participation by mariners and the adoption of identified stratgeies to ensure reduced vessel collisions with marine mammals. Relying on voluntary participation inherently introduces uncertainties regarding how much progress can be made toward restoration outcomes. Providing incentives, establishing agreements, and providing edcuation and outreach can help reduce these uncertainties.

#### D.5.7.2 OPA Appropriateness Evaluation

The restoration approach "Reduce injury and mortality of marine mammals from vessel collisions" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline and compensate for interim losses of large whales and small cetaceans by reducing injury and mortality from vessel strikes.

A comprehensive mitigation strategy would help to better understand the nature of vessel collisions and strategies to best avoid them. Use of passive acoustic data, predictive modeling, and tagging data could inform recommendations and approaches to benefit the conservation and protection of marine mammals. The techniques described above are reasonable and effective ways to address marine mammal injury and mortality from vessel strikes. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

## D.6 Bird Restoration Approaches

1. Restore and conserve bird nesting and foraging habitat

2. Establish or re-establish breeding colonies

3. Prevent incidental bird mortality

### D.6.1 Restore and Conserve Bird Nesting and Foraging Habitat

This approach involves conserving and restoring target habitat areas or land parcels for bird resources. Multiple restoration techniques are available for use, individually or in combination, as potential restoration projects. In addition to those techniques found among the habitat restoration approaches, this restoration approach could employ, but is not limited to, the following techniques:

- **Enhance habitat through vegetation management.** This technique would create or preserve bird nesting habitat through vegetation management. Managing vegetation is a common restoration technique to enhance habitat for specific bird species. Reducing vegetation on beaches, for example, can provide nesting and foraging habitat for birds such as shorebirds and terns. Conversely, adding vegetation can provide habitat for other bird species such as wading birds and brown pelicans. Common vegetation management methods include mechanical treatments, application of pesticides or herbicides, biological control to manage plant species, and active planting.

- **Restore or create riverine islands.** This technique would restore bird species injured by the spill that winter along the Gulf Coast and migrate elsewhere to nest. These species migrate to major nesting areas in the upper U.S. midwestern states along the Mississippi migration flyway as well as areas in the West along the central flyway. They nest primarily or exclusively on islands in lakes or rivers. Creating or enhancing riverine islands will expand nesting habitat and/or increase the longevity of those islands, resulting in increases in production of the bird species using the islands.

- **Create or enhance oyster shell rakes and beds.** This technique would create or enhance oyster shell rakes and beds to provide nesting and foraging habitat for birds. Shell rakes, build-ups of oyster and other shells found along beaches and the edges of marshy islands, constitute important nesting and roosting habitat for shorebirds, American oystercatchers, in particular. Intertidal oyster beds provide foraging sites at low tide when the shellfish are accessible to oystercatchers. Oyster beds above mean high tide serve a critical function for oystercatchers by providing foraging and high-quality high tide roost sites. This technique can be implemented in several ways, including directly placing shell hash on beaches and using bagged blocks of living oysters to enhance or create living oyster reefs.

- **Nesting and foraging area stewardship.** This technique would protect bird nesting and foraging habitat using exclusion devices and vegetated buffers, maintaining beach wrack and distance buffers, and/or using patrols by wildlife stewards and targeted outreach and education. Predation can significantly increase bird mortality when nest sites or colonies are located in habitat that does not offer adequate protection. Several options exist for removing or excluding predator threats to nesting birds. Predator control by nonlethal (e.g., exclusionary fencing or live

trapping) and lethal methods consistent with current management practices could be implemented at the discretion of the land-managing agencies based on their evaluation of necessity and feasibility. This technique could also include shoreline stewardship to emphasize the maintenance of wrack on beaches. Wrack refers to the accumulation of seaweed, terrestrial plants, animal remains, and/or other organic debris along the high tide line of a beach, which provides habitat for invertebrates, an important food source for beach-dependent birds (Dugan et al. 2000; FWS 2012). Shoreline stewardship could emphasize the maintenance of wrack and wrack production processes. Human disturbance is also recognized as a substantial threat affecting multiple bird species. Human disturbance can lead to failure of nests, increased egg and chick predation, or even total colony abandonment. This technique has been shown to effectively reduce anthropogenic disturbance in and around nesting birds by establishing buffer distances. Buffer distances would be determined for a particular species relative to the type of activity occurring, taking into account factors such as intensity, time of year, and sensitivity of the species.

- **Provide or enhance artificial nest sites.** This technique would provide or enhance artificial nest sites to facilitate breeding. The lack of suitable nesting sites, such as those provided by tree cavities or shrub or tree platforms, can limit local bird densities. Providing artificial nest sites, such as nest platforms and nest boxes, can help mitigate this limitation, facilitating breeding for certain bird species.
- **Increase availability of foraging habitat at inland, managed moist-soil impoundments, agricultural fields, and aquaculture ponds.** This technique would manage flood depth and timing of shallowly flooded impoundments, fields, ponds, and agricultural fields to provide foraging habitat. Shallowly flooded inland impoundments, fields, and ponds can serve as foraging areas for shorebirds, wading birds, and waterfowl and provide suitable prey or food items, especially during migration and periods of drought. This technique involves managing flood depth and timing of shallowly flooded impoundments, fields, ponds, and agricultural fields for the benefit of migrating birds. Helmers (1992) and others provide detailed guidelines for managing moist-soil impoundments and rice fields for the benefit of migrating and wintering shorebirds. Such guidance should be considered in actions designed to benefit birds.



#### D.6.1.1 Implementation Considerations

This restoration approach has been used extensively to increase bird production, health, and survival. Common implementation considerations include 1) the quality of the target habitat and its ability to provide services to birds in the context of local bird population dynamics and needs; 2) long-term protection of restoration investments; 3) local opportunities given site-specific logistics, 3) coordination with the local community; 4) local acceptance; 5) potential effects on other resources; 6) engineering and design needs; 7) the presence of abandoned or current infrastructure within project areas; and 8) local, state and federal laws. This approach will target important nesting and foraging areas for injured birds. Therefore, restoration could occur in upper regions of the Gulf Coast or outside of the Gulf, as appropriate; however, restoration will be prioritized for the northern Gulf of Mexico. The techniques described above are reasonable and well-established within a number of local and regional restoration plans and documents guiding restoration of bird habitat (e.g., Brown & Brindock 2011; Carney &

Sydeman 1999; Golder et al. 2008; Hunter 2000; Hunter et al. 2006; Nol & Humphrey 2012; NRCS 2011; Page et al. 2009; Sabine et al. 2008; Vermillion 2012; Vermillion & Wilson 2009; Visser et al. 2005). These techniques include components of various restoration design models for birds that address threats to species and/or their habitats, bird-habitat relationships, and bird distributions.

#### D.6.1.2 OPA Appropriateness Evaluation

The restoration approach "Restore and conserve bird nesting and foraging habitat" meets the criteria for being appropriate restoration under OPA. If implemented properly, it can help return injured natural resources and services to baseline by supporting increased health and reproduction of birds. Additionally, this approach can help compensate for interim services losses to birds adversely affected by the DWH oil spill through restoring, rehabilitating, and/or replacing habitats providing services to injured bird species.

These techniques are commonly used to provide services to birds, including during DWH NRDA Early Restoration (Phases II, III, and IV). Any collateral injury to other natural resources is expected to be minimal and short term; however, project selection and design should consider potential impacts on existing habitat, such as the smothering of aquatic resources during island construction or enhancement**.** The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



### D.6.2 Establish or Re-establish Breeding Colonies

This restoration approach focuses on establishing or re-establishing bird breeding colonies through translocating chicks and/or attracting breeding adults to restoration sites. Since the 1970s, this restoration approach has been implemented worldwide to encourage colonization of sites by bird nesting colonies. Techniques commonly include translocating chicks to new colonies and using acoustic vocalization playbacks and decoys to attract breeding adults to restoration sites. These techniques are often employed with other restoration activities that enhance a target site for breeding birds (Jones & Kress 2012). For example, actively reintroducing seabirds to breeding areas is a proven technique to help mitigate losses from factors such as oil spills (e.g., Apex Houston Trustee Council 2011; Kress 1983; Parker et al. 2007).

#### D.6.2.1 Implementation Considerations

This approach has been successfully used at various locations with different species, including as part of NRDA restoration actions (e.g., Apex Houston Trustee Council 2011; Kress 1983; Parker et al. 2007), though success has varied depending on species and location. A phased approach to implementation could identifying the best techniques. For example, testing combinations of translocation and/or attractant techniques can help ensure site- or species-specific success. Combining this with other bird restoration approaches will be considered to maximize success.

#### D.6.2.2 OPA Appropriateness Evaluation

The restoration approach "Establish or re-establish breeding colonies" meets the criteria for being appropriate restoration under OPA. If implemented properly, it can help return injured natural

resources and services to baseline by directly facilitating additional production of injured bird species. Additionally, this approach can help compensate for interim services losses to birds adversely affected by the DWH oil spill by replacing habitats providing services to injured bird species.

The approach described above is reasonable and well-established. It has been implemented worldwide since the 1970s to facilitate production by target bird species (Jones & Kress 2012), including to help mitigate losses from factors such as oil spills (e.g., Apex Houston Trustee Council 2011; Kress 1983; Parker et al. 2007). Collateral injury to other natural resources is expected to be minimal or nonexistent. The Trustees do not anticipate that the approach will negatively affect public health or safety. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.6.3 Prevent Incidental Bird Mortality

A number of anthropogenic activities can lead to incidental bird mortality, but a variety of restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Remove derelict fishing gear.** Water bird mortality associated with fishing line entanglement and/or hooking by anglers can be a significant source of mortality. Rookery islands, in particular, become aggregation points for entangling debris because when birds forage around the region, they can become entangled and return to the colony bringing the material with them. Birds also sometimes collect discarded fishing netting and plastic debris from the ocean surface around breeding colonies for nest building. Parents and chicks can sometimes become entwined in debris, resulting in mortality. This technique involves reducing bird entanglement and accidental hooking by recreational fishers by removing derelict fishing gear in and around popular fishing areas (e.g., boat ramps and piers) and bird colonies, providing public education regarding management of fishing gear to avoid bird entanglement and accidental capture, providing education regarding release techniques, and providing support for rescue and release of entangled birds.

- **Support bird rehabilitation centers.** This technique would restore bird species injured by the spill by supporting the collection of sick, injured, or disoriented birds by agency staff and their rehabilitation and release by specialized wildlife rehabilitation centers. Sick, injured, or disoriented birds are often found by members of the general public. These birds are sometimes captured and transported to specialized wildlife rehabilitation clinics or reported to state or federal natural resource agencies in an effort to secure rehabilitation. Depending on the species, the number of breeding adults dying from otherwise treatable symptoms can have significant negative consequences on a local population. This technique would support targeted enhancements in sick or injured bird recovery and rehabilitation efforts to increase the number of birds rehabilitated and released, decreasing preventable mortality.

- **Reduce collisions by modifying lighting and/or lighting patterns on oil and gas platforms.** Millions of birds partake in annual migrations across the Gulf of Mexico and to the Gulf from

other breeding areas. Much of this occurs during the night. Offshore oil/gas platforms and alternative energy production facilities (e.g., wind turbines and kinetic energy facilities) constitute major sources of artificial light in this environment. Red and white lights used by these structures can disrupt magnetic and visual cues used by migrating birds, causing collision and/or circulation events, whereby birds confused by platform lights initiate a pattern of circling, which ultimately causes exhaustion and death (Evans Ogden 1996; Montevecchi et al. 2006; Poot et al. 2008; Russell 2005; Wiese et al. 2001). This technique would reduce offshore lighting-related mortality by replacing existing white (tube lights) and red (sodium high-pressure) lighting on oil and gas platforms with lights low in spectral red or shield lights, and/or modifying lighting patterns (e.g., steady on to flashing or blinking) to reduce mortalities.

- **Reduce seabird bycatch through voluntary fishing gear and/or technique modifications.** Many seabirds are proficient swimmers, some diving many tens of meters in pursuit of fish. Diving, unfortunately, makes them vulnerable to being inadvertently caught by commercial fishers during fishing operations. Diving seabirds swim into, become entangled, and drown in fine nylon mesh gill nets owing to their lack of visibility (Melvin et al. 1999), and they can become entangled in seine or trawl nets as they are retrieved (NOAA 2001). Seabirds can be hooked by longline fishing gear when they forage behind vessels for bait and fish waste (Anderson et al. 2011). More than 40 different combinations of fishing gear are used to target different fish in the northwest Atlantic for U.S.-based fisheries alone. Fisheries in which bird bycatch has been observed include Atlantic cod, Atlantic herring, Atlantic halibut, swordfish, bluefin tuna, and pollock. Bird bycatch in these types of commercial fishing operations occurs at varying levels. Although a lack of data exists within the Gulf of Mexico relative to other areas, bird bycatch also occurs in this region (NOAA 2001). The North American Waterbird Conservation Plan identifies fisheries bycatch as a serious threat to at least 17 species of seabirds in the mid-Atlantic/New England/maritimes, and southeastern regions, an area including all U.S. Atlantic waters (Kushlan et al. 2002). This technique would target fisheries resulting in bird bycatch to reduce bycatch and, thus, bird mortality. Activities may include working with fishers to voluntarily avoid fishing in areas and at times when seabird interactions are most intense; limiting bird access to baited hooks; reducing collisions with trawl lines and cables; reducing net entanglements; and increasing education, training, and outreach to fishers to reduce practices leading to bird bycatch.

### D.6.3.1 Implementation Considerations

Implementation of this approach should maximize benefits by targeting areas where a known opportunity to prevent incidental mortality exists. Selected projects will need to ensure collected derelict fishing gear and other waste are disposed of properly. Projects near colonies should consider coordinating timing of implementation with nesting periods to reduce colony disturbance. Projects will need to consider implementer safety when conducting field work, especially in and around fishing piers, bridges, and bird colonies, and when handling wildlife. Support for specialized wildlife rehabilitation clinics should target those capable of and with past successes treating target bird species. Modifications to lighting and/or lighting patterns on oil and gas platforms would need to comply with industry-specific lighting requirements. Available site-specific data should be considered before selecting target locations. This technique would constitute a voluntary partnership with the owner/operator of infrastructure.

Implementers should always ensure the safety of birds, especially when handling them. Similarly, for fishing gear modification, because of the varying levels of impacts, project considerations should include historic site- and fishery-specific impacts, willingness of fishing fleets to engage in bycatch reduction efforts, and potential economic losses to the fishery resulting from project. A phased approach to implementation could help test implementation methodologies for modifying lighting or reducing bird bycatch in various areas, which could guide and provide support for broader-scale implementation.

#### D.6.3.2 OPA Appropriateness Evaluation

The restoration approach "Prevent incidental bird mortality" meets the criteria for being appropriate restoration under OPA. If implemented properly, it can help return injured natural resources and services to baseline by protecting bird nesting and/or foraging habitat and, thus, directly supporting production of young; providing resting areas for migrating species; and directly preventing premature mortality of injured birds. Additionally, this approach can help compensate for interim services losses to birds adversely affected by the DWH oil spill in the same manner.

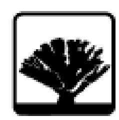
The approach is cost-effective and directly addresses well-established threats to bird survival. Collateral injury to other natural resources is not expected. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



## D.7 Mesophotic and Deep Benthic Restoration Approaches

1. Coral transplantation and placement of hard ground substrate
2. Protect and manage mesophotic and deep benthic coral communities

### D.7.1 Place Hard Ground Substrate and Transplant Coral



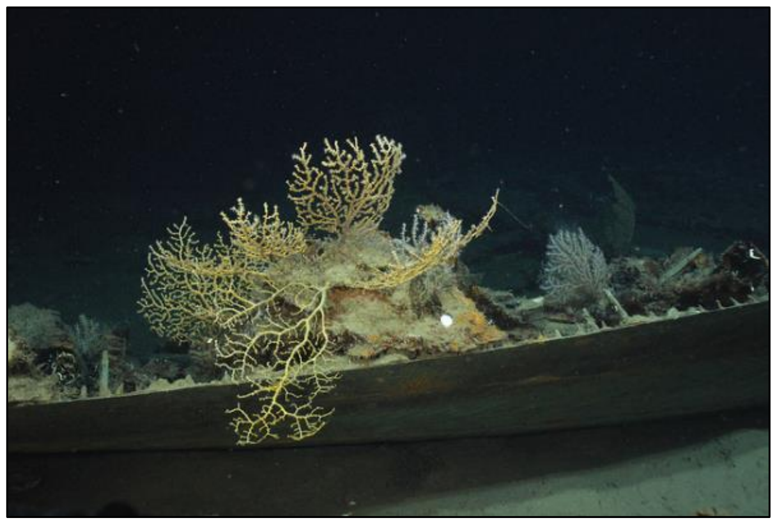
This restoration approach includes placement of new hard-ground substrate and transplantation of coral to restore mesophotic and deep benthic corals and their associated communities. Multiple techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Place substrate.** Hard substrate would be strategically placed in ideal locations and conditions for coral colonization or fish use. This technique includes restoring relict reefs, mesophotic reefs, and deep water corals. On the inner continental shelf, the relict reefs[4] or banks are some of the only natural areas that provide important habitat for fish such as red snapper in the northern Gulf (Rooker et al. 2004). These habitats serve as nursery grounds for juvenile reef fish until they outgrow the habitat and, presumably, move to deeper water (Etnoyer & Warrenchuk 2007; Szedlmayer & Howe 1997). Restoring these habitats could include placing oyster shell, limestone

[4] Relict reef systems are drowned barrier islands or reef complexes made of hard substrate shell or carbonate fragments (Wells et al. 2009; Rezak et al. 1990).

rubble, or a mixture of both substrates to re-create these types of complex habitats, such as low profile reefs or shell mounds, to provide interim habitat as juveniles move offshore (GMFMC & NOAA 2007; Mikulas & Rooker 2008; Rooker et al. 2004). In the mesophotic zone, the hard substrate could be three-dimensional structures, which would serve as interim habitat and protection for small planktivorous reef fish that are typically associated with mesophotic corals. The hard substrate would also serve as a potential site for coral recruits to colonize, as well as a dependable site for placing coral transplants (Brooke et al. 2006). This restoration approach would draw on restoration experience with shallower waters and known substrates that mesophotic and deep water corals have colonized in the past (Amar & Rinkevich 2007; Rinkevich 2000; Shafir et al. 2006). Most of the injured coral species naturally grow on carbonate boulders and rubble and clam or coral rubble (Brooks et al. 2013; Gittings et al. 1992; Rezak et al. 1990; Silva et al. 2014; Weaver et al. 2002). These species can also commonly be found on artificial substrates such as shipwrecks, oil rigs, and even lost fish traps (Figure 5.D-41; Cresson et al. 2014; Doughty et al. 2014; Larcom et al. 2014).

- **Implement coral transplanting or fragmenting.** Although coral transplantation is not as well studied at these depths as at shallower depths, this method of transplanting coral fragments onto degraded reefs has been applied successfully at various scales in shallow water coral reefs; it has also been used in a few cases in the mesophotic zone (Amar & Rinkevich 2007; Rinkevich 2000; Shafir et al. 2006). Because recruitment rates are low and natural growth rates are slow for mesophotic and deep water corals (Hourigan et al. 2007; Quattrini et al. 2014), transplanting coral fragments could help to accelerate an otherwise protracted natural recovery process (Brooke et al. 2006).



***Source:*** *Rob Church, Lophelia II 2009.*

**Figure 5.D-41.** The Green Lantern Wreck (915 meters), an unknown ship wreck named for a lantern artifact, which sank in the Gulf of Mexico between 1905 and 1915. In this photo from September 2009, *Paramuricea* sp. (likely genotype B3) is located along the edge of the hull.



### D.7.1.1 Implementation Considerations

Because conducting research on corals at these depths is difficult, and because their presence on the sea floor is patchy, knowledge of and experience with some key parameters that could influence restoration success are limited (Van Dover et al. 2013). Small-scale design studies could be conducted to determine the optimal design for restoration success. The approach would be deployed in multiple

phases, each of which will be accompanied by extensive monitoring to facilitate rapid, appropriate, and responsive decision-making.

Initial phases of implementation could use existing and newly acquired multibeam bathymetry, deep-sea coral predictive habitat suitability modeling, and genetic information to identify project sites, source corals, and reference sites. Deep-sea coral community characterization, improved understanding of foodweb dynamics and trophic connectivity, and mapping of existing deep-sea coral sites can better inform restoration efforts. Predictive habitat suitability models have been developed for some deep-sea (50 meters to more than 2,000 meters) corals (Georgian et al. 2014; Kinlan et al. 2013; Leverette & Metaxas 2005; Linares et al. 2008; R. Tong et al. 2013). However, efforts to date have not focused on the individual species that were injured during the spill and would need to be restored. With further expansion of these already existing models, target sites for substrate placement could be identified.

Additionally, research would be done to investigate the appropriate genetic population for use as coral fragmentation sources to augment the corals that were injured and ensure that the coral fragments would have the highest chance of survival at the desired restoration depths. For example, some *Paramuricea* spp. haplotypes appear to be primarily segregated by depth; source coral sites should reflect the same depth ranges as the restoration sites. Collecting genetic information is also important to avoid the use of rare and isolated populations as source coral (Doughty et al. 2014). Fragmentation and/or transplantation efforts will focus on injured coral species, or appropriate proxies, since this type of restoration has not occurred at these depths before. However, this restoration approach will avoid using the four ESA-listed corals that occur in the northern Gulf of Mexico (i.e., lobed star, mountainous star, boulder star, elkhorn) as proxies.

Site placement will be important for transplant survival, because corals are sensitive and need ideal environmental conditions, such as proper food availability and water temperature, to survive. Small-scale design studies will explore various project design parameters, including ideal coral fragment size and collection methods, propagation methods, fragment survival for in situ grow-out versus husbandry conditions, methods for attaching fragments, hard ground substrate type and treatment, structure design, habitat characterization, and fish habitat use (depending on depth). For example, most of the injured coral species naturally grow on carbonate boulders and rubble and clam or coral rubble (Brooks et al. 2013; Gittings et al. 1992; Rezak et al. 1990; Silva et al. 2014; Weaver et al. 2002) To date, however, researchers have not conducted any studies specific to the types of artificial substrate appropriate for restoration of these injured species. To determine which parameters are the most important for ensuring successful restoration, project design monitoring studies would be conducted and analyzed to help define the subsequent implementation phases. Results from small-scale design studies would ultimately be used to design larger-scale implementation using the successful designs and methodologies identified. Substrate will not intentionally be placed on top of ESA-listed corals (i.e., lobed star, mountainous star, boulder star, and elkhorn). Human activities, such as fishing and oil and gas activities, may pose a challenge to successful implementation of this restoration technique. Fishing activities that involve dredging, traps, or trawls could topple the structures and destroy newly placed coral fragments (Brooke et al. 2006). Oil and gas activities that include exploration drilling, development drilling, anchoring, discharging muds and cuttings, installing pipelines, and placing seafloor templates

disturb the sea floor and pose a potential threat to the already sensitive restoration sites (Hourigan et al. 2007). Therefore, it could be important to couple this restoration approach with protective measures.

Research conducted in the Experimental *Oculina* Research Reserve provides a good example of this technique's feasibility in the mesophotic depth range. The research showed survival of coral transplants, evidence of coral recruitment, and increased fish populations on the reef balls and reef disks that were deployed (Brooke et al. 2006). Moreover, although most restoration in shallow water coral reef systems uses stony reef-building corals such as *Acropora* spp., restorations using transplanted soft octocoral species have been successful as well (Hudson & Diaz 1988; Linares et al. 2008).

#### D.7.1.2 OPA Appropriateness Evaluation

The restoration approach "Place hard ground substrate and transplant coral " meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by increasing the mesophotic and deep benthic coral cover through active placement of injured coral species transplants and provision of substrate for improved coral colonization by those coral species. This approach also provides interim habitat for reef fish that were injured during the spill by restoring complex habitats that are used for protection and foraging. Additionally, this approach can help compensate for interim services losses to mesophotic and deep-sea communities adversely affected by the DWH oil spill.

This approach has been utilized frequently in shallow water coral, with a few examples of successful coral transplantation survival in the mesophotic zone. Additionally, researchers have documented that coral recruitment in deeper waters is successful on artificial substrates such as limestone reef balls, metal oil rigs, and wooden shipwrecks (Amar & Rinkevich 2007; Rinkevich 2000; Shafir et al. 2006). Substrate placement can also provide important services for reef fish and reef-associated species by providing habitat that is essential for reef fish recruitment in the Gulf of Mexico. Additionally, the use of design studies will ensure success of this technique by determining the optimal design for implementation and allowing responsive decision-making. Collateral injury to other natural resources is expected to be minimal due to the relatively small footprint of hard substrate placement on a vastly large expanse of soft sediment substrate. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).



### D.7.2 Protect and Manage Mesophotic and Deep Benthic Coral Communities

This restoration approach focuses on establishing areas for spatially discrete management of and protection for mesophotic and deep benthic communities and associated resources. For some natural resources, projects that manage and prevent future injuries from known threats can often have more certain outcomes and be more cost-effective than projects designed to create these resources (Chapman & Julius 2005). The acquisition of equivalent natural resources or services for public management has long been considered as a viable restoration option (Wickham et al. 1993). The mesophotic and deep benthic coral communities would particularly benefit from a preventive restoration project, because they are sessile and, therefore, susceptible to threats such as oil and gas

activities, fishing activities, and marine debris. A marine protected area (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" (MPA Executive Order 13158). Examples of federal MPAs include national marine sanctuaries (NMS), Essential Fish Habitat, habitat areas of particular concern, and oil and gas no-activity zones. Establishing protections for mesophotic and deep benthic communities could include expanding existing management or designating new areas for management.

MPAs could establish multiple zones and management levels to protect resources while meeting the interests and needs of multiple users. The purpose of an MPA is to apply a comprehensive, ecosystem-based approach to conserve marine resources; allow for various uses within its boundaries; provide the flexibility to resolve conflicting use problems; and provide the authority to enforce protections. Management actions could include increasing setbacks of oil and gas infrastructure, limits on bottom-tending fishing gear, limits on anchoring and the discharge of pollutants, removal of marine debris such as derelict fishing gear, and invasive species removal. Establishing protections can help reduce these local stressors on the system, thereby maintaining ecological integrity and potentially increasing ecosystem resilience.

#### D.7.2.1 Implementation Considerations

An understanding of the threats to the resources being protected is integral to understanding the types of benefits likely to be obtained from a preventative restoration project. Therefore, when considering the necessary protections needed to prevent future injury to mesophotic and deep benthic communities, the Trustees must also consider the types of potential threats that exist for those resources. Analyses that look at the benefits of MPAs on taxa show their efficacy (e.g., Lester et al. 2009). Globally, coral reefs that are protected by MPAs have experienced an increase in coral cover over time, while reefs that are unprotected have experienced a loss (Selig & Bruno 2010). MPAs also have a positive effect on fish biomass (Edgar et al. 2011; Harborne et al. 2008) and abundance (Jeffrey et al. 2012), particularly in no-take reserves (Edgar et al. 2011; Kramer & Heck 2007).

The resource benefits from MPAs, however, may take time to develop (Molloy et al. 2009). Selig and Bruno (2010) suggest benefits to corals emerge approximately 10 years after MPA establishment. These results are consistent with findings from the Flower Garden Banks National Marine Sanctuary (FGBNMS) monitoring, which over the last 20 years have not indicated any significant decrease in coral cover but show stable assemblages of fish despite persistent stressors such as hurricanes, bleaching, and disease (Johnston et al. 2013). The success of FGBNMS in preventing coral loss and maintaining fish populations is important to note because the sanctuary 1) is geographically proximate to the location of the spill, 2) contains resources (i.e., fish and coral) that are similar to those injured by the spill, and 3) was specifically designated to protect coral and mesophotic ecosystems (NOAA 1991). The successes of FGBNMS provide evidence that active management of offshore MPAs protects mesophotic communities.

Restoring for injured resources using resource management and land acquisition for NRDA cases has precedence; these past cases help provide rationale and guidance in the context of this NRDA for establishing an MPA to restore mesophotic and deep benthic communities. For example, restoration practitioners offset injuries from the February 1997 grounding of the Contship Houston in the lower

Florida Keys by installing a RACON navigational system to help prevent future groundings (Chapman & Julius 2005; English et al. 2009).

In the marine environment, acquisition and protection projects can be complicated because marine areas are often already within the public trust but allow extractive (e.g., oil and gas production and commercial fishing) and/or recreational (e.g., diving and recreational fishing) activities, some of which may significantly affect natural resources. MPAs are, therefore, put in place to manage the types of human activities in a given marine location for the benefit of natural resources. Many federal statutes and mechanisms govern the use, management, protection, and conservation of marine areas and marine resources. A few of these allow for the administrative designation of new MPAs by federal agencies. Examples of federal MPAs include NMS, no-activity zones, and habitat areas of particular concern.

For example, the National Marine Sanctuaries Act (NMSA) provides a comprehensive management system that was designed to balance long-term protection of nationally significant resources and vital habitats with human activities (Baur et al. 2013; Upton & Buck 2010). It authorizes the Secretary of Commerce to designate marine areas of national significance due to “conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or esthetic qualities,” as NMS (16 USC § 1433[a][2][A]). NMSA has previously been used to provide protections to similar resources as the ones that were injured during the DWH spill (i.e., FGBNMS). NMSA creates the authority to apply a comprehensive, ecosystem-based approach to conserve marine resources; allows for various uses within its boundaries; provides the flexibility to resolve conflicting use problems; and provides the authority to enforce protections. Federal authorities governing other classifications of protected areas, such as national parks and wilderness areas, generally apply significant restrictions on human activities, while NMSA facilitates lawful public and private sanctuary uses that are compatible with resource protection. NMSA allows for civil penalties, enabling enforcement without involving federal prosecutors, while certain other marine environment legal authorities fail to establish any formal accountability. Furthermore, NMSA requires a management plan to be developed, regularly re-evaluated, and updated, which is consistent with the principles of adaptive management. Along with monitoring, this process is critical for ensuring restoration for resources associated with little restoration precedence (such as those found in mesophotic and deep benthic communities).

As an example, the use of an NMS to restore for mesophotic and deep benthic resources could be accomplished through new designation or expansion of an existing NMS. Expansion of an NMS can occur through an administrative order, whereas a new designation would need to follow a new sanctuary nomination process followed by a separate legal designation process outlined in NMSA. Therefore, the plan for an NMS (including specifics of location and management) would need to be submitted as a formal nomination package to the Director of NOAA’s Office of National Marine Sanctuaries (ONMS) in accordance with the newly established nomination process (NOAA 2014b, 2014c). Alternatively, similar to what was done for the Rose Atoll Marine National Monument, the Antiquities Act could be used to create a national monument with a contingency that the monument would become a new NMS (The White House 2009). Congressional designation can also be used to create sanctuaries (e.g., Stellwagen Bank NMS). Through the NMSA, NEPA, and NRDA processes, scoping and public comment opportunities

ensure that public participation in restoration sanctuary planning processes have been and will continue to be available.

Once established, protections and management plans would be regularly re-evaluated and updated to be consistent with the principles of adaptive management and to allow for new information to be incorporated over time. Management actions would be developed in close coordination with other management authorities in the Gulf, including the Gulf of Mexico Fisheries Management Council, the Bureau of Ocean Energy Management, and user groups.

#### D.7.2.2 OPA Appropriateness Evaluation

The restoration approach "Protect and manage mesophotic and deep benthic coral communities" meets the criteria for being appropriate restoration under OPA. If implemented properly, it can help return injured natural resources and services to baseline by preventing future injury to mesophotic and deep-sea communities from potential threats such as fishing and oil and gas activities. Additionally, this approach can help compensate for interim services losses to mesophotic and deep-sea communities adversely affected by the DWH oil spill. Threats to these habitats may include impacts from oil and gas exploration and extraction, fishing activities, invasive species colonization, marine debris, land-based pollution, and climate change. The restoration approach may manage and protect at-risk mesophotic and deep-sea communities from threats, allowing intact communities to persist and compensating for lost services by protecting similar, uninjured resources. Also, by managing and protecting communities affected by the spill, this approach may allow these communities to have a full recovery if given sufficient time.



The approach described above is proven to be successful in marine systems around the world, and specifically in the Gulf of Mexico, where FGBNMS has maintained coral cover and stable fish assemblages over the last 20 years despite persistent stressors, such as hurricanes, bleaching, and disease (Johnston et al. 2013). Collateral injury to other natural resources is expected to be minimal, because these techniques require little environmental disturbance or infrastructure. Other than activities with minor impacts, such as monitoring, enforcement, and marker buoy deployment, the environment will remain undisturbed. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

## D.8 Recreational Use Restoration Approaches

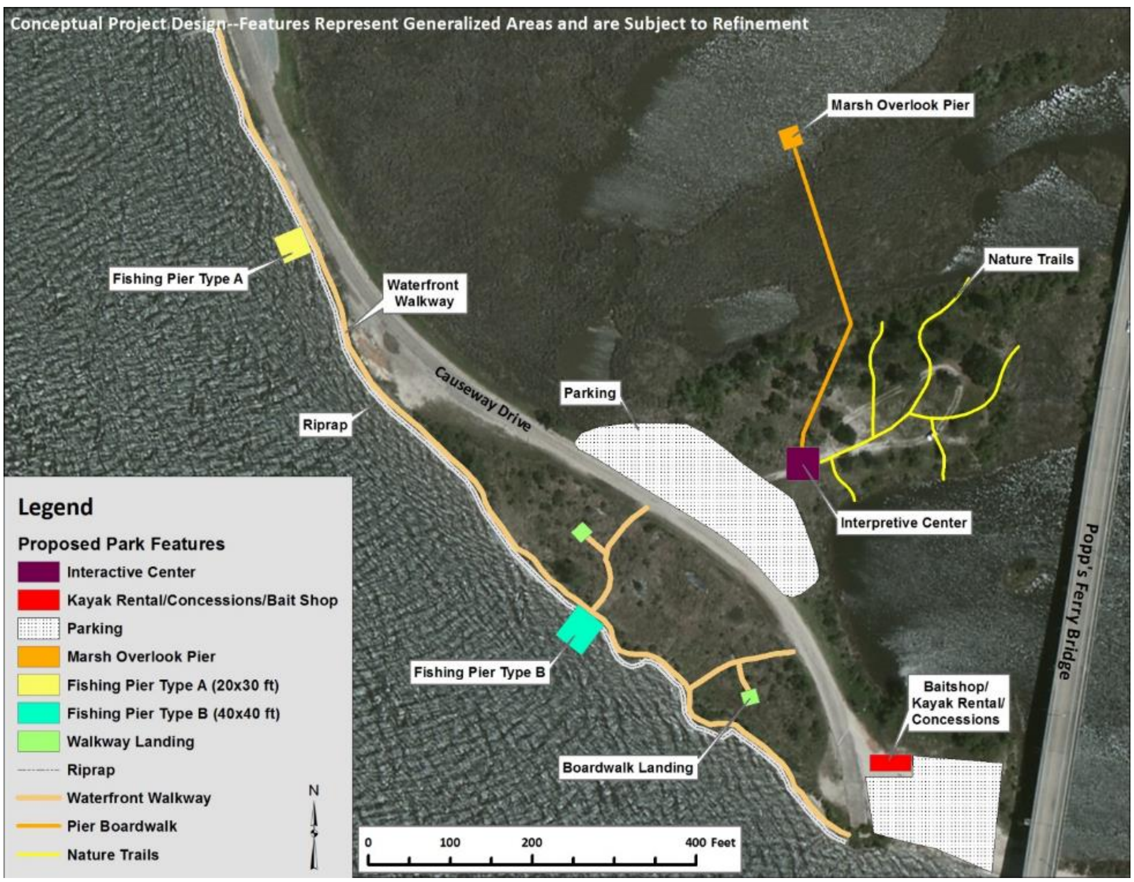
1. Enhance public access to natural resources for recreational use
2. Enhance recreational experiences
3. Promote environmental stewardship, education, and outreach

### D.8.1 Enhance Public Access to Natural Resources for Recreational Use

This restoration approach focuses on creating new or improved access to natural resources for recreational purposes. Access to recreational areas can be improved by enhancing or constructing infrastructure (e.g., boat ramps, piers, boardwalks, dune crossovers, camp sites, educational/interpretive spaces, navigational channel improvements and dredging, safe harbors, navigational aids, ferry services, rebuilding of previously damaged or destroyed facilities, promenades, trails, roads and bridges to access natural resources, and marina pump out stations). For example, besides providing access, new construction can improve the recreational experience by providing for wildlife viewing platforms and fish cleaning shelters. New construction could also provide meeting spaces for resource-based education and other programs. Improved public access could also be accomplished by providing or improving water access in publicly owned areas (e.g., parks and marinas), which might also increase boating safety. The construction and operation of boat ramps, piers, or other infrastructure could occur on publicly owned lands. Larger-scale infrastructure improvements, such as a ferry service or the construction or improvement of roads and bridges, could also serve to improve access to natural resources. Enhancing public access would also include targeted acquisition of land parcels to serve as public access points.

### D.8.1.1 Implementation Considerations

Construction or enhancement of recreational infrastructure is a broad restoration technique that was extensively used in Early Restoration to compensate for lost recreational use (see Figure 5.D-42).




***Source:*** *Mississippi Department of Environmental Quality.*

**Figure 5.D-42.** The Popp's Ferry project in Biloxi, Mississippi was a Phase III Early Restoration project designed to enhance access to the natural resources in Back Bay.

Specific project types that were implemented in Early Restoration included, but were not limited to, construction and rehabilitation of boat ramps, construction of dune crossovers, boardwalk construction, construction of piers, and construction and rehabilitation of camping facilities. Much of this infrastructure is or can be located in sensitive resource areas, such as occupied beach mouse habitat, Gulf sturgeon critical habitat, and Essential Fish Habitat. Therefore, specific project design must consider the potential impacts on these resources and include BMPs and other mitigation measures to avoid adversely affecting sensitive natural resources.

Preservation of habitats through acquisition of land or easements will involve only willing sellers or participants. Landowners will be under no obligation to sell to any of the governments associated with the Trustees. Neighbors adjacent to land purchased to gain access to resources under this restoration plan will retain all their current rights to their land. The government agencies are required to pay fair market value for land purchased. Fair market value will be determined through established appraisal procedures.

Although areas could be selected based on their ability to improve recreational use, complementary benefits could be provided for other restoration goals, such as habitat protection and water quality improvements. Areas could be nominated based on their ability to protect wetlands and other significant coastal habitats and/or create connections between protected areas that are used for recreational purposes, or because they are under direct threat of development and are better served as areas for the community to experience natural resources.



#### D.8.1.2 OPA Appropriateness Evaluation

The restoration approach “Enhance public access to natural resources for recreational use” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by increasing opportunities for the pubic to access natural resources for recreational purposes. Additionally, by increasing public access to natural resources, this approach can help compensate for interim services losses to recreational use of natural resources adversely affected by the DWH oil spill.

This approach is well-established and directly replaces lost recreational use opportunities. It also has been used widely in NRDA cases in the northern Gulf of Mexico, including extensively in Early Restoration. Risk of collateral injury to other natural resources will be minimized during the planning process for each of these projects. Each project will consider natural resources during planning and will minimize impacts on these resources through siting (avoidance if possible) and development of BMPs. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.8.2 Enhance Recreational Experiences

This restoration approach focuses on enhancing the public’s recreational experiences. The experience of recreational activities such as swimming, boating, diving, bird watching, beach-going, and fishing can vary depending on the appearance and functional condition of the

surrounding environment in which they occur. Multiple restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Place stone, concrete, or permissible materials to create artificial reef structures.** An artificial reef is defined as a submerged structure that is constructed or placed on the existing substrate in coastal or marine waters. Properly sited, constructed, and managed, reef sites can be attractive locations for recreation, including fishing, snorkeling, and scuba diving (see Figure 5.D-43). An artificial reef can be constructed from a variety of different materials including, but not limited to, stone, concrete blocks, decontaminated vessels, or engineered reef unit structures. The site considerations could include locations that enhance or create habitat, support a diversity of fishery resources, and do not impede or interfere with navigation. Artificial reefs enhance recreational opportunities for users such as anglers, snorkelers, and divers.

- **Enhance recreational fishing opportunities through aquaculture.** This technique can include the breeding, rearing, and release of finfish and shellfish species into the Gulf of Mexico and adjacent coastal bays to increase densities of target species for recreational fishing. In the context of restoration, stock enhancement programs could have one or more goals, including providing additional catch for anglers, providing information to fishery managers, and/or helping to mitigate losses suffered from anthropogenic effects. Stock enhancement could include the expansion of existing hatchery operations, the construction of new facilities, and the release and monitoring of finfish and shellfish species reared in those facilities.



***Source:*** *FWC; released under Creative Commons BY-ND 2.0 license.*

**Figure 5.D-43.** Deployment of artificial reef materials designed to enhance recreational fishing experiences.

- **Reduce and remove land-based debris.** Land-based debris can enter the ocean as a result of storms or through the intentional or unintentional disposal of domestic or industrial wastes.

Land-based debris can be disturbing and disruptive to recreational activities such as hiking, beach-going, and boating. Removal of marine debris not only restores the beauty of coastal environments but removes debris that is potentially harmful to humans and wildlife. Efforts to reduce land-based debris could incorporate public education and awareness, as well as physical removal of debris. Specific techniques for removing land-based debris are varied and will depend in large part on the characteristics of the relevant habitat and debris. In general, techniques can be categorized into two types: 1) manual methods (e.g., workers using hand tools) and 2) mechanized methods (e.g., using all-terrain vehicles or tractors with sifters, backhoes, roll-off dumpsters, and/or similar machinery).

#### D.8.2.1 Implementation Considerations

Implementation of restoration projects that restore for lost recreational use has the potential to negatively affect natural resources. For example, artificial reef projects could be located in sensitive resource areas such as Gulf sturgeon critical habitat, habitat for threatened and endangered species, and Essential Fish Habitat. However, substrate will not intentionally be placed on top of ESA-listed corals (i.e., lobed star, mountainous star, boulder star, and elkhorn). Specific project design for all project types must consider the potential impacts on these resources and include BMPs and other mitigation measures to avoid adversely affecting sensitive natural resources. Projects that occur in marine waters will also require a nautical archeological survey to avoid affecting submerged archeological resources.

Aquaculture projects implemented under this approach can be used to inform fishery management decision-making, with the potential to enhance recreational experiences. For example, techniques for bait and sport fish hatchery production and holding systems can be developed and refined. Fish produced in hatcheries can be marked, released, and monitored for the purpose of informing fishery managers about the recruitment, survival, and population health of recreationally significant marine fish species. Each stock enhancement project will be evaluated on a project-specific basis that identifies its goals and objectives and ensures quantification of those parameters that enable measurement of project success. Any stock enhancement project must use the “Responsible Approach” techniques that have been outlined by Blankenship and Leber (1995) and Lorenzen et al. (2010).[5]

#### D.8.2.2 OPA Appropriateness Evaluation

The restoration approach “Enhance recreational experiences” meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by improving the public recreational use of natural resources, thereby enhancing recreational experiences, including, but not limited to, fishing, beach-going, and bird watching. Additionally, by enhancing existing recreational experiences, this approach can help compensate for interim services losses to recreational use of natural resources adversely affected by the DWH oil spill.



[5] Such “Responsible Approach” techniques include, but are not limited to, structuring the project around the specific restoration goal(s); evaluating habitat needs and conditions (abundance of prey and predators) to ensure adequate habitat availability and suitability for stocked individuals; managing and assessing ecological impacts through a well-designed hatchery/broodstock and release program (e.g., one that considers the ecosystem, genetic issues, and disease management); assessing the economic and social benefits and costs; incorporating post-release monitoring protocols (i.e., identification of stocked individuals and contribution and potential substitution rates); and using adaptive management (e.g., modify or cease stocking program depending on monitoring and evaluation results) (Blankenship & Leber 1995; Lorenzen et al. 2010).

The techniques described above are widely used in NRDA to compensate for lost recreational use, and were used in DWH Early Restoration. Specific project design will consider the potential collateral injury to nontarget resources and will use BMPs and other mitigation measures to avoid adversely affecting sensitive natural resources. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

### D.8.3 Promote Environmental Stewardship, Education, and Outreach

This approach involves providing and enhancing recreational opportunities through environmental stewardship, education, and outreach activities. Multiple restoration techniques are available for use, individually or in combination, as potential restoration projects. This restoration approach could employ, but is not limited to, the following techniques:

- **Create or enhance natural resource-related education facilities.** Facilities established to educate visitors about natural resources and restoration include, but are not limited to, museums, aquariums, interpretive centers, natural laboratories for researchers and students, research and teaching laboratories, and classrooms and offices for technical and support personnel. The aim of these facilities is to provide a location in which environmental education and outreach can occur through a variety of different media. These facilities could vary in form, content, and even function, but would concentrate on the coastal and marine resources of the Gulf of Mexico.

- **Create or enhance natural resource-related education programs.** The focus on marine and coastal resources and restoration activities could stimulate the general public's interest in and understanding of the natural science and environment of the Gulf coastal region. This interest would be enhanced by providing educational features for both the public and students through coastal exhibits and collections, hands-on activities, educational outreach programs related to coastal resources, and other interactive activities. The public would learn about the complexity and importance of coastal ecosystems and come away with a better understanding of the surrounding marine ecosystems of the Gulf and the impact humans are having on these environments. These programs could link recreational activities such as bird watching, hiking, and fishing with educational components. For example, a bird specialist could accompany a bird-watching group, or a youth fishing pond could be paired with educational information on the management of recreational fishing in the Gulf of Mexico.



#### D.8.3.1 Implementation Considerations

Construction of educational infrastructure and programs is a restoration technique that was used in Early Restoration (e.g., INFINITY Science Center). Educational infrastructure may be sited in sensitive resource areas, such as occupied beach mouse habitat, wetlands, or sensitive upland habitats. Therefore, specific project design must consider the potential impacts on these resources and include BMPs and other mitigation measures to avoid adversely affecting sensitive natural resources.

### D.8.3.2 OPA Appropriateness Evaluation

The restoration approach "Promote environmental stewardship, education, and outreach" meets the criteria for being appropriate under OPA. If implemented properly, it can help return injured natural resources and services to baseline by providing human use benefits through the construction of educational facilities and the development of programs targeted at educating the public about natural resources in the Gulf of Mexico region. Additionally, through the development of educational opportunities that enhance the public enjoyment of natural resources, this approach can help compensate for interim services losses to recreational use of natural resources adversely affected by the DWH oil spill.

The techniques described above are based on directly educating the public about the Gulf of Mexico natural resources and have been used in previous NRDA cases and in Phase III Early Restoration. Specific project design will consider the potential collateral injury to nontarget resources and will use BMPs and other mitigation measures to avoid adversely affecting sensitive natural resources. The Trustees do not anticipate that the approach will negatively affect public health or safety and consider it likely to benefit other natural resources. Although the Trustees find this overall restoration approach to be appropriate under OPA, they will ensure project appropriateness by conducting and selecting projects based on a project-specific evaluation of the OPA evaluation standards found at 15 CFR § 990.54(a).

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# Appendix E. Monitoring and Adaptive Management Framework

## E.1 Introduction

According to the NRDA regulations for OPA (15 CFR § 990.55), a draft restoration plan should include "a description of monitoring for documenting restoration effectiveness, including performance criteria that will be used to determine the success of restoration or need for interim corrective action." Given the unprecedented temporal, spatial, and funding scales associated with this restoration plan, the Trustees recognize the need for a robust monitoring and adaptive management framework to measure the beneficial impacts of restoration and support restoration decision-making. In order to increase the likelihood of successful restoration, the Trustees will conduct monitoring and evaluation needed to inform decision-making for current projects and refine the selection, design, and implementation of future restoration. This monitoring and adaptive management framework may be more robust for elements of the restoration plan with higher degrees of uncertainty or where large amounts of restoration are planned within a given geographic area and/or for the benefit of a particular resource.

This document presents the Trustees' monitoring and adaptive management framework to support the restoration plan. Section E.2, Adaptive Management, describes adaptive management why it is needed, and how it has been interpreted for this restoration plan. Section E.3, Monitoring and Adaptive Management Framework, describes the monitoring and adaptive management framework for the restoration plan as it would be applied to restoration projects and injured resources and across resources. Sections E.4 through E.6 discuss the development of monitoring and adaptive management plans, data management and reporting considerations, and coordination with other restoration programs on monitoring and scientific support, respectively.

## E.2 Adaptive Management

### E.2.1 What Is Adaptive Management?

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). This process both advances scientific understanding and provides critical feedback to inform future decision-making (Williams et al. 2007). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000; Thom et al. 2005). This iterative process to restoration implementation will allow the Trustees to continually evaluate restoration effectiveness, document ongoing progress towards established restoration objectives, and provide feedback to inform future restoration decisions.

Figure 5.E-1 shows an overview of the monitoring and adaptive management process interpreted for this restoration plan. The steps of this iterative process include injury assessment, restoration planning (including the development of monitoring and adaptive management plans), implementation of the initial restoration plan, monitoring of restoration actions, evaluation of restoration effectiveness, feedback of information to restoration planning and implementation, refinements to restoration implementation, and reporting on restoration progress toward meeting restoration goals and objectives.

The adaptive management feedback loop, including monitoring, evaluation, feedback, and implementation, provides the Trustees the opportunity to adjust restoration actions, as needed, based on monitoring and evaluation of restoration outcomes (Williams 2011; Williams et al. 2007). This feedback loop will not necessarily be needed in all instances. Projects that meet their success criteria, as determined during the evaluation step, may not need to utilize the adaptive management feedback loop. In other cases, multiple iterations of the feedback loop may be intentionally incorporated into project implementation. For example, a new restoration approach may be implemented first on a small scale to test design options and resolve any uncertainties through multiple iterations of the feedback loop prior to implementing the project on a larger scale.

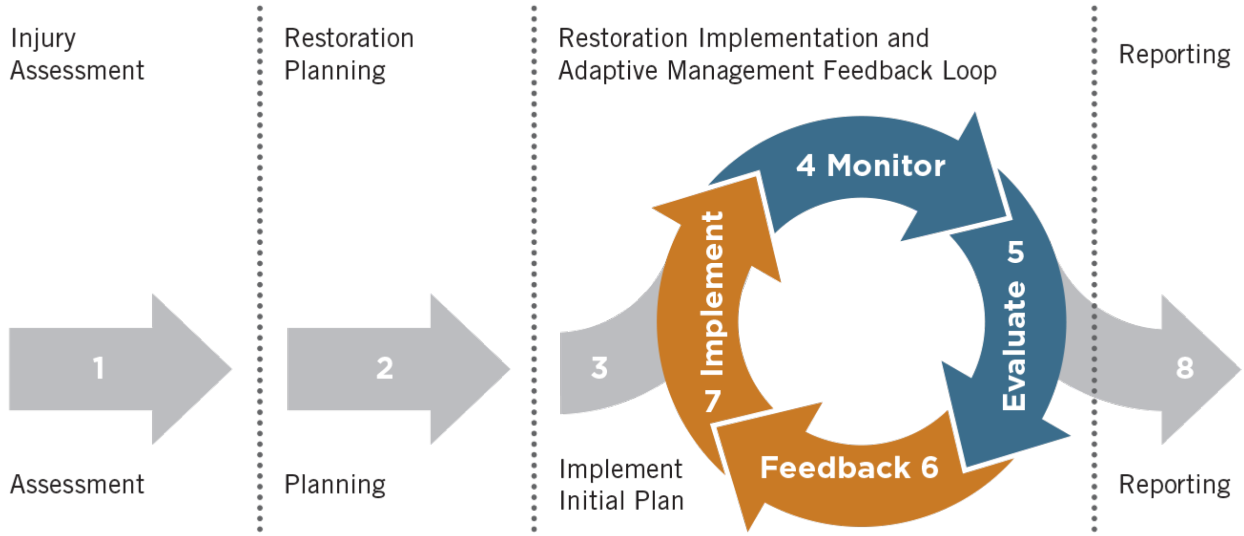


**Figure 5.E-1**. The Monitoring and Adaptive Management framework as interpreted for restoration in this plan, including a feedback loop represented by orange and blue arrows. This process includes four overarching phases: injury assessment, restoration planning, restoration implementation and reporting (Williams 2011). An adaptive management feedback loop of monitoring (Arrow #4), evaluation (Arrow #5), feedback (Arrow #6), and adjustment of restoration actions (Arrow #7) is included within the restoration implementation phase. Orange arrows represent steps of the feedback loop related to decision-making and governance (see Chapter 7), while blue arrows represent steps related to the collection and analysis of information (described in more detail in Section E.3, Monitoring and Adaptive Management Framework, below).



### Key Steps of the Adaptive Management Framework

- **Injury assessment (Figure 5.E-1, Arrow #1).** Under the NRDA injury assessment process, potential injuries to natural resources and services are evaluated and/or quantified. For more detail on the *Deepwater Horizon* (DWH) incident injury assessment, see Chapter 4, Injury to

Natural Resources.

- **Restoration planning (Figure 5.E-1, Arrow #2).** Following the injury assessment, potential restoration approaches are identified to restore injured resources and services.[1]The development of well-defined, high-level goals and measurable objectives will guide the selection of restoration into the future. This step includes the identification and resolution of any critical information gaps through targeted monitoring, modeling, analysis and other scientific support activities. It also includes concurrent development of monitoring plans and data management standards.
- **Implementation of restoration (Figure 5.E-1, Arrow #3).** Restoration is selected and implemented to achieve the established goals and objectives.
- **Adaptive management feedback loop (Figure 5.E-1, Arrows #4–7).** This iterative feedback loop is the core of the adaptive management process and provides opportunities to address uncertainties and adjust restoration implementation as needed. The feedback loop consists of the following four steps:
    - **Monitoring restoration actions (Figure 5.E-1, Arrow #4).** After restoration is selected and implemented, it is monitored to gauge progress toward restoration goals and objectives. Consistency in monitoring plans and metrics would allow for evaluation and reporting across projects and resources. Data management is also a key component of this step.
    - **Evaluation of restoration effectiveness (Figure 5.E-1, Arrow #5).** The monitoring information collected is used to evaluate the effectiveness of restoration. Project-specific evaluations will include the comparison of monitoring results to pre-specified performance criteria to determine project success or the need for corrective actions.
    - **Feedback of information (Figure 5.E-1, Arrow #6).** Evaluation of the effectiveness of restoration is critically reviewed to identify any adjustments needed and inform future restoration actions.
    - **Refinements to restoration implementation (Figure 5.E-1, Arrow #7).** After initial implementation, refinements to restoration implementation are made, as needed, based on the feedback provided. Modifications could be applied to current (e.g., through corrective actions) or future restoration.
- **Reporting (Figure 5.E-1, Arrow #8).** Progress toward meeting restoration goals and objectives will be periodically reported to the public, Trustees, and other interested entities. Final reports on restoration outcomes may also be provided after restoration is complete.



[1] Trustees have pursued an iterative and phased restoration planning process, which will continue after the issuance of this document (for more details see Chapter 5, Restoring Natural Resources, and Chapter 7, Governance).

### E.2.2 Why Is Adaptive Management Critical for This Restoration Plan?

Adaptive management is critical for this restoration plan due to the unprecedented temporal, spatial, and funding scales of the restoration that will be undertaken. As restoration is implemented, the Trustees will continually evaluate restoration outcomes and progress toward meeting restoration objectives. The need for more robust monitoring and adaptive management is driven by 1) system-wide external factors that may influence the effectiveness of restoration and may require the refinement of restoration overtime and 2) uncertainties related to specific restoration elements.

#### Uncertainties Related to Systemwide Factors

Systemwide factors may influence uncertainties related to restoration implemented in this plan. In developing the restoration plan, the Trustees recognize the following:

- The Gulf of Mexico is a **complex, interconnected ecosystem**, with interactions between and among resources and habitats and important ecological functions and services (Gosselink & Pendleton 1984; Lamberti et al. 2010; O'Connell et al. 2005). Restoration conducted to address a specific resource or habitat may have direct or indirect impacts on other resources, habitats, or functions.
- The Gulf of Mexico is a **dynamic and changing environment**, influenced by external factors and stressors such as pollution, climate change, sea level rise, hurricanes, and other events. Restoration will take place over many years, and restoration may have to be modified to adapt to changing environmental conditions (Bricker et al. 2008; Choi et al. 2008; Hobbs 2007; Nichols et al. 2011).
- A **matrix of restoration efforts** are being conducted in the Gulf of Mexico (e.g., Gulf Coast Ecosystem Restoration Council [RESTORE], National Fish and Wildlife Foundation Gulf Environmental Benefit Fund [NFWF GEBF], North American Wetlands Conservation Council [NAWCA], and Coastal Wetlands Planning, Protection and Restoration Program [CWPPRA]). This restoration plan is one of several concurrent Gulf of Mexico restoration efforts. Each of these efforts are at different stages of planning and implementation, with different restoration goals and mandates.
- There is potential that **currently unknown conditions** may influence restoration outcomes.

#### Uncertainties Related to Restoration Elements

The amount of monitoring and science support needed for restoration varies with the degree of uncertainty associated with the restoration elements identified in this plan. The Trustees expect higher uncertainty for some restoration elements. For instance, a limited scientific understanding of target resources, the use of novel approaches and/or techniques, restoration at large spatial scales and/or long time scales, and strong socioeconomic influence, among other factors, may lead to higher uncertainty as described below and depicted in Figure 5.E-2. Higher uncertainty could drive a greater need to utilize the adaptive management feedback loop for some elements of the restoration plan (Gregory et al. 2006).

- **Scientific understanding of target resources.** Some restoration will focus on organisms, habitats, or ecosystems that have not been well studied. In these cases, important information about populations and trophic dynamics (and other issues) needed to inform restoration planning may not be available. Robust monitoring and adaptive management will be particularly important where current scientific understanding of the resource is limited, e.g., deep benthic communities. (Van Dover et al. 2013; White et al. 2012)

- **Approach or technique novelty.** Although many of the restoration elements described in this restoration plan are well established, some elements are relatively novel (see Appendix 5.D, Restoration Approaches and OPA Evaluation, for more details on restoration approaches). Because of the higher uncertainty regarding optimal design and effectiveness, these elements could require scientific support during project design, implementation, and/or evaluation. It will be critical for the Trustees to learn as implementation proceeds for such projects in order to increase effectiveness in meeting goals and objectives.

- **Restoration scale.** Even for restoration approaches and/or techniques that are relatively well established (e.g., coastal habitat restoration), uncertainties about the aggregate benefits and/or impacts of restoration projects will be higher as the total number of projects implemented, size of individual projects, and extent to which projects are concentrated in particular geographic areas increases. As restoration scale (i.e., number and size of restoration projects, both independently and within a particular geographic area) increases, it will be more important to ensure that the information about aggregate restoration benefits and potential unintended consequences are incorporated into the monitoring and adaptive management framework (e.g., LoSchiavo et al. 2013; Steyer & Llewellyn 2000).

- **Socioeconomic influence.** Socioeconomic factors may also influence restoration effectiveness, particularly when restoration depends on voluntary participation or commercial activities. For example, socioeconomic factors influence fishery-based restoration approaches (Grafton & Kompas 2005). The adoption rate of fishing gear exchanges or practice changes may be influenced by receptivity of the community to changes in fishing practices or by market conditions that affect the profitability of a new practice. Each of these factors, among others, may influence the rate at which targeted audiences volunteer to participate in restoration.

- **Time scale.** It will take many years to implement all the restoration necessary to compensate the public for the injuries that occurred as a result of the DWH incident. The likelihood that external factors could affect restoration outcomes could increase with the duration over which implementation occurs. It will be increasingly important to incorporate an adaptive management approach as the time scale of implementation increases (Simenstad et al. 2006; Williams & Brown 2012).



## E.3 Monitoring and Adaptive Management Framework

The Trustees will utilize robust monitoring, modeling, analysis, engagement of internal and external scientific experts and/or other scientific support as needed to guide ongoing restoration decision-making and document restoration success (Lyons et al. 2008; Roni 2005; Thayer et al. 2003; Thom 2000).

Such monitoring and scientific support provides critical feedback about restoration outcomes, can be used to improve restoration effectiveness, and allows the Trustees to demonstrate benefits of restoration actions to the public over the long term. The amount of monitoring and scientific support needed for specific elements of the restoration plan will depend on factors such as the amount of restoration performed for each resource, the degree of uncertainty associated with restoration approaches and/or techniques, and the availability and utility of existing data (See Figure 5.E-2).

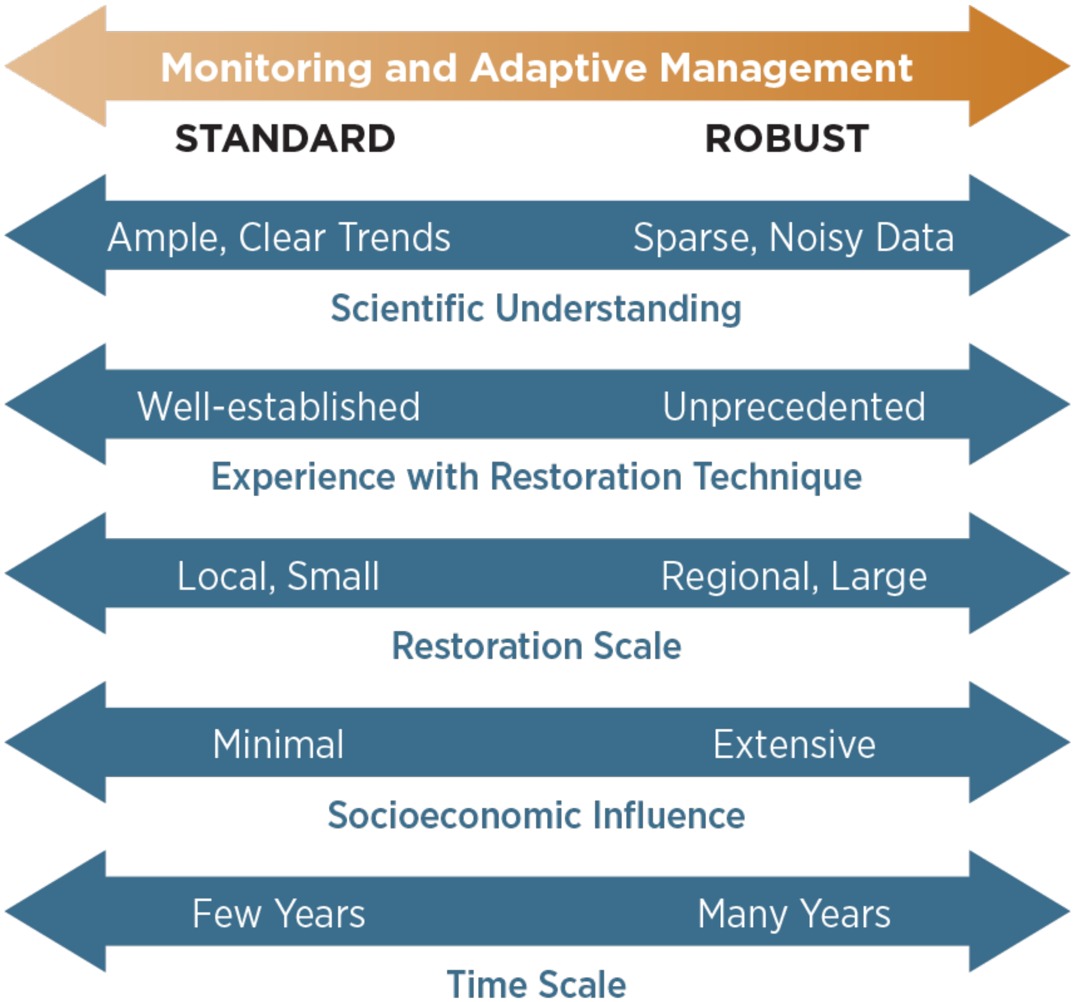


**Figure 5.E-2**. The degree of monitoring and adaptive management needed at the project and resource-levels depends on several factors, including the status of scientific understanding of key species, habitats, or ecosystem dynamics; the novelty of a given approach or technique; the scale at which restoration is implemented; the influence of socioeconomic factors; and the time scale over which restoration will be implemented.

Monitoring and adaptive management efforts conducted with settlement funds to support restoration can serve a number of purposes, including the following:

- Supporting restoration planning for Restoration Types and selection of projects.

- Evaluating progress and success of restoration projects and informing modifications as needed.
- Understanding the aggregate effects of restoration and resource recovery over time.
- Characterizing currently unknown conditions.
- Ensuring regulatory compliance.
- Reporting progress toward meeting key restoration goals and objectives to the public, Trustees, and other interested parties.

Not only is monitoring necessary for tracking restoration and recovery, it is also required under several statutes. As per Natural Resource Damage Assessment (NRDA) regulations under the Oil Pollution Act (OPA), monitoring will be included for all projects and will be used to evaluate project success and determine the need for corrective actions. Restoration projects must also meet requirements within the Record of Decision in the NEPA regulations and demonstrate regulatory compliance with other pertinent statues (such as the Magnusson-Stevens Act, Endangered Species Act, and Marine Mammal Protection Act). Additionally, as monitoring and scientific support activities are developed for this restoration plan, they will need to comply with NEPA and other regulatory requirements as appropriate.

To successfully support restoration efforts in this plan, monitoring and adaptive management may be needed at the project, resource, and cross-resource levels (Table 5.E-1). Project-level monitoring and adaptive management includes the monitoring and scientific support needed for planning, implementing, and evaluating individual restoration projects. Resource-level monitoring and adaptive management focuses on evaluating the collective benefits to the injured resource across projects while informing planning and implementation for Restoration Types. Cross-resource-level monitoring and adaptive management includes any monitoring and scientific support more broadly needed to support restoration and evaluate benefits for multiple injured resources. The monitoring and adaptive management activities that may be conducted at each of these levels are described in more detail in the following sections and depicted in Table 5.E-1.

**Table 5.E-1.** Summary of monitoring and adaptive management activities that will be conducted to support restoration planning, implementation, and evaluation at the project, resource, and cross-resource levels.

| Monitoring and Adaptive Management Activities | Planning | Implementation | Evaluation and Reporting |
|---|---|---|---|
| **Project** | | | |
| Inform project planning | • | | |
| Performance monitoring | | • | • |
| Validation monitoring | | | • |
| Compliance monitoring | | • | |
| **Resource** | | | |
| Inform resource restoration planning and implementation | • | • | |
| Evaluate resource restoration progress | • | • | • |

| Monitoring and Adaptive Management Activities | Planning | Implementation | Evaluation and Reporting |
|---|---|---|---|
| **Cross-Resource** | | | |
| Inform cross-resource planning | • | • | |
| Evaluate overall restoration progress | | | • |
| Characterize previously unknown injuries | • | • | • |

The Trustees will evaluate existing data and/or data collection networks to determine whether they are suitable for measuring restoration benefits and supporting adaptive management of restoration at the project, resource, and cross-resource levels. For some monitoring data needs, use of existing data or continuation of existing data collection programs may be sufficient. For others, new data may need to be collected to fill critical data gaps or supplement existing data.

### E.3.1 Project Level Monitoring and Adaptive Management

Monitoring and scientific support for individual projects informs restoration planning, supports evaluation of project performance, and ensures project compliance (Roni 2005; Thayer et al. 2003; Thom & Wellman 1996). Project-level monitoring may include pre-implementation monitoring to document initial conditions, as-built monitoring to document successful completion of construction elements (if applicable), and post-implementation monitoring to gauge restoration progress and success. Project-level monitoring may also be conducted at reference and/or control sites if needed to determine progress and success. Through adaptive management, information feedback may be used to make adjustments to a current project or to inform the planning and implementation of future projects.

The Trustees developed monitoring frameworks and conceptual monitoring plans for many project types implemented under Early Restoration, which served as guidelines for project monitoring plans. For more detail on monitoring frameworks, see Section E.4 and Table 5.E-2 through Table 5.E-10.

#### Monitoring to Support Project Planning

The optimal design and expected benefits for many restoration projects are well understood. However, critical uncertainties may remain regarding the relative effectiveness, proper design, and appropriate geographic location for some restoration projects. In such cases, monitoring and scientific support for project planning is intended to resolve key uncertainties during the planning of restoration projects. Monitoring and targeted scientific support for project planning may use existing or newly collected data and will likely be most relevant for restoration projects that are highly novel or particularly complex.

For example, one of the techniques that may be employed under the restoration approach “Create, restore, and enhance coastal wetlands” is marsh creation with dredged material, which may require pre-project baseline monitoring (Thom & Wellman 1996). Before the project is implemented, sediment (geotech) sampling, collection of existing information on local subsidence rates, and modeling of estimated sea level rise may be needed to identify the target elevation for the marsh platform.

#### Performance Monitoring

Performance monitoring will be conducted for all restoration projects developed under this restoration plan. The intent of performance monitoring is to document whether the projects have met their

established performance criteria and determine the need for corrective actions (15 CFR § 990.55(b)(1)(vii)). The selection of performance criteria may be based on desired conditions of the restoration site, conditions at appropriate reference site(s), or literature values. Because most restoration projects take many years to reach full function, performance criteria may include conditions representative of interim recovery. Establishment of interim milestones may help project managers determine if the project will be able to meet restoration objectives at an acceptable pace or if interim corrective actions are needed. Although some new performance monitoring data will be collected for nearly all projects, evaluation of project performance may be augmented by data collected by existing programs (e.g., fisheries observer programs and marine mammal and sea turtle stranding networks), and/or pre-established robust, system-wide monitoring networks (e.g., Hijuelos & Hemmerling 2015; Steyer et al. 2003; Watson et al. 2014). Some system-wide networks may provide data sufficient to monitor project-specific performance. Additionally, monitoring data may be collected on environmental conditions that could influence restoration outcomes in order to better understand drivers of project performance and support project adaptive management, including corrective actions.

For example, for a coastal marsh restoration project, performance monitoring could include measurements of the habitat structure (e.g., elevation), development of the vegetative community (e.g., percent cover of marsh vegetation and species composition), and utilization by marsh species (e.g., birds and fish). Performance criteria could be based on elevation of the marsh platform and percent cover of vegetation. Additional environmental monitoring that could be conducted to inform appropriate corrective actions may include salinity or sediment characteristics monitoring.



### Validation Monitoring

Trustees may choose to perform more robust project-scale monitoring on a subset of projects to better understand ecosystem functions and services provided by projects (La Peyre et al. 2014; Neckles et al. 2002; Roni 2005). This validation monitoring is intended to help project managers optimize implementation of the approach and address critical uncertainties in understanding project function, as needed. Validation monitoring would help the Trustees to better evaluate the benefits provided by restoration projects to the injured resources and inform the planning of future, similar projects.

For example, for an oyster restoration project, additional monitoring may be conducted to better understand the productivity of the habitat, e.g., benthic production or fish production (Grabowski et al. 2005), or additional functions the habitat provides, such as shoreline protection (Piazza et al. 2005; Scyphers et al. 2011).

### Compliance Monitoring

Compliance monitoring is intended to collect information needed to demonstrate compliance with regulatory requirements, including the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA), among other applicable statues. Compliance monitoring may include proper implementation of project design criteria (PDCs) and other terms and conditions provided through ESA Section 7 consultations. Compliance monitoring will be required for many projects and will be incorporated as appropriate.

For example, the Trustees will be supporting projects that enhance recreational access to compensate for injuries related to the DWH incident. However, projects focused on improved recreational access to beaches must be designed to avoid the negative impacts of such access on nesting sea turtles, which are protected under ESA. Compliance monitoring or other terms and conditions may be required as part of ESA consultation on these projects to ensure that adverse impacts to sea turtles are avoided and/or minimized through consideration of PDCs.

### E.3.2 Resource Level Monitoring and Adaptive Management

Monitoring and adaptive management at the resource level includes Restoration Type planning and evaluation of restoration progress for injured resources. Resource-level monitoring and scientific support may inform ongoing decision-making during restoration planning and implementation for each Restoration Type and may also facilitate aggregating and evaluating the collective benefits of restoration to an injured resource (Neckles et al. 2002). Whereas project monitoring focuses on the data needs for a single restoration project, resource-level monitoring and scientific support can fulfill data and information needs for multiple projects benefitting a common injured resource, thereby promoting efficiency and consistency in data collection and restoration evaluation.

#### Monitoring to Support Restoration Planning and Implementation for Restoration Types

Targeted resource-level monitoring and scientific support activities may be needed where substantial gaps exist in scientific understanding that limit restoration planning and implementation for individual Restoration Types. Gaps in scientific understanding exist for certain aspects of many of the Gulf of Mexico living coastal and marine resources targeted by this restoration plan (fish, oysters, sea turtles, marine mammals, birds, and mesophotic and deep benthic communities). This monitoring and targeted scientific support for Restoration Type planning and implementation is intended to support restoration planning across a suite of projects that benefit the same resource. Scientific activities to address these uncertainties could include targeted data collection, modeling, and/or other analyses to better characterize status, trends, and spatiotemporal distributions of injured resources and/or habitats to be restored.

For example, deep-sea coral community characterization, improved understanding of foodweb dynamics and trophic connectivity, and mapping of existing deep-sea coral sites could inform restoration efforts across multiple projects affecting this resource (Cordes et al. 2008; Quattrini et al. 2014). A more in-depth understanding of communities' life history characteristics such as age structure, growth rates, fecundity, and connectivity may be important for restoration project design and evaluation (Van Dover et al. 2013).

#### Evaluation of Resource Restoration Progress

Evaluation of collective restoration efforts and reporting on the recovery status of injured resources is important given the unprecedented scale of restoration that will be undertaken to compensate for natural resource injuries resulting from the DWH incident. Evaluation efforts at the resource level will help the Trustees understand and evaluate the aggregate effects of multiple restoration projects on the recovery of the targeted resource. Evaluation of aggregate restoration outcomes will improve understanding of the approaches that are most effective and efficient at restoring injured resources in

the Gulf, which can inform future project selection and design. Monitoring and scientific support for evaluation of resource restoration progress is intended to provide information needed to track the recovery status of habitats and resources. Monitoring and scientific support for evaluation of resource restoration progress may include, but is not limited to, aggregation of project level monitoring data across multiple projects within a Restoration Type, compilation of existing resource data, identification of critical data gaps and targeted collection of new monitoring data, and development of models to estimate population- or stock-level effects of restoration actions.

For example, an improved understanding of status and trends in focal sea turtle stocks (e.g., Kemp's ridley) could support the Trustees' evaluation of the aggregate benefits of sea turtle restoration projects and whether the implemented projects have accelerated the recovery of the species.

### E.3.3 Cross-Resource-Level Monitoring and Adaptive Management

Monitoring and adaptive management at the cross-resource level informs planning and implementation across Restoration Types and evaluation of overall restoration progress. The Trustees recognize that the specific injured resources targeted by this restoration plan are not independent but interact as part of the larger ecosystem. Cross-resource-level monitoring and scientific support will allow the Trustees to synthesize monitoring information and restoration outcomes across multiple injured resources. These activities will address information needs to support restoration planning across multiple Restoration Types, support restoration evaluation and inform adaptive management at regional scales, and facilitate evaluation and reporting on overall restoration progress to the public and other interested parties. Cross-resource-level monitoring and scientific support can fulfill data and information needs common among multiple injured resources, thereby promoting efficiency and consistency in data collection and restoration evaluation.

#### Monitoring to Support Restoration Planning and Implementation Across Restoration Types

Some key knowledge gaps in the selection, design, and optimization of restoration will affect planning and implementation for multiple resources. In such cases, it would be most efficient and consistent for the Trustees to address these knowledge gaps in a coordinated fashion by collecting data relevant to all of the resources that depend on those data and/or analyses. Potential cross-resource monitoring and adaptive management needs could include predicting and/or measuring the influence of external factors (e.g., sea level rise or large-scale disturbance events) on restoration outcomes, characterizing interactions among restoration actions that benefit different resources, and/or collecting additional data needed to support regional-scale restoration (Hijuelos & Hemmerling 2015; Steyer et al. 2003). Monitoring and scientific support activities for planning and implementation across Restoration Types is intended to fill key information gaps to support restoration for multiple resources. Monitoring and science support for this may include the compilation of existing relevant data, identification of key data gaps, targeted data collection, modeling, and/or analyses.

#### Evaluation of Overall Restoration Progress

The Restoration Types and approaches presented in this plan were selected to restore for the resources and services injured by the DWH incident. Due to the large scale of restoration that will be undertaken, the Trustees recognize the need to synthesize monitoring information and overall restoration results to

document progress toward meeting restoration goals and objectives. This synthesis will provide the feedback needed for adaptive management of restoration for multiple injured resources and may inform planning and implementation of the restoration program outlined in this restoration plan. Monitoring and scientific support for evaluation of overall restoration progress is intended to integrate resource monitoring and analysis outputs in order to understand overall restoration benefits and track the combined influence of restoration projects. This monitoring and scientific support may include regional monitoring to assess the combined effects of restoration projects within geographic regions strongly affected by the DWH incident (e.g., Hijuelos & Hemmerling 2015; Steyer et al. 2003), development of a portfolio of metrics appropriate for each Restoration Type, and/or the evaluation of ecological functions and services derived from restoration actions.

### E.3.4 Characterization of Currently Unknown Conditions, as Needed

The inherent difficulties in studying many oceanic systems limit the degree to which some conclusions can be reached with numerical precision, and continued injury characterization likely will not result in information that will substantially alter the Trustees' current conclusions. Further, confounding factors can arise over time, making injury quantification even more difficult as time passes. Therefore, the Trustees have decided that the best way to address unquantified losses is to initiate restoration now rather than delay in the hope that further study will enhance quantification. By starting work sooner rather than later, the restoration achieved will help to prevent further injury. Although the Trustees feel confident in this damage assessment and restoration plan, the volume of the DWH incident, large area affected, and complexity of the environment introduce uncertainty in the full understanding of injury and development of appropriate restoration. As the Trustees begin implementation of this restoration plan they will review all monitoring data collected and trends identified to detect any unanticipated results that may signal the existence of currently unknown conditions that could influence overall restoration progress and/or the recovery of injured resources. Beyond data generated directly as a result of activities associated with this restoration plan, the Trustees could also develop the capacity to maintain awareness of other scientific and monitoring activities that are ongoing in the Gulf of Mexico to identify any outside data or research findings that may suggest the existence of such currently unknown conditions. In the event that currently unknown conditions are discovered in the future, the Trustees may choose to conduct additional monitoring and scientific support intended to document and characterize currently unknown conditions. Monitoring and scientific support could include tracking research results presented in the scientific literature, targeted research studies to better understand the nature of currently unknown conditions, and/or monitoring, modeling, and analysis needed to support adaptive management to address the unknown condition. The Trustees will use this information to determine whether adjustments are needed to restoration at the project, resource, or cross-resource levels to ensure recovery of the resources from injury caused by the DWH incident.

## E.4 Development of Monitoring Plans

To help initiate consistent monitoring protocols, the Trustees developed monitoring frameworks and conceptual monitoring plans for many project types implemented under Early Restoration (see Table 5.E-1 through Table 5.E-10, which are placed at the end of this appendix). The Trustees chose to develop frameworks and conceptual monitoring plans for the subset of restoration approaches that were most likely to be used for multiple projects in Early Restoration. These frameworks served as guidelines for

project monitoring plans. For this restoration plan, the Trustees will build on these tools developed under Early Restoration to develop a set of guidelines for standard monitoring and adaptive management practices. These guidelines will include performance and additional monitoring for restoration projects (as discussed in Section E.3.1, Project Level Monitoring and Adaptive Management), the establishment of a suite of core parameters and monitoring methods (i.e., minimum monitoring standards) to be used consistently across projects in order to facilitate the aggregation of project monitoring results and the evaluation of restoration progress for each Restoration Type (Neckles et al. 2002).

Monitoring and adaptive management plans will be developed for each project concurrent with development of the restoration plan. These monitoring plans will establish methodologies and parameters for data collection, identify key uncertainties, and establish measurable objectives with associated performance standards to demonstrate how project monitoring will track progress toward meeting the Trustees' restoration goals and objectives. Evaluation of project performance is a critical focus of NRDA regulations under OPA. As specified in the NRDA regulations, components of a NRDA monitoring plan should include measurable restoration objectives that are specific to the injury and the desired project outcome, as well as performance criteria that are used to determine project success or the need for corrective actions.[2] In addition, restoration project monitoring plans should address duration and frequency, sampling level, reference sites, and costs.[3] The monitoring plans will also be consistent with the standard practices for monitoring and adaptive management developed by the Trustees.

The Trustees may develop strategic plans for some resources that will include monitoring and adaptive management plans that identify key uncertainties and any monitoring and scientific support needed to address these uncertainties and guide adaptive management for the resource. The development of resource-specific strategic plans may be particularly important for mobile organisms, as their restoration cannot be defined by geopolitical boundaries, or for particularly large-scale habitat-based monitoring intended to restore many habitat functions.

## E.5 Data Management and Reporting

To support the adaptive management process outlined above, the Trustees will maintain the Restoration Management Portal to provide a central location for storing monitoring information in order to facilitate aggregation of data across projects and resources to report on restoration outcomes to the public, which is further discussed in Chapter 7, Governance. Standard operating procedures (SOPs) would document minimum data standards, QA/QC procedures, metadata, and data sharing protocols. The Trustees may also support the development of data infrastructure for monitoring and adaptive management that will facilitate data analysis and synthesis, ease of discovery, assimilation and integration, and data visualization and transparency.

Reporting progress towards meeting restoration goals and objectives is a key step of science-based adaptive management. Individual Trustees will report regularly on the progress of restoration projects

[2] 15 CFR § 990.55 (b)(3).
[3] 15 CFR § 990.55 (b)(3).

via the Restoration Management Portal. Information collected during each reporting cycle will be shared with the public and other interested entities. Reporting and tracking details and minimum requirements will be described in detail in an SOP for long-term restoration management and implementation.

In addition to reporting on progress of specific projects, the Trustees will summarize and communicate restoration progress information, including data and analyses, to the public. Information may be communicated to the public through restoration status reports, report cards, white papers, datasets, published research, or other means.

## E.6 Coordination on Monitoring and Scientific Support

This restoration plan exists within a matrix of restoration and science efforts and programs across the Gulf of Mexico, both originating from and unrelated to the DWH incident. There are already many relevant science and other technical data sets, research results, models, and decision support tools available. These data and tools cover Gulf resources, habitats, and human use patterns, as well as existing data management systems that may support monitoring and adaptive management. Trustees will leverage existing work, when possible, to address priority uncertainties and conduct monitoring and scientific support activities efficiently. Throughout the restoration process, the Trustee Council will maintain coordination with the RESTORE Council and other appropriate restoration programs and/or partners in the Gulf of Mexico in order to identify synergies across programs and ensure efficiencies are realized where applicable.

Minimum monitoring standards, including monitoring parameters, methods, metadata, and data reporting standards, may be developed in coordination with other restoration and science programs. In addition, consistent monitoring plans, data aggregation, and reporting for this restoration plan may be coordinated with other restoration partners. These standards are important for enhancing transparency to the public, coordinating with other restoration partners, and ensuring accessibility to and utility of data for the scientific community.

The Trustees are responsible for detecting irregularities that may signal the existence of emerging unknown conditions that could influence restoration outcomes. Currently unknown conditions may be detected by analyzing aggregated monitoring information provided by the Trustees, but detection may also require an awareness of other ongoing scientific and restoration efforts in the Gulf of Mexico.

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## **Table 5.E-2.** Monitoring framework: barrier island restoration.

Restoration Description: This restoration project type involves the placement of sediments, installation of sand fencing, and/or planting of vegetation to enhance an existing barrier island or create a new barrier island over an existing habitat.

Goal: Restore a barrier island habitat.

Objectives: 1) Restore a barrier island that is sustained for the expected lifespan of the project.
2) Promote establishment of dune and back-barrier marsh vegetation.

Offset/Injury: Back-barrier marsh, beach, and dune habitat.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | **Pre-Construction Monitoring** | **Construction Monitoring** | **Post-Construction Monitoring** |
| **Performance Monitoring**: Evaluate effectiveness of the project in meeting the established restoration objectives and assist in determining the need for corrective actions. | Parameters for Objective 1:<br>• Elevation and area of beach, dune, back-barrier marsh, and adjacent subtidal areas[b] [k]<br><br>Parameters for Objective 2:<br>• Species composition, % cover, and height of dune and back-barrier marsh vegetation[c]<br><br>Other parameters that could be included | Parameters for Objective 1:<br>• Elevation and area of beach, dune, back-barrier marsh, and adjacent subtidal areas[b] [k]<br>• Settlement[d] [k]<br>• Structural integrity observations of sand fencing (if applicable[d])<br><br>Parameters for Objective 2:<br>• % survival of plantings (optional) | Parameters for Objective 1:<br>• Elevation and area of beach, dune, back-barrier marsh, and adjacent subtidal areas[b]: Year 5[e]<br>• Settlement[f]: Year 1 or 2 and 5<br><br>Parameters for Objective 2:<br>• % survival of plantings (optional): Within one year following planting<br>• Species composition, % cover, and height of dune and back-barrier marsh vegetation and |

[a] The parameters listed under the different monitoring timeframes are intended to include those parameters that are relevant to that specific monitoring category. For example, parameters that will help evaluate whether the project is meeting the established restoration objectives and assist in determining the need for corrective actions are listed under "performance monitoring."

[b] Adjacent subtidal areas should be monitored for elevation and area if present within the project area.

[c] May not apply to all barrier island restoration projects.

[d] Only applies to projects that are installing sand fencing.

[e] The timing of the post-construction surveys may vary depending on project scope and scale. Surveys should, at a minimum, be performed at Year 0, at or after Year 5, and, if possible, one year in the interim. Additional surveys may be warranted if the project site is directly affected by a major storm.

[f] Settlement may or may not be tied to a performance criteria.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| | based on additional project goals/objectives:<br>• Species utilization and/or nesting activity (e.g., bird, nekton, turtle, beach mice)<br>• Marsh productivity (e.g., biomass of vegetation, nekton, infauna)<br>• Hydrology (e.g., tidal inundation)<br>• Hydrodynamics (e.g., currents, sediment transport) | | presence of undesirable vegetation: Late summer for Years 1-5[g]<br>Other parameters that could be included based on additional project goals/objectives:<br>• Species utilization and/or nesting activity (e.g., bird, nekton, turtle, beach mice)<br>• Marsh productivity (e.g., biomass of vegetation, nekton, infauna)<br>• Hydrology (e.g., tidal inundation)<br>• Hydrodynamics (e.g., currents, sediment transport) |
| | Timing/Frequency:<br>Once before construction begins | Timing/Frequency:<br>Area, elevation, and structural integrity: During as-built survey<br>Settlement: Weekly during construction and once during the as-built survey<br>% survival: Within one year following planting | Timing/Frequency:<br>Specified above |
| | Location:<br>Proposed restoration site | Location:<br>Restoration site | Location:<br>Restoration site<br>Reference and/or control site[h] |
| **Additional Monitoring** (optional, project-specific): Collect additional information on site conditions to potentially<br>• Support existing project | Example parameters:<br>• Sediment classification and grain size of beach/dune soil[i] and borrow sediment<br>• % organic matter, bulk density, and % moisture of marsh soil[j] and borrow sediment | Example parameters:<br>• Sediment classification and grain size of beach/dune soil<br>• % organic matter, bulk density, and % moisture of marsh soil | Example parameters:<br>• Sediment classification and grain size of beach/dune soil<br>• % organic matter, bulk density, and % moisture of marsh soil |

g Depending on the scope/scale of the project, annual vegetation surveys may not be appropriate (e.g., timing of planting, timing of other monitoring activities, and project location). Vegetation surveys should, at a minimum, be performed at Year 5 and, if appropriate, one year in the interim (Year 2, 3, or 4). Interim vegetation surveys (Year 2, 3, or 4) should be conducted if no percent survival measurement is taken at Year 0 or 1, or they may be triggered by other site observations.

h Reference site and/or control site may be monitored for vegetation, etc.

i Only applies to projects where beach/dune is present pre-construction.

j Only applies to projects where marsh is present pre-construction.

k Survey costs may be included in engineering/design or construction budget.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| planning and implementation<br>• Support project evaluation and management<br>• Support future project planning and implementation (e.g., future project design, restoration scaling assumptions)<br>• Gain additional scientific knowledge on restoration ecology | • Subsidence/relative sea level rise<br>• Vegetation (e.g., height, aboveground biomass, belowground biomass)<br>• Fauna (e.g., benthic invertebrate density/biomass, crustacean density/biomass, nekton biomass, bird density/nest success)<br>• Soil (e.g., macro-organic matter, soil nitrogen, soil carbon)<br>• Accretion rate<br>• Erosion rate<br>• Ratio of marsh area:water area | • Vegetation (e.g., aboveground biomass, belowground biomass)<br>• Fauna (e.g., benthic invertebrate density/biomass, crustacean density/biomass, nekton biomass, bird density/nest success)<br>• Soil (e.g., macro-organic matter, soil nitrogen, soil carbon)<br>• Accretion rate<br>• Erosion rate<br>• Ratio of marsh area:water area | • Subsidence<br>• Vegetation development (e.g., aboveground biomass, belowground biomass)<br>• Fauna development (e.g., benthic invertebrate density/biomass, crustacean density/biomass, nekton biomass, bird density/nest success)<br>• Soil development (e.g., macro-organic matter, soil nitrogen, soil carbon)<br>• Accretion rate<br>• Erosion rate<br>• Ratio of marsh area:water area |
| | Timing/Frequency:<br>Project-specific | Timing/Frequency:<br>Immediately following completion of all project features | Timing/Frequency:<br>Project-specific |
| | Location:<br>Proposed restoration site<br>Reference and/or control site[h] | Location:<br>Restoration site<br>Reference and/or control site[h] | Location:<br>Restoration site<br>Reference and/or control site[h] |

Note: This monitoring framework was developed for a generic DWH early restoration barrier island restoration project intended to compensate for injury to back-barrier marsh, beach, and dune habitat. The purpose of this document is to provide a template that can guide the development of a project-specific monitoring plan for a barrier island restoration project. The project-specific monitoring plan should be adapted to fit the needs of that specific project. Depending on the goals, objectives, scope, and scale of the specific project, this document could be modified or expanded to include additional monitoring parameters, longer monitoring timelines, and increased sampling frequency. The conceptual monitoring plans developed by the Trustees are working documents and may be revised and adapted over time as necessary. Existing monitoring programs and/or partnerships in the region could be leveraged to conduct portions of the project-specific monitoring plan or expand the monitoring effort.

If shoreline protection is an additional project component (e.g., breakwaters), the monitoring outlined in the shoreline protection monitoring framework should also be considered.

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[l] Survey costs may be included in engineering/design or construction budget.

**Table 5.E-3.** Monitoring framework: beach nourishment.

Restoration Description: Addition of sandy sediment to a beach.

Goal: Restore beaches for human use.

Objective: 1) Nourish a beach that is sustained for the expected lifespan of the project.
2) Enhance recreational use.

Offset: Shoreline Recreational Use.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Baseline Monitoring | Implementation Monitoring | Performance Monitoring (Years 1–5) |
| **Performance Monitoring:** Evaluate effectiveness of the project in meeting the established restoration objectives and assist in determining the need for corrective actions. | Objective 1:<br>• Spatial extent of beach system[b]<br>• Elevation, width, and profile of the beach<br>• Sediment type, grain size, and color[b] | Objective 1:<br>• Spatial extent of beach system[b]<br>• Elevation, width and profile of the beach<br>• Sediment type, grain size, and color[c] | Objective 1:<br>• Spatial extent of beach system[b]: Year 2 and 5<br>• Elevation, width and profile of the beach: Year 2 and 5<br>• Sediment type, grain size, and color[c]: Annually for Years 1-5<br><br>Other parameters that could be included based on additional project goals:<br>• Presence of undesirable vegetation<br>• Bird utilization<br>• Turtle utilization |
| | Timing/Frequency:<br>Once before construction begins | Timing/Frequency:<br>Immediately following construction | Timing/Frequency:<br>Specified above |
| | Location: Proposed beach nourishment site | Location: Beach nourishment site | Location: Beach nourishment site |

[a] The parameters listed under the different monitoring timeframes are intended to include those parameters that are relevant to that specific monitoring category. For example, parameters that will help evaluate whether the project is meeting the established restoration objectives and assist in determining the need for corrective actions are listed under "performance monitoring."

[b] Spatial extent survey may not be warranted on all beach nourishment projects.

[c] Sediment sampling may not be warranted on all beach nourishment projects.

Note: This monitoring framework was developed for a generic DWH early restoration beach renourishment restoration project intended to compensate for injury to shoreline recreational use. The purpose of this document is to provide a template that can guide the development of a project-specific monitoring plan for a beach renourishment restoration project. The project-specific monitoring plan should be adapted to fit the needs of that specific project. Depending on the goals, objectives, scope, and scale of the specific project, this document could be modified or expanded to include additional monitoring parameters, longer monitoring timelines, and increased sampling frequency. The conceptual monitoring plans developed by the Trustees are working documents and may be revised and adapted over time as necessary. Existing monitoring programs and/or partnerships in the region could be leveraged to conduct portions of the project-specific monitoring plan or expand the monitoring effort.

Monitoring of the burrow site should be considered on a project-by-project basis, and, if applicable, included in the project-specific monitoring plan.

**Table 5.E-4.** Monitoring framework: dune restoration.

Restoration Description: Restoration activities may include planting vegetation, installing sand fencing, and/or installing signage.

Goal: Restore dune habitat.

Objective: 1) Create, stabilize, protect, and/or enhance the dune system.
2) Promote establishment of dune vegetation.

Offset/Injury: Dune habitat.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | **Pre-Construction Monitoring** | **Construction Monitoring** | **Post-Construction Monitoring** |
| **Performance Monitoring:** Evaluate effectiveness of the project in meeting the established restoration objectives and assist in determining the need for corrective actions. | Objective 1:<br>• Elevation/height and area of dune restoration project area (if applicable[b])<br><br>Objective 2:<br>• Vegetation species composition and % cover (if applicable[c])<br><br>Other parameters that could be included based on additional project goals:<br>• Bird utilization and nesting activity<br>• Turtle utilization and nesting | Objective 1:<br>• Elevation/height and area of dune restoration project area (if applicable[b])<br>• Structural integrity of sand fencing and/or signage (if applicable[d])<br><br>Objective 2:<br>• Percent survival of plantings (if applicable[e])<br>• Presence of undesirable vegetation | Objective 1:<br>• Elevation/height and area of dune restoration project area (if applicable[b]): Year 2 and 5[f]<br>• Structural integrity of sand fencing and/or signage (if applicable[d]): Annually for Years 1-5<br><br>Objective 2:<br>• Percent survival of plantings (if applicable[e]): Once after the 1st growing season<br>• Vegetation species composition, % cover, and presence of undesirable vegetation: Annually in late summer for Years 1-5[g] |

[a] The parameters listed under the different monitoring timeframes are intended to include those parameters that are relevant to that specific monitoring category. For example, parameters that will help evaluate whether the project is meeting the established restoration objectives and assist in determining the need for corrective actions are listed under "performance monitoring."

[b] Spatial extent is applicable if the project objective includes creating, stabilizing, protecting, and/or enhancing the dune.

[c] Applies to projects where vegetation is present pre-construction.

[d] Applies to projects where sand fencing and/or signage was installed.

[e] Percent survival monitoring applies to projects that plant vegetation. Percent survival measurements to be conducted once 60-180 days after planting and/or once after the 1st growing season.

[f] Additional surveys may be needed if the project site is affected by a major storm.

| Monitoring Category | Monitoring Timeframe[a] Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
|---|---|---|---|
| | activity<br>• Beach mice utilization and burrowing activity | | Other parameters that could be included based on additional project goals/objectives:<br>• Bird utilization and nesting activity<br>• Turtle utilization and nesting activity<br>• Beach mice utilization and burrowing activity |
| | Timing/Frequency:<br>Once before construction begins | Timing/Frequency:<br>Percent survival: 60-180 days after planting<br>Other parameters: Immediately following construction | Timing/Frequency:<br>Specified above |
| | Location:<br>Proposed dune restoration site<br>Reference site[h] | Location:<br>Restored dune site | Location:<br>Restored dune site<br>Reference site[h] |
| **Additional Monitoring** (optional, project-specific): Collect additional information on site conditions to potentially<br>• Support existing project planning and implementation<br>• Support project evaluation and management<br>• Support future project planning and implementation (e.g., future project design, restoration scaling assumptions)<br>• Gain additional scientific knowledge on restoration ecology | Example parameters:<br>• Presence of predators | Example parameters:<br>• Presence of predators | Example parameters:<br>• Presence of predators |
| | Timing/Frequency:<br>Project-specific | Timing/Frequency:<br>Immediately following completion of all project features | Timing/Frequency:<br>Project-specific |
| | Location:<br>Proposed restoration site | Location:<br>Restoration site | Location:<br>Restoration site |

[g] Depending on the project scope/scale, annual vegetation surveys may not be appropriate. Vegetation surveys should, at a minimum, be performed at Year 5 and, if appropriate, one year in the interim (Year 2, 3, or 4). Interim vegetation survey (Year 2, 3, or 4) should be conducted if no % survival measurement is taken at Year 0 or 1, or may be triggered by other site observations.

[h] Reference site may be monitored for spatial extent of the dunes and/or vegetative community based on project objectives.

Note: This monitoring framework was developed for a generic DWH Early Restoration dune restoration project intended to compensate for injury to dune habitat. The purpose of this document is to provide a template that can guide the development of a project-specific monitoring plan for a dune restoration project. The project-specific monitoring plan should be adapted to fit the needs of that specific project. Depending on the goals, objectives, scope, and scale of the specific project, this guidance document could be modified or expanded to include additional monitoring parameters, longer monitoring timelines, and increased sampling frequency. The monitoring frameworks developed by the Trustees are working documents and may be revised and adapted over time as necessary. Existing monitoring programs and/or partnerships in the region could be leveraged to conduct portions of the project-specific monitoring plan or expand the monitoring effort.

**Table 5.E-5.** Monitoring framework: high-relief oyster reefs.

Restoration Description: This restoration project types involves the construction of high-relief oyster reef structures using rip-rap, bagged oyster shell, and/or other structural material suitable for settlement.

Goal: Restore high-relief oyster reefs to support secondary production.

Objectives: 1) Create or enhance high-relief oyster reefs that are sustained for the expected lifespan of the project.

2) Support habitat utilization of oyster reefs by bivalves and other invertebrate infauna and epifauna.

Offset/Injury: Oyster reef secondary production (including mobile and sessile invertebrate infauna and epifauna associated with the reef).

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| **Performance Monitoring**: Evaluate effectiveness of the project in meeting the established restoration objectives and assist in determining the need for corrective actions. | Parameters for Objective 1:<br>• Reef height/elevation and area[b h]<br>• Bivalve species composition, density (bivalves/$m^2$), and size distribution (mm)<br>• Infauna and epifauna species composition, density (individuals/$m^2$), and biomass (g ww/$m^2$)<br><br>Other parameters that could be included | Parameters for Objective 1:<br>• Structural integrity observations of reef structure<br>• Reef height/elevation and area[h] | Parameters for Objective 1:<br>• Structural integrity observations of reef structure: Annually, Years 1-5[c]<br>• Reef height/elevation and area: Years 2 and 5[d]<br>• Consolidation rate of reef structure[e]: Years 2 and 5[f]<br><br>Parameters for Objective 2: |

[a] The parameters listed under the different monitoring timeframes are intended to include those parameters that are relevant to that specific monitoring category. For example, parameters that will help evaluate whether the project is meeting the established restoration objectives and assist in determining the need for corrective actions are listed under “performance monitoring.”

[b] Only applies to projects where oyster reefs are present pre-implementation.

[c] Additional surveys may be warranted if the project site is directly affected by a major storm.

[d] The timing of the post-construction surveys may vary depending on project scope/scale but, at a minimum, should be conducted during the as-built survey, one to three years post-construction, and four to seven years post-construction. Additional surveys may be warranted if the project site is directly affected by a major storm.

[e] May not apply to all high relief oyster reef projects.

[f] The timing of the post-construction surveys may vary depending on project scope/scale, but it is recommended that elevation readings of settlement plates be conducted during the construction period, one to three years post-construction, and four to seven years post-construction. Additional surveys may be warranted if the project site is directly affected by a major storm.

[g] Survey/monitoring costs may be included in engineering/design or construction budget.

| Monitoring Category | Monitoring Timeframe[a] Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
|---|---|---|---|
| | based on additional project goals/objectives:<br>• Nekton utilization | | • Bivalve species composition, density (bivalves/m²), and size distribution (mm): Late summer or early fall for Years 1-5<br>• Infauna and epifauna species composition, density (individual/m²), and biomass (g ww/m²): Late summer or early fall for Years 1-5<br><br>Other parameters that could be included based on additional project goals/objectives:<br>• Nekton utilization |
| | Timing/Frequency:<br>Once before construction begins | Timing/Frequency:<br>During as-built survey | Timing/Frequency:<br>Specified above |
| | Location:<br>Proposed restoration site<br>Control site and/or reference site[g] | Location:<br>Proposed restoration site<br>Control site and/or reference site[g] | Location:<br>Proposed restoration site<br>Control site and/or reference site[g] |
| **Additional Monitoring** (optional, project-specific): Collect additional information on site conditions to potentially<br>• Support existing project planning and implementation<br>• Support project evaluation and management<br>• Support future project planning and implementation (e.g., future project design, restoration scaling assumptions)<br>• Gain additional scientific knowledge on restoration ecology | Example parameters:<br>• Water temperature, salinity, and dissolved oxygen<br>• Oyster disease prevalence and intensity<br>• Algal coverage of reef<br>• Bivalve biomass (g afdw/m²)<br>• Infauna and epifauna biomass (g afdw/m²) | Example parameters:<br>• Water temperature, salinity, and dissolved oxygen<br>• Oyster disease prevalence and intensity<br>• Algal coverage of reef<br>• Bivalve biomass (g afdw/m²)<br>• Infauna and epifauna biomass (g afdw/m²) | Example parameters:<br>• Water temperature, salinity, and dissolved oxygen<br>• Oyster disease prevalence and intensity<br>• Algal coverage of reef<br>• Bivalve biomass (g afdw/m²)<br>• Infauna and epifauna biomass (g afdw/m²) |
| | Timing/Frequency:<br>Project specific | Timing/Frequency:<br>Immediately following completion of all project features | Timing/Frequency:<br>Project specific |
| | Location:<br>Proposed restoration site<br>Control site and/or reference site[g] | Location:<br>Restoration site<br>Control site and/or reference site[g] | Location:<br>Restoration site<br>Control site and/or reference site[g] |

[h] Control site and/or reference may be monitored for bivalves, infauna, and epifauna, etc.

Note: This monitoring framework was developed for a generic DWH early restoration high-relief oyster reef restoration project intended to compensate for injury to mobile and sessile invertebrate infauna and epifauna associated with the reef structures. The purpose of this document is to provide a template that can guide the development of a project-specific monitoring plan for a high-relief oyster reef restoration project. The project-specific monitoring plan should be adapted to fit the needs of that specific project. Depending on the goals, objectives, scope, and scale of the specific project, this guidance document could be modified or expanded to include additional monitoring parameters, longer monitoring timelines, and increased sampling frequency. The monitoring frameworks developed by the Trustees are working documents and may be revised and adapted over time as necessary. Existing monitoring programs and/or partnerships in the region could be leveraged to conduct portions of the project-specific monitoring plan or expand the monitoring effort.

**Table 5.E-6.** Monitoring framework: living shorelines.

Restoration Description: This restoration project type involves the construction of reef structures parallel to the shoreline using rip-rap, bagged oyster shell, and/or other structural material suitable for settlement.

Goal: Construct reef structures to protect shoreline from erosion and support secondary production.

Objectives: 1) Build living shorelines that are sustained for the expected lifespan of the project.
2) Support habitat utilization of reefs by bivalves and other invertebrate infauna or epifauna.
3) Reduce shoreline erosion.

Offset/Injury: Marsh habitat (or another shoreline habitat) and oyster reef secondary production (including mobile and sessile invertebrate infauna and epifauna associated with the reef).

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | **Pre-Construction Monitoring** | **Construction Monitoring** | **Post-Construction Monitoring** |
| **Performance Monitoring**: Evaluate effectiveness of the project in meeting the established restoration objectives and assist in determining the need for corrective actions. | Parameters for Objective 3:<br>• Shoreline profile/elevation[g]<br>• Marsh-edge position[g]<br><br>Other parameters that could be included based on additional project goals/objectives:<br>• Marsh vegetation species composition, % cover, and height<br>• Marsh accretion rate<br>• SAV species composition and % cover | Parameters for Objective 1:<br>• Structural integrity observations of reef structure<br>• Reef height/elevation and area[g]<br><br>Parameters for Objective 3:<br>• Shoreline profile/elevation[g]<br>• Marsh-edge position[g]<br><br>Other parameters that could be included | Parameters for Objective 1:<br>• Structural integrity observations of reef structure: Annually, Years 1-5[b]<br>• Reef height/elevation and area: Years 2 and 5[c]<br>• Consolidation rate of reef structure[d]: Years 2 and 5[e]<br><br>Parameters for Objective 2:<br>• Bivalve species composition, density |

[a] The parameters listed under the different monitoring timeframes are intended to include those parameters that are relevant to that specific monitoring category. For example, parameters that will help evaluate whether the project is meeting the established restoration objectives and assist in determining the need for corrective actions are listed under "performance monitoring."

[b] Additional surveys may be warranted if the project site is directly affected by a major storm.

[c] The timing of the post-construction surveys may vary depending on project scope/scale but, at a minimum, should be conducted during the as-built survey, one to three years post-construction, and four to seven years post-construction. Additional surveys may be warranted if the project site is directly affected by a major storm.

[d] May not apply to all living shoreline projects.

[e] The timing of the post-construction surveys may vary depending on project scope/scale, but it is recommended that elevation readings of settlement plates be conducted during the construction period, one to three years post-construction, and four to seven years post-construction. Additional surveys may be warranted if the project site is directly affected by a major storm.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | **Pre-Construction Monitoring** | **Construction Monitoring** | **Post-Construction Monitoring** |
| | • Nekton utilization | based on additional project goals/objectives:<br>• % survival of planted species[g] | (bivalves/m²), and size distribution (mm): Late summer or early fall for Years 1-5<br>• Infauna and epifauna species composition, density (individual/m²), and biomass (g ww/m²): Late summer or early fall for Years 1-5<br><br>Parameters for Objective 3:<br>• Shoreline profile/elevation: Years 2 and 5[c]<br>• Marsh-edge position: Annually, Years 1-5[b]<br>• Wave energy (optional): During sampling events<br><br>Other parameters that could be included based on additional project goals/objectives:<br>• % survival of planted species<br>• Marsh vegetation species composition, % cover, and height<br>• Marsh accretion rate<br>• SAV species composition and % cover<br>• Nekton utilization |
| | Timing/Frequency:<br>Once before construction begins | Timing/Frequency:<br>As-built survey | Timing/Frequency:<br>Specified above |
| | Location:<br>Proposed restoration site<br>Control site and/or reference site[f] | Location:<br>Proposed restoration site<br>Control site and/or reference site[f] | Location:<br>Proposed restoration site<br>Control site and/or reference site[f] |

[f] Control site and/or reference site may be monitored for shoreline profile, marsh-edge position, bivalves, and/or other infauna and epifauna.

[g] Survey /monitoring costs may be included in engineering/design or construction budget.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| **Additional Monitoring** (optional, project-specific): Collect additional information on site conditions to potentially:<br>• Support existing project planning and implementation<br>• Support project evaluation and management<br>• Support future project planning and implementation (e.g., future project design, restoration scaling assumptions)<br>• Gain additional scientific knowledge on restoration ecology | Example parameters:<br>• Water temperature, salinity, and dissolved oxygen<br>• Sediment grain size<br>• Oyster disease prevalence and intensity<br>• Bivalve species composition, density (bivalves/$m^2$), size distribution (mm), and biomass (g afdw/$m^2$)<br>• Infauna and epifauna species composition, density (individuals/$m^2$), and biomass (g ww/$m^2$ and g afdw/$m^2$) | Example parameters:<br>• Water temperature, salinity, and dissolved oxygen<br>• Sediment grain size<br>• Oyster disease prevalence and intensity<br>• Bivalve species composition, density (bivalves/$m^2$), size distribution (mm), and biomass (g afdw/$m^2$)<br>• Infauna and epifauna species composition, density (individuals/$m^2$), and biomass (g ww/$m^2$ and g afdw/$m^2$) | Example parameters:<br>• Water temperature, salinity, and dissolved oxygen<br>• Oyster disease prevalence and intensity<br>• Algal coverage of reef<br>• Sediment grain size<br>• Bivalve biomass (g afdw/$m^2$)<br>• Infauna and epifauna biomass (g afdw/$m^2$) |
| | Timing/Frequency:<br>Project specific | Timing/Frequency:<br>Immediately following completion of all project features | Timing/Frequency:<br>Project specific |
| | Location:<br>Proposed restoration site<br>Control site and/or reference site[f] | Location:<br>Restoration site<br>Control site and/or reference site[f] | Location:<br>Restoration site<br>Control site and/or reference site[f] |

Note: This monitoring framework was developed for a generic DWH early restoration living shorelines project intended to compensate for injury to marsh habitat and mobile and sessile invertebrate infauna and epifauna associated with the reef structures. The purpose of this document is to provide a template that can guide the development of a project-specific monitoring plan for a living shorelines project. The project-specific monitoring plan should be adapted to fit the needs of that specific project. Depending on the goals, objectives, scope, and scale of the specific project, this guidance document could be modified or expanded to include additional monitoring parameters, longer monitoring timelines, and increased sampling frequency. The monitoring frameworks developed by the Trustees are working documents and may be revised and adapted over time as necessary. Existing monitoring programs and/or partnerships in the region could be leveraged to conduct portions of the project-specific monitoring plan or expand the monitoring effort.

**Table 5.E-7**. Monitoring framework: marsh creation.

Restoration description: This restoration project type involves the placement of sediment and, if appropriate, the planting of native marsh vegetation to enhance an existing marsh or create a new marsh over an existing habitat.

Goal: Restore marsh habitat.

Objectives: 1) Create or enhance a marsh that is sustained for the expected lifespan of the project.
2) Promote establishment of marsh vegetation.

Offset/Injury: Marsh habitat.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| **Performance Monitoring**: Evaluate effectiveness of the project in meeting the established restoration objectives and assist in determining the need for corrective actions. | Parameters for Objective 1:<br>• Elevation[h]<br>• Marsh area[h]<br><br>Parameters for Objective 2:<br>• Vegetation species composition, % cover, and height (if applicable[b])<br><br>Other parameters that could be included based on additional project | Parameters for Objective 1:<br>• Elevation[h]<br>• Marsh area[h]<br><br>Parameters for Objective 2:<br>• Presence of undesirable plant species[c] | Parameters for Objective 1:<br>• Elevation[d]: Year 5[e]<br>• Marsh area: Year 5[e]<br><br>Parameters for Objective 2:<br>• % survival of plantings (if applicable[f]): Dependent on timing of planting<br>• Vegetation species composition, % cover, height, and presence of undesirable plant species: Late summer for Years 1-5[g] |

[a] The parameters listed under the different monitoring timeframes are intended to include those parameters that are relevant to that specific monitoring category. For example, parameters that will help evaluate whether the project is meeting the established restoration objectives and assist in determining the need for corrective actions are listed under "performance monitoring."

[b] Only applies to projects where marsh vegetation is present pre-construction.

[c] May not apply to all marsh creation projects.

[d] Year 5 elevation survey may not apply to all marsh creation projects.

[e] Increased frequency of post-construction topographic surveys may be warranted depending on project design/scale/location and if the project site was directly affected by a major storm.

[f] Only applies to projects that are planting vegetation.

[g] Depending on the scope/scale of the project, annual vegetation surveys may not be appropriate (e.g., timing of planting, timing of other monitoring activities, and project location). Vegetation surveys should, at a minimum, be conducted at Year 0 and Year 5, and one in the interim (Year 2, 3, or 4).

[h] Survey/monitoring costs may be included in engineering/design or construction budget.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| | goals/objectives:<br>• Bird utilization<br>• Nekton utilization<br>• Hydrology<br>• Marsh-edge position<br>• Accretion rate | | Other parameters that could be included based on additional project goals/objectives:<br>• Bird utilization<br>• Nekton utilization<br>• Hydrology<br>• Marsh-edge position<br>• Accretion rate |
| | Timing/Frequency:<br>Once before construction begins | Timing/Frequency:<br>During as-built survey | Timing/Frequency:<br>Specified above |
| | Location:<br>Proposed restoration site | Location:<br>Restoration site | Location:<br>Restoration site |
| **Additional Monitoring** (optional, project-specific): Collect additional information on site conditions to potentially<br>• Support existing project planning and implementation<br>• Support project evaluation and management<br>• Support future project planning and implementation (e.g., future project design, restoration scaling assumptions)<br>• Gain additional scientific knowledge on restoration ecology | Example parameters:<br>• % organic matter, bulk density, and % moisture of marsh soil<br>• Vegetation (e.g., height, above-ground biomass, below-ground biomass)<br>• Fauna (e.g., benthic invertebrate density/biomass, crustacean density/biomass, nekton density/biomass, bird density/nesting success)<br>• Soil (e.g., macro organic matter, soil nitrogen, soil carbon, bulk density, soil nutrients)<br>• Accretion rate<br>• Ratio of marsh area:water area | Example parameters:<br>• % organic matter, bulk density, and % moisture of marsh soil<br>• Vegetation (e.g., above-ground biomass, below-ground biomass)<br>• Fauna (e.g., benthic invertebrate density/biomass, crustacean density/biomass, nekton density/biomass, bird density/nesting success)<br>• Soil (e.g., macro-organic matter, soil nitrogen, soil carbon, bulk density, soil nutrients)<br>• Accretion rate<br>• Ratio of marsh area:water area | Example parameters:<br>• % organic matter, bulk density, and % moisture of marsh soil<br>• Vegetation development (e.g., aboveground biomass, belowground biomass)<br>• Fauna development (e.g., benthic invertebrate density/biomass, crustacean density/biomass, nekton density/biomass, bird density/nesting success)<br>• Soil development (e.g., macro-organic matter, soil nitrogen, soil carbon, bulk density, soil nutrients)<br>• Accretion rate<br>• Ratio of marsh area:water area |
| | Timing/Frequency:<br>Project-specific | Timing/Frequency:<br>Immediately following completion of all project features | Timing/Frequency:<br>Project-specific |
| | Location:<br>Proposed restoration site<br>Natural marsh reference site | Location:<br>Restoration site<br>Natural marsh reference site | Location:<br>Restoration site<br>Natural marsh reference site |

Note: This monitoring framework was developed for a generic DWH early restoration marsh creation project intended to compensate for injury to marsh habitat. The purpose of this document is to provide a template that can guide the development of a project-specific monitoring plan for a marsh creation project. The project-specific monitoring plan should be adapted to fit the needs of that specific project. Depending on the goals, objectives, scope, and scale of the specific project, this guidance document could be modified or expanded to include additional monitoring parameters, longer monitoring timelines, and increased sampling frequency. The monitoring frameworks developed by the Trustees are working documents and may be revised and adapted over time as necessary. Existing monitoring programs and/or partnerships in the region could be leveraged to conduct portions of the project-specific monitoring plan or expand the monitoring effort.

**Table 5.E-8.** Monitoring framework: oyster cultch creation or enhancement.

Restoration Description: This restoration project type involves the construction of oyster cultch areas by placing cultch material (e.g., limestone rock, crushed concrete, oyster shell) onto oyster seed grounds.

Goal: Restore oyster cultch areas to produce oysters suitable for commercial or recreational use.

Objectives: 1) Create or enhance oyster cultch areas that are sustained for the expected lifespan of the project.
2) Support oyster settlement and growth.

Offset/Injury: Oysters.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| **Performance Monitoring:** Evaluate effectiveness of the project in meeting the established restoration objectives and assist in determining the need for corrective actions. | Parameters for Objective 1:<br>• Oyster cultch area (if applicable[b])[d]<br><br>Parameters for Objective 2:<br>• Oyster density (oysters/m$^2$), mortality (% dead oysters), and size distribution (mm) (if applicable[b]) | Parameters for Objective 1:<br>• Oyster cultch area[d] | Parameters for Objective 1:<br>• Oyster cultch area: Years 3 and 5[c]<br><br>Parameters for Objective 2:<br>• Oyster density (oysters/m$^2$), mortality (% dead oysters), and size distribution (mm): 1-2 times a year for Years 1-5 |
| | Timing/Frequency:<br>Once before construction begins | Timing/Frequency:<br>Within 90 days following construction | Timing/Frequency:<br>Specified above |
| | Location:<br>Proposed restoration site | Location:<br>Restoration site | Location:<br>Restoration site |
| **Additional Monitoring** (optional, project-specific): Collect additional information on site conditions to potentially | Example parameters:<br>• Water temperature, salinity, and dissolved oxygen | Example parameters:<br>• Water temperature, salinity, and dissolved oxygen | Example parameters:<br>• Water temperature, salinity, and dissolved oxygen |
| | Timing/Frequency: | Timing/Frequency: | Timing/Frequency: |

[a] The parameters listed under the different monitoring timeframes are intended to include those parameters that are relevant to that specific monitoring category. For example, parameters that will help evaluate whether the project is meeting the established restoration objectives and assist in determining the need for corrective actions are listed under "performance monitoring."

[b] May only apply to oyster cultch enhancement projects

[c] Year 5 spatial extent survey may not apply to all projects depending on project lifespan. Additional surveys may be warranted depending on project lifespan or if the project site is directly affected by a major storm.

[d] Survey costs may be included in engineering/design or construction budget.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| • Support existing project planning and implementation<br>• Support project evaluation and management<br>• Support future project planning and implementation (e.g., future project design, restoration scaling assumptions)<br>• Gain additional scientific knowledge on restoration ecology | Project-specific | Immediately following completion of all project features | Project-specific |
| | Location:<br>Proposed Restoration site | Location:<br>Restoration site | Location:<br>Restoration site |

Note: This monitoring framework was developed for a generic DWH early restoration oyster cultch creation or enhancement project intended to compensate for injury to oysters. The purpose of this document is to provide a template that can guide the development of a project-specific monitoring plan for an oyster cultch creation or enhancement project. The project-specific monitoring plan should be adapted to fit the needs of that specific project. Depending on the goals, objectives, scope, and scale of the specific project, this guidance document could be modified or expanded to include additional monitoring parameters, longer monitoring timelines, and increased sampling frequency. The monitoring frameworks developed by the Trustees are working documents and may be revised and adapted over time as necessary. Existing monitoring programs and/or partnerships in the region could be leveraged to conduct portions of the project-specific monitoring plan or expand the monitoring effort.

**Table 5.E-9.** Monitoring framework: seagrass restoration.

Restoration Description: Restoration activities may include planting seagrass, installing bird stakes, installing signage/buoys, and/or filling in propeller scars, blowouts, and/or anchor scouring scars (scars) with sediment fill.

Goal: Restore seagrass habitat.

Objectives: 1) Stabilize, protect, and/or enhance seagrass beds through the installation of bird stakes, signage, and/or buoys, filling in scars, and/or planting seagrass.
2) Promote regrowth and/or expansion of seagrass beds.

Offset/Injury: SAV habitat.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| **Performance Monitoring**: Evaluate effectiveness of the project in meeting the established restoration objectives and assist in determining the need for corrective actions. | Parameters for Objective 1:<br>• Length, number, and/or area of scars (if applicable[b])<br>• Depth of scars (cm) (if applicable[b])<br><br>Parameters for Objective 2:<br>• Area of seagrass beds (if applicable[c])<br>• Seagrass species composition, % cover, and shoot density (shoots/m$^2$) | Parameters for Objective 1:<br>• Length, number, and/or area of scars (if applicable[b])<br>• Depth of scars (cm) (if applicable[b])<br>• Structural integrity of bird stakes, signage, and/or buoys (if applicable[d])<br><br>Parameters for Objective 2:<br>• % survival of seagrass planting units (if applicable[e])<br>• Area of seagrass beds (if applicable[c]) | Parameters for Objective 1:<br>• Length, number, and/or area of scars (if applicable[b]): Years 2 and 5<br>• Depth of scars (cm) (if appliable[2]): Annually for Years 1-5<br>• Structural integrity of bird stakes, signage, and/or buoys (if applicable[d]): Annually during spring months for Years 1-5[f]<br><br>Parameters for Objective 2:<br>• Area of seagrass beds (if applicable[c]): Years 2 and 5<br>• Seagrass species composition, % cover, |

[a] The parameters listed under the different monitoring timeframes are intended to include those parameters that are relevant to that specific monitoring category. For example, parameters that will help evaluate whether the project is meeting the established restoration objectives and assist in determining the need for corrective actions are listed under "performance monitoring."

[b] Applicable if the restoration project is filling in scars.

[c] Applicable when seagrass area expansion is a stated project objective.

[d] Applicable if the restoration project is installing bird stakes, signage, and/or buoys.

[e] Applicable if the restoration project is planting vegetation.

[f] Additional surveys may be warranted if the project site is directly affected by a major storm.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| | | | and shoot density (shoots/m$^2$): Biannually (early spring and late summer) for Year 1, and then at least annually (late summer) for Years 2-5 |
| | Timing/Frequency:<br>Once before construction begins | Timing/Frequency:<br>During as-built survey<br>% survival: 30 and 90 days after plantings | Timing/Frequency:<br>Specified above |
| | Location:<br>Proposed restoration site<br>Reference site[g] | Location:<br>Restoration site<br>Reference site[g] | Location:<br>Restoration site<br>Reference site[g] |
| **Additional Monitoring** (optional, project-specific): Collect additional information on site conditions to<br>• Support project planning, evaluation of project performance, and/or inform adaptive management or corrective actions<br>• Evaluate, and refine future, restoration scaling assumptions<br>• Gain additional scientific knowledge on restoration ecology | Example parameters:<br>• Underwater photographs<br>• Water depth, temperature, salinity, and light penetration | Example parameters:<br>• Underwater photographs<br>• Water depth, temperature, salinity, and light penetration | Example parameters:<br>• Underwater photographs<br>• Water depth, temperature, salinity, and light penetration |
| | Timing/Frequency:<br>Project-specific | Timing/Frequency:<br>Immediately following completion of all project features | Timing/Frequency:<br>Project-specific |
| | Location:<br>Proposed restoration site<br>Reference site[f] | Location:<br>Restoration site<br>Reference site[f] | Location:<br>Restoration site<br>Reference site[f] |

Note: This monitoring framework was developed for a generic DWH early restoration seagrass restoration project intended to compensate for injury to SAV habitat. The purpose of this document is to provide a template that can guide the development of a project-specific monitoring plan for a seagrass restoration project. The project-specific monitoring plan should be adapted to fit the needs of that specific project. Depending on the goals, objectives, scope, and scale of the specific project, this guidance document could be modified or expanded to include additional monitoring parameters, longer monitoring timelines, and increased sampling frequency. Existing monitoring programs and/or partnerships in the region could be leveraged to conduct portions of the project-specific monitoring plan or expand the monitoring effort.

[g] Reference site may be monitored for vegetation surveys, underwater photographs, and water quality monitoring.

**Table 5.E-10.** Monitoring framework: shoreline protection.

Restoration Description: This restoration project type involves the construction of breakwaters (submerged and/or emergent) along eroding shorelines using rip-rap and/or other structural material.

Goal: Construct breakwaters to protect the shoreline from erosion.

Objectives: 1) Build breakwaters that are sustained for the expected lifespan of the project.
2) Reduce shoreline erosion.

Offset/Injury: Marsh habitat

<table>
<tr><th rowspan="2">Monitoring Category</th><th colspan="3">Monitoring Timeframe[a]</th></tr>
<tr><th>Pre-Construction Monitoring</th><th>Construction Monitoring</th><th>Post-Construction Monitoring</th></tr>
<tr><td>Performance Monitoring: Evaluate effectiveness of the project in meeting the established restoration objectives and assist in determining the need for corrective actions.</td><td>Parameters for Objective 2:<br>• Shoreline profile/elevation[e]<br>• Marsh-edge position[e]<br>• Wave energy (optional)<br><br>Other parameters that could be included based on additional project goals/objectives:<br>• Marsh vegetation species composition, % cover, and height<br>• Marsh accretion rate</td><td>Parameters for Objective 1:<br>• Structural integrity observations of breakwaters<br>• Breakwater height/elevation and area[e]<br>• Consolidation rate of breakwater structure[b,e]<br><br>Parameters for Objective 2:<br>• Shoreline profile/elevation[e]<br>• Marsh-edge position[e]<br><br>Other parameters that could be included based on additional project goals/objectives:<br>• % survival of planted species[e]</td><td>Parameters for Objective 1:<br>• Structural integrity observations of breakwaters: Year 5 and as needed in interim years<br>• Breakwater height/elevation and area: Year 5 and an optional interim year[c]<br>• Consolidation rate of breakwater structure[b]: Year 1 or 2 (optional) and Year 5[c]<br><br>Parameters for Objective 2:<br>• Shoreline profile/elevation: Year 5 and an optional interim year[c]<br>• Marsh-edge position: Year 5 and an optional interim year[c]<br>• Wave energy (optional): During sampling events<br>Other parameters that could be included based on additional project goals/objectives:</td></tr>
</table>

[a] The parameters listed under the different monitoring timeframes are intended to include those parameters that are relevant to that specific monitoring category. For example, parameters that will help evaluate whether the project is meeting the established restoration objectives and assist in determining the need for corrective actions are listed under "performance monitoring."

[b] May not apply to all shoreline protection projects.

[c] Additional surveys may be warranted if the project site is directly affected by a major storm or as triggered by other observations.

| Monitoring Category | Monitoring Timeframe[a] | | |
|---|---|---|---|
| | Pre-Construction Monitoring | Construction Monitoring | Post-Construction Monitoring |
| | | | • % survival of planted species<br>• Marsh vegetation species composition, % cover, and height<br>• Marsh accretion rate |
| | Timing/Frequency:<br>Once before construction begins | Timing/Frequency:<br>As-built survey | Timing/Frequency:<br>Specified above |
| | Location:<br>Proposed restoration site<br>Nonbreakwater control site and/or reference site[d] | Location:<br>Proposed restoration site<br>Nonbreakwater control site and/or reference site[d] | Location:<br>Proposed restoration site<br>Nonbreakwater control site and/or reference site[d] |

Note: This monitoring framework was developed for a generic DWH early restoration shoreline protection project intended to compensate for injury to marsh habitat. The purpose of this document is to provide a template that can guide the development of a project-specific monitoring plan for a shoreline protection project. The project-specific monitoring plan should be adapted to fit the needs of that specific project. Depending on the goals, objectives, scope, and scale of the specific project, this guidance document could be modified or expanded to include additional monitoring parameters, longer monitoring timelines, and increased sampling frequency. The monitoring frameworks developed by the Trustees are working documents and may be revised and adapted over time as necessary. Existing monitoring programs and/or partnerships in the region could be leveraged to conduct portions of the project-specific monitoring plan or expand the monitoring effort.

If marsh creation is an additional project component, the monitoring outlined in the marsh creation monitoring framework should also be included.

[d] Control site and/or reference may be monitored for shoreline profile, marsh-edge position, etc.
[e] Survey/monitoring costs may be included in engineering/design or construction budget.