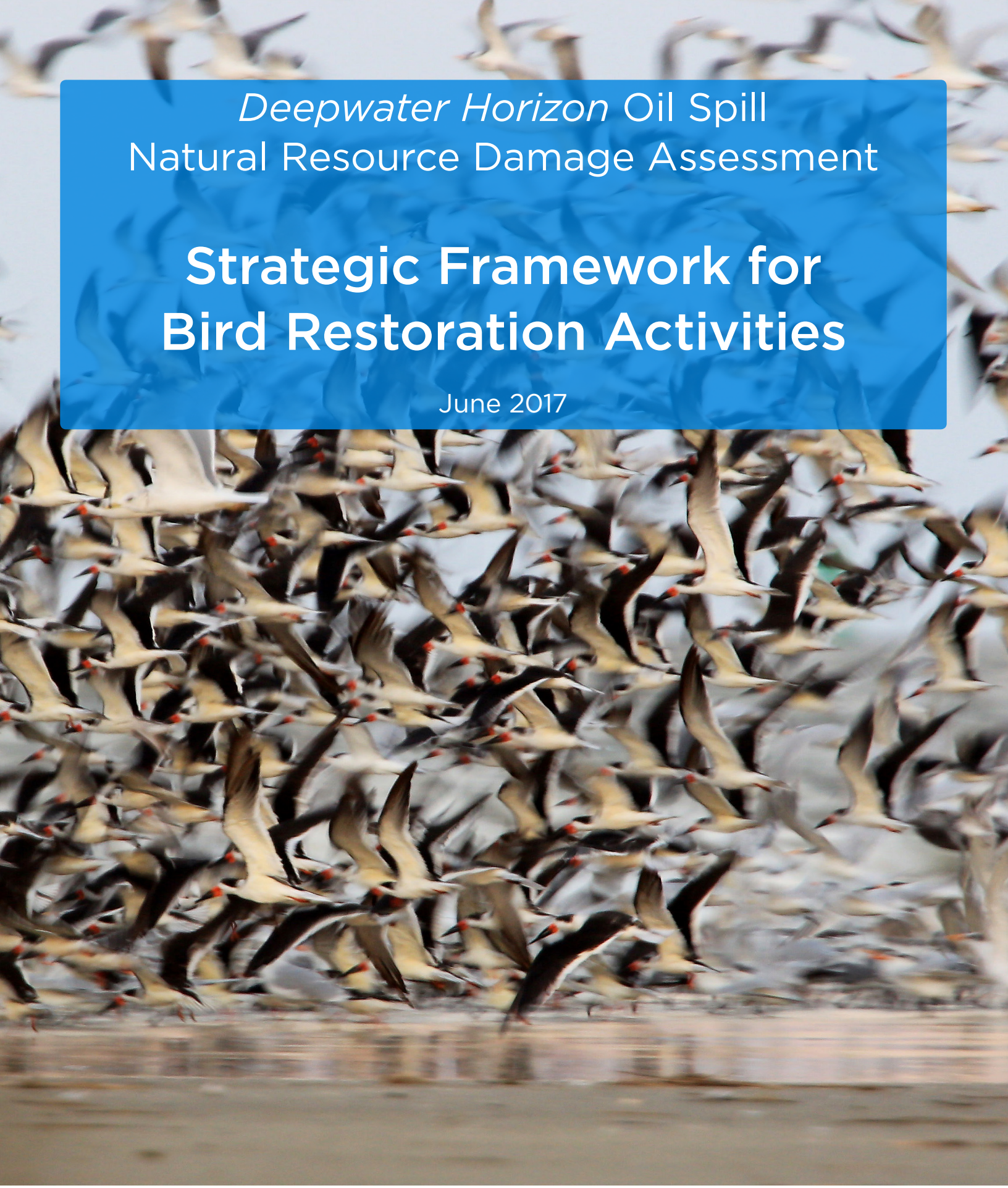
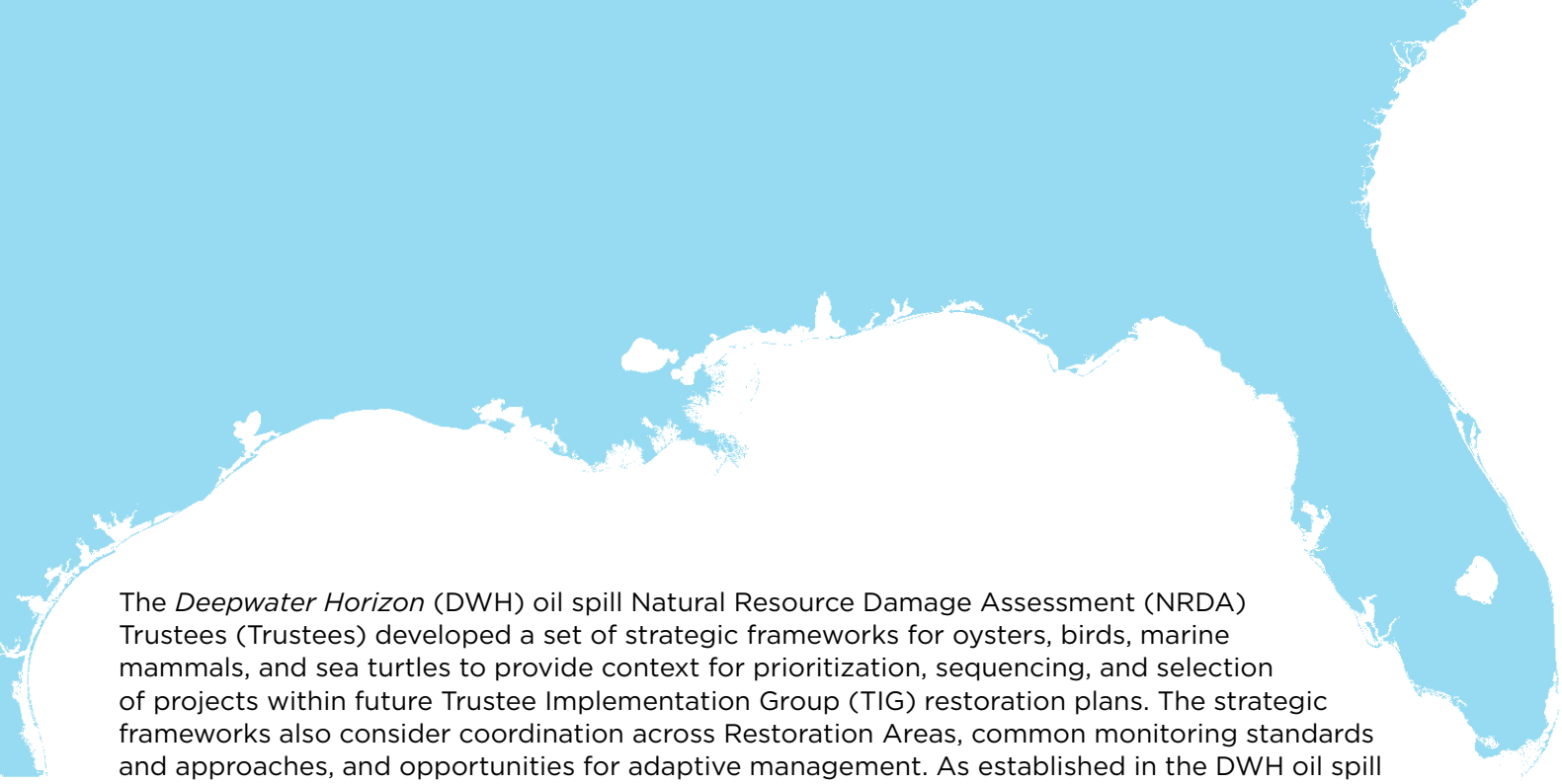


Deepwater Horizon Oil Spill
Natural Resource Damage Assessment

Strategic Framework for Bird Restoration Activities

June 2017



The *Deepwater Horizon* (DWH) oil spill Natural Resource Damage Assessment (NRDA) Trustees (Trustees) developed a set of strategic frameworks for oysters, birds, marine mammals, and sea turtles to provide context for prioritization, sequencing, and selection of projects within future Trustee Implementation Group (TIG) restoration plans. The strategic frameworks also consider coordination across Restoration Areas, common monitoring standards and approaches, and opportunities for adaptive management. As established in the DWH oil spill Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS), these frameworks will help the Trustees consider each resource at the ecosystem level, while implementing restoration at the local level.

The Regionwide TIG authorized the creation of these strategic frameworks to promote information sharing and coordination across TIGs for the four resources (oysters, birds, marine mammals, and sea turtles) that will receive restoration funding allocated to the Regionwide TIG. The Trustees also anticipate that the strategic frameworks will be useful for restoration planning and implementation by all TIGs. Developed by teams of Trustee scientists and resource experts, each framework includes four modules with information for the TIGs to consider for planning, implementing, and monitoring restoration activities:

Module 1: A brief summary of the information in the PDARP/PEIS related to each resource, including an overview of the injury, restoration goals, restoration approaches and techniques, and monitoring considerations

Module 2: Biological and ecological information on each resource, including geographic distribution, life history, and key threats

Module 3: An overview of other recent and ongoing conservation, restoration, management, and monitoring activities related to each resource in the northern Gulf of Mexico

Module 4: Considerations for the prioritization, sequencing, and selection of restoration projects to benefit the resource, including additional information on restoration approaches and techniques, potential project concepts, and monitoring needs.

Citations and references are included throughout the modules, so that the reader can easily investigate each topic in more detail. The strategic frameworks may be updated based on new knowledge obtained by Trustee efforts or the broader science community, and updates to relevant species recovery or management plans prepared under other statutes.

Strategic frameworks are not intended to exhaustively present all possible restoration techniques and project concepts, nor to prescriptively describe the complete restoration plan for the resource across all TIGs. Readers are encouraged to submit restoration projects to the Trustee Project Portal (http://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas) or to state-specific project portals, as available.

Please visit www.gulfspillrestoration.noaa.gov for the latest version of this document.

Suggested citation: Deepwater Horizon Natural Resource Damage Assessment Trustees. 2017. Deepwater Horizon Oil Spill Natural Resource Damage Assessment: Strategic Framework for Bird Restoration Activities. June. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

Module 1

Summary of Information from the PDARP – Birds

KEY ASPECTS OF BIRD INJURY THAT INFORMED RESTORATION PLANNING

Large-scale and pervasive bird injuries were documented in the northern Gulf of Mexico (GOM) as a result of the *Deepwater Horizon* (DWH) oil spill, including direct mortality of birds and lost future reproduction. These losses affected nearly every coastal bird guild and their habitats, including beaches, marshes, islands supporting nesting colonies, open water, and algal, specifically *Sargassum*, rafts.

- At least 93 species of birds, including both resident and migratory species and across all five Gulf Coast states, were exposed to DWH oil in multiple northern GOM habitats, including open water, islands, beaches, bays, and marshes.
- Trustee scientists quantified that between 51,600 and 84,500 birds died as a result of the DWH oil spill, although significant mortality occurred that was unquantified. Further, of those quantified dead birds, the breeding-age adults would have produced an estimated 4,600 to 17,900 fledglings. Due to a number of factors that likely led to underestimation of mortality, quantified mortality is likely closer to the upper ranges than the lower.
- Trustees recognize that access restrictions within expansive oiled coastal marshes and island bird colonies, habitats which maintain significant bird concentrations, limited their ability to more fully characterize the extent of the true avian injury.
- The magnitude of the injury and the number of species affected makes the DWH spill an unprecedented human-caused injury to birds of the region.

See Section 4.7 in the Final Programmatic Damage Assessment and Restoration Plan (PDARP) and Final Programmatic Environmental Impact Statement (PEIS).

Birds in the Gulf of Mexico (GOM) are highly valued and ecologically important components of the northern Gulf of Mexico (GOM) ecosystem. This region supports a diversity of coastal bird species throughout the year, as nesting grounds during the summer, as a stopover for migrating species in the spring and fall, and as wintering habitat for numerous species that breed elsewhere.

The *Deepwater Horizon* (DWH) oil spill exposed at least 93 species of birds to oil in a variety of northern GOM habitats, including open water, coastal islands preferred by nesting birds, barrier islands, beaches, bays, and marshes. Birds were exposed through physical contact with oil in the environment and ingestion of oil during preening and foraging through contaminated prey, water, and/or sediment.

Settlement funding allocation for bird restoration (millions $)

	Funds Allocated to Birds in Early Restoration	Final Settlement Allocation
Regionwide TIG	$1.8	70.4
Open ocean TIG	-	70.0
Texas TIG	$20.6	20.0
Louisiana TIG	$71.9	148.5
Mississippi TIG	-	25.0
Alabama TIG	$0.2	30.0
Florida TIG	$2.8	40.0
Total funding	**$97.3**	**403.9**

Funding allocation is approximate. Numbers are rounded.

Bird funds have been allocated across all seven Trustee Implementation Groups (TIGs) because of the diverse array of species injured and geographic areas that they inhabit. Because some bird species affected by DWH range outside of the GOM, the Trustees may use funds for restoration outside the GOM as ecologically appropriate. Specific approaches could include conserving, creating, or enhancing nesting and foraging habitat; reestablishing breeding colonies; managing bird predators; and addressing direct human threats to certain bird species.

In addition, the Trustees initiated bird projects under Early Restoration. Specific projects included the Enhanced Management of Avian Breeding Habitat Injured by Response in the Florida Panhandle, Alabama, and Mississippi (Phase II) project; the Louisiana Outer Coast Restoration project (Phase III); the Texas Rookery Islands project (Phase IV); and the Osprey Restoration in Coastal Alabama (Phase IV) project.

Trustees are using a nested framework of programmatic restoration goals, types, and approaches and techniques to guide and direct the subsequent phases of restoration:

TRUSTEES' PROGRAMMATIC RESTORATION GOAL:

Replenish and protect living coastal and marine resources

RESTORATION TYPE: BIRDS

The goals of the Bird Restoration Type include:

- Restore lost birds by facilitating additional production and/or reduced mortality of injured bird species.
- Restore or protect habitats on which injured birds rely.
- Restore injured birds by species where actions would provide the greatest benefits within geographic ranges that include the GOM.

For additional information on bird restoration goals, see Section 5.5.12.1 in the Final PDARP/PEIS.

STRATEGY TO ACHIEVE GOALS

This Restoration Type will enhance bird reproductive success and survival by restoring or protecting habitats.

- Although bird species using the GOM are varied and diverse, many face similar threats to reproduction and survival, including habitat degradation or alteration, high predation rates from introduced and invasive native predators, disease, pollution, and climate change. Others experience additional, unique threats, such as becoming fisheries bycatch and colliding with at-sea structures.
- Restoration to mitigate threats to birds will address habitat loss and alteration, including managing bird predators.
- The Trustees would also restore birds injured by the DWH oil spill by addressing direct human threats to target bird species.

The large number of individuals, diversity of species, broad geographic ranges, and specific life history requirements of birds injured necessitate a portfolio of restoration approaches to adequately address injuries. Restoration would, therefore, take place in areas across the Gulf of Mexico and in non-Gulf areas where injured bird species migrate to and/or breed.

RESTORATION APPROACHES AND TECHNIQUES

The restoration approaches and potential techniques associated with bird restoration include:

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.
- Restore or create riverine islands.
- Create or enhance oyster shell rakes and beds.
- Nesting and foraging area stewardship.

- Provide or enhance artificial nest sites.
- Increase availability of foraging habitat at inland, managed moist-soil impoundments, agricultural fields, aquaculture ponds, and wetlands.

Establish or re-establish breeding colonies

Since the 1970s, this restoration approach has been implemented worldwide to encourage colonization of sites by bird nesting colonies. These techniques are often employed with other restoration activities that enhance a target site for breeding birds. Potential techniques include:

- Translocate chicks to new colonies.
- Use acoustic vocalization playbacks and decoys to attract breeding adults to restoration sites.

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. Potential techniques include:

- Remove derelict fishing gear.
- Support bird rehabilitation centers.
- Reduce collisions by modifying lighting and/or lighting patterns on oil and gas platforms.
- Reduce seabird bycatch through voluntary fishing gear and/or technique modifications.

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. Potential techniques include:

- Create or enhance coastal wetlands through placement of dredged material.
- Backfill canals.
- Restore hydrologic connections to enhance coastal habitats.
- Construct breakwaters.

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. Potential techniques include:

- Renourish beaches through sediment addition.
- Restore dune and beach systems through the use of passive techniques to trap sand.
- Plant vegetation on dunes.
- Construct groins and breakwaters or use sediment bypass methods.
- Protect dune systems through the use of access control.

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. Potential techniques include:

- Restore or construct barrier and coastal islands and headlands via placement of dredged sediments.
- Plant vegetation on dunes and back-barrier marsh.

Restore and enhance submerged aquatic vegetation

This restoration approach focuses on restoring and protecting submerged aquatic vegetation (SAV) habitat. Potential techniques include:

- Backfill scars with sediment.
- Revegetate SAV beds via propagation and/or transplanting.
- Protect SAV beds with buoys, signage, and/or other protective measures.
- Protect and enhance SAV through wave attenuation structures.

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. Potential techniques include:

- Acquire lands for conservation.
- Develop and implement management actions in conservation areas and/or restoration projects.
- Establish or expand protections for marine areas.

For additional information on avian restoration approaches and techniques, see Section 5.5.12.2 and Appendix 5.D.6 in the Final PDARP/PEIS.

MONITORING

A monitoring and adaptive management framework will be used to support restoration implementation and provide the DWH Trustees with a flexible, science-based decision-making approach to ensure that the restoration portfolio provides long-term benefits to the natural resources and services injured by the spill.

Project-level monitoring. Performance monitoring and tracking at the scale of the individual project will be used for evaluating how well restoration projects meet their restoration objectives and determining the need for any corrective actions or adaptive management. Project-level monitoring may include pre-implementation monitoring and incorporation of existing data to document initial conditions, as well as post-implementation monitoring to gauge restoration progress and success. These efforts are intended to maximize benefits for birds through projects related to restoring nesting, foraging and/or roosting habitats and bycatch reduction. Although project-level objectives will vary, common metrics will be used, where possible, to evaluate the performance success of bird restoration projects. Performance monitoring for specific projects may rely on existing and/or enhancement of monitoring programs like breeding colony surveys, mortality monitoring, and data collection during implementation.

Resource-level monitoring. Collection of resource-level monitoring can fulfill data and information needs to support adaptive management and inform restoration planning, implementation, and evaluation. Monitoring and scientific support at the resource level may include regional metapopulation conditions, movement, and interactions; behaviors of target species given chronic and acute threats; site- and regional-specific recruitment survival rates and drivers; effects of patterns of dispersal on recruitment; and the potential for species to shift to alternate nesting habitats in response to habitat loss and/or creation. Additional monitoring and scientific support may include compilation and analyses of relevant information and data about birds, their habitats, and threats to their populations, as well as filling any information needs or data gaps to properly make analyses.

For additional information on avian restoration monitoring, see Section 5.5.12.4 in the Final PDARP/PEIS.

PHOTO CREDITS.
Page 1 (*top*). Nesting brown pelicans and laughing gulls. Audubon Island, Bay County, Florida. *Amy Raker, Florida Fish and Wildlife Conservation Commission.*
Page 1 (*bottom*). Reddish egret. *James C. Leupold, U.S. Fish and Wildlife Service.*
Page 2. Least tern. *Marc Rivadeneyra, Florida Fish and Wildlife Conservation Commission.*
Page 4. Evia Island terns. *Jarrett Woodrow, U.S. Fish and Wildlife Service.*

Module 2

Biological and Ecological Information – Birds

1. Introduction

The *Deepwater Horizon* oil spill and response efforts (DWH oil spill) impacted birds and their habitats at an unprecedented scale, causing extensive injuries. The large number of individuals, diversity of species, broad geographic range, and specific life-history requirements of bird species injured[1] necessitate a portfolio of restoration actions to address bird species injured by the DWH oil spill (Appendix A).

This module provides relevant biological and ecological information to support the design, implementation, and management of bird restoration projects intended to address injuries caused by the DWH oil spill. Most of the information herein is adapted from the *Deepwater Horizon* Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement (PDARP/PEIS; DWH NRDA Trustees, 2016) or from other relevant published literature and agency reports cited in the text.

1.1 Resource Management

The northern Gulf of Mexico (GOM) intersects with three of the four major migration flyways in North America, including the Central, Mississippi, and Atlantic flyways (Figure 1). Nearly 300 bird species are known to utilize the GOM's abundant and diverse habitats for breeding, as stopover locations as they migrate north or south and/or as wintering habitat following fall migrations from the north. Several species of birds injured by the DWH oil spill nest in areas other than the northern GOM, such as the Caribbean, the Midwestern United States, Canada, and remote oceanic islands. Consideration of this and other habitat types (e.g., wintering areas, migratory corridors) represent critical components for the overall survival of these bird species.

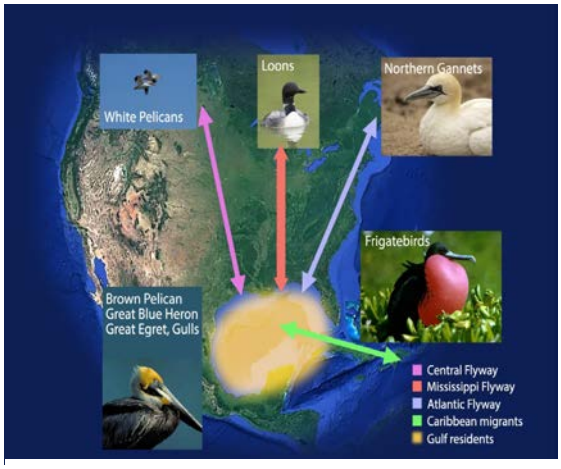


Figure 1. Major flyways of birds that occupy the Gulf of Mexico.

Birds play vital roles in ecosystems, serving as both predators and prey in a large number of food webs. In addition, birds make significant direct economic contributions to the GOM region. For example, both consumptive

1. Injuries were documented to at least 93 different bird species (DWH NRDA Trustees, 2016; Table 4.7-3).

(e.g., migratory bird hunting) and non-consumptive (e.g., bird watching) activities generate billions of dollars annually in economic activity (USFWS, 2013).

1.2 Habitat Types

Four broad habitat types were impacted by the DWH oil spill in the northern GOM. Each of these habitats is occupied by somewhat distinct bird assemblages (Table 1). A number of national wildlife refuges (NWRs), national parks, state parks, state wildlife management areas, and other protected lands within the area impacted by the DWH oil spill provide habitat for both resident and migratory bird species. Some of these lands, such as the Breton NWR and the Isle Dernieres Refuge in Louisiana, were created specifically for the protection and conservation of birds.

Bayou Platte rookery at Marsh Island Refuge. Credit: LDWF.

Table 1. Northern Gulf of Mexico bird habitats exposed to the Deepwater Horizon oil spill

Habitat types	Examples of injured species that use habitat type
Offshore/open water	Shearwaters, storm-petrels, frigatebirds, terns
Island waterbird colonies	Pelicans, gulls, wading birds, terns, black skimmers
Nearshore	
Nearshore habitats/waters	Gannets, loons, cormorants, waterfowl, grebes
Beaches	Shorebirds, wading birds, gulls, pelicans
Marsh edge	Shorebirds, black skimmers
Interior marsh	Rails, seaside sparrows, waterfowl, wading birds

1.2.1 Offshore/Open Water Habitats

Bird species that utilize offshore or open water habitats include boobies, shearwaters, storm-petrels, and several species of terns. Some of these species, such as the Audubon's shearwater (*Puffinus iherminieri*) and masked booby (*Sula dactylatra*), are frequently found in offshore areas of the northern GOM (Ribic et al., 1997; Davis et al., 2000), but do not nest within the region. Free-floating mats of Sargassum algae are considered an important offshore habitat feature (Haney, 1986) as they attract diverse bird prey species (e.g., fish, zooplankton)

and serve as important resting areas. In this habitat type, birds interacted with and were injured by surface oiling and associated response activities from the DWH oil spill (PDARP Section 4.2, DWH NRDA Trustees, 2016).

1.2.2 Island Waterbird Colonies

During the reproductive season, select locations within the northern GOM become areas in which a host of species, including brown pelicans (*Pelecanus occidentalis*), gulls, terns, black skimmers (*Rynchops niger*), wading birds, and others, annually congregate. These congregations are referred to as colonies. Islands that support colonies provide a wide range of services, including diverse nesting habitats (e.g., trees, shrubs, sandy beaches) and expansive forage opportunities, required to support adults, juveniles, and hatchlings. These islands are sometimes located away from land, which greatly limits the potential impacts of terrestrial predators and human disturbance, but are also often located in coastal bays and within the Intracoastal Waterway. At the time of the DWH oil spill, mixed aggregations (i.e., tens of thousands of adults, juveniles, and chicks in some locations) were located within these colonies, making them highly susceptible to injury, both acute and chronic, from exposure to oil (e.g., physical fouling, inhalation, dietary), as well as impacts from response activities (e.g., habitat and nest destruction, hazing, human encroachment) within or adjacent to colonies (Baker, 2015).

1.2.3 Nearshore Habitats[2]

The DWH oil spill impacted a variety of northern GOM coastal habitats (e.g., coastal waters, beaches, marsh edges) that support a diverse assemblage of resident and migratory birds, including the federally endangered piping plover (*Charadrius melodus*) and the federally threatened red knot (*Calidris canutus*). Coastal habitats are considered among the most important habitat type for colonial birds, especially herons, ibises, pelicans, cormorants, skimmers, terns, gulls, and non-colonial birds such as rails (Hunter et al., 2006). Sandy beach habitats, primarily beaches, dunes, sand bars, and sandy inlet shorelines, provide nesting, roosting, and loafing areas for several solitary nesting shorebirds [e.g., American oystercatcher (*Haematopus palliates*), snowy plover (*Charadrius nivosus*), Wilson's plover (*Charadrius wilsonia*)], as well as colonial species such as black skimmers, laughing gulls (*Leucophaeus atricilla*), and several species of terns. Habitats along the edges of marshes, including mudflats and tidal flats, provide critical foraging areas for birds such as marsh birds, shorebirds, wading birds, gulls, terns, and others.

Northern GOM coastal marshes support high concentrations of birds throughout the year. This is due, in part, to their highly productive nursery habitats that generate an expansive array of seasonal prey items (e.g., fish, shrimp, invertebrates). Year-round resident species include clapper rails (*Rallus crepitans*), seaside sparrows (*Ammodramus maritimus*), pied-billed grebes (*Podilymbus podiceps*), common gallinules (*Gallinula galeata*), least bitterns

2. As defined in the PDARP, Nearshore Habitat includes nearshore waters, as well as sandy beach habitat (e.g., mainland beaches, dunes, sand bars, inlet shorelines) and marsh edges along the Gulf Coast. Additionally, this may also include other habitats important to injured bird species (e.g., intertidal nearshore reefs).

(*Ixobrychus exilis*), marsh wrens (*Cistothorus palustris*), egrets, herons, ibises, and mottled ducks (*Anas fulvigula*). Additional winter migrants include long-billed curlews (*Numenius americanus*), soras (*Porzana carolina*), and many species of waterfowl (Woodrey et al., 2012). Coastal habitats along the northern GOM also serve as important foraging, stopover, and wintering areas for significant numbers of migrating waterfowl that utilize the Atlantic, Mississippi, and Central flyways (Figure 1). DWH NRDA Trustees (the Trustees) documented expansive avian and habitat injuries in association with the DWH oil spill within nearshore habitats.

1.2.4 Interior Marshes

Coastal interior marshes, including those within the DWH oil spill area, have historically supported high concentrations of birds throughout the year (Remsen et al., 2015). This is due, in part, to their highly productive nursery habitats that generate an expansive array of seasonal prey items (e.g., fish, shrimp, invertebrates). Similar to nearshore habitats, interior marshes are host to year-round resident bird species, including rails, soras, marsh passerines (e.g., seaside sparrows, marsh wrens), wading birds, shorebirds, and waterfowl. This habitat is also an important stopover habitat for migratory birds. The dynamic nature of this habitat throughout the northern GOM serves as important foraging, stopover, and wintering areas for significant numbers of migrating waterfowl that utilize the Atlantic, Mississippi, and Central flyways (Figure 1). The Trustees documented expansive oiling throughout northern GOM interior marsh habitats, especially in coastal Louisiana, where marsh habitat constitutes two-thirds of the state's coastline. Further, the Trustees assert that injury to and within this habitat caused impacts, both acute and chronic, to a significant number of resident or migratory birds (Wiebe et al., 2015).

1.3 Threats to Injured Bird Species

Bird species injured by the DWH oil spill face additional threats to reproduction and survival from both natural and human-caused sources where they breed, rest, and/or migrate. Although these species are varied and diverse, many of the threats they face are similar. For example, habitat loss and alteration together rank as one of the greatest threats to birds due to development, agriculture, and forestry practices. Other significant threats include predation from native and introduced predators, disease, declines in forage base, pollution, marine debris, human disturbance, artificial marine lighting, and climate change. Some species experience additional, unique threats at sea, such as fisheries bycatch and collisions with at-sea structures. These threats may be important at different geographic scales or locations. For example, species that nest outside of the northern GOM may face significant threats in their breeding grounds (e.g., the prairie pothole region, arctic breeding areas, remote island nesting areas).

Consideration of these threats, as well as identifying potential means for addressing or managing them, was the foundation of bird restoration approaches and techniques in the PDARP and are considered key components of this framework. This framework was developed using the standardized bird threats lexicon provided by Salafsky et al. (2008) to organize applicable primary threats faced by bird species injured by the DWH oil spill. The Trustees then developed a strategy to reduce threats such as these in target areas (see Module 4). This process is a well-supported strategy in conserving bird species (see Kushlan

et al., 2002; Schulte, 2016), and provides an effective means to help restore bird species injured by the DWH oil spill.

1.3.1 Habitat Loss and Alteration

Habitat loss and alteration together rank as one of the greatest threats to birds using the GOM. Habitat loss is extensive along the Gulf Coast and is related to numerous stressors, including human development, habitat modification, catastrophic weather, and sea level rise from factors associated with climate change and coastal subsidence. Across the GOM, ongoing conversion of vegetated and structured coastal and nearshore habitats to open water affects species that depend on those habitats. Anthropogenic impacts (e.g., river channelization, oil and gas activities, bulkheads, dredging, filling, residential development) have directly contributed to the loss of coastal habitats and limited their sustainability. The Trustees recognize that systemic issues exist which adversely affect these habitats (PDARP Section 5.5.2.2, DWH NRDA Trustees, 2016).

1.3.2 Human Development and Alteration

Human development and alteration across the Gulf Coast, along migratory routes and in non-GOM nesting areas, constitute a significant threat to quality habitat for bird species. Some examples include:

- Buildings and infrastructure development, including shoreline protection (e.g., sea walls, jetties; USFWS, 2016).
- Beach habitat alteration (e.g., removal of wrack or natural marine debris) that can impact bird forage, roosting habitat, and nest success (Flemming et al., 1988; Frid and Dill, 2002; Dugan et al., 2003; USFWS, 2016).
- Hydrology alterations, such as modifications (e.g., canals, levees, dredging) that destroy coastal wetland habitat and affect natural deposition and erosional processes (Turner, 1997).
- Coastal forested wetland loss: projections indicate a > 40% loss of this habitat over the next 50 years due primarily to saltwater intrusion and hydrology modification practices (Wilson et al., 2002).
- Loss of inland stopover habitats: extensive loss of marsh habitat used by migrating birds for foraging has occurred throughout the southeastern United States due to a variety of land management practices (e.g., precision land leveling, clearing, mowing emergent vegetation; Esslinger and Wilson, 2001; Hunter et al., 2006).
- Local habitat modification: regional wetland loss in the Prairie Pothole Region of the upper Midwestern United States and central Canada has ranged from 27% to > 90%, reducing the number of nesting waterbirds. Modifications of habitat characteristics in nesting areas, particularly vegetative structure, can significantly impact species-specific site selection, behavior, and nest success.

Huguenot royal tern colony.
Credit: Marc Rivadeneyra, FWC.

1.3.3 Catastrophic Weather

Catastrophic weather, such as hurricanes and tropical storms, are significant seasonal factors that have the potential to both create and destroy bird habitats within the GOM. The historical timing of these weather events (i.e., June 1 through November 30) coincides roughly with the bird nesting season, making their reproductive success especially vulnerable to major storm events. Strong winds alone can dislodge eggs and chicks from nests. Wind energy and atmospheric pressure generated from large storms create storm surge and extraordinary high tide events that can flood nests and chicks, especially species that nest on mainland beaches and the exterior of coastal islands (e.g., brown pelicans, terns, black skimmers). Depending on storm severity, this type of flooding can lead to large-scale reproductive loss for entire colonies. Storm surge also has the ability to substantially modify coastal habitat. For example, Hurricane Georges (1998) and Katrina (2005) caused massive erosion and abandonment of tern and brown pelican colonies in the Chandeleur Islands in Louisiana (Doran et al., 2009). In 2011, Wine Island in Terrebonne Bay, Louisiana, was overwashed by a storm event, causing colony abandonment by brown pelicans. The island became an underwater shoal a few months later due to Tropical Storm Lee.

1.3.4 Climate Change

Relationships between the survival of certain bird species and environmental variability are poorly understood (Weimerskirch, 2002); however, impacts associated with climate change have the potential to exacerbate many of the threats described in this module. Climate change-related impacts affecting birds include:

- Sea level rise, an occurrence that is exacerbating coastal habitat loss, specifically to marshes and low-lying beaches. Within Louisiana alone, approximately 1,900 square miles of land, including coastal wetlands, have been lost, in large part to physical (e.g., filling and draining) and climate (e.g., relative sea level rise) changes over the past 80 years (CPRA, 2012). Projections estimate that approximately 20% of coastal marsh in the Mississippi River Coastal Wetlands Initiative area will be lost over the next 50 years (Wilson and Esslinger, 2002). Results from the Sea Level Affecting Marshes Model and others have also concluded that wetlands will respond to climate change-induced sea level rise by

migrating landward or be lost (National Research Council, 1987; Moorhead and Brinson, 1995).

- Changes in the frequency and timing of freeze events may lead to shifts in habitat ranges. If there are fewer days with freezing temperatures in the northern GOM, mangrove habitats may expand northward, crowding out existing salt marsh habitat (Osland et al., 2017). This type of change may benefit some bird species while having negative impacts on others.
- Increased storm frequency, a global threat to marine and coastal habitats, including bird habitats and related foraging resources within the GOM (Rijnsdorp et al., 2009; Watson et al., 2015).
- Acidification, a process caused by increased carbon dioxide in sea water that reduces the ability of marine algae and free-swimming zooplankton to maintain protective shells. This process affects the survival of larval marine species, including commercial fish and shellfish (Rijnsdorp et al., 2009). This could have indirect yet profound consequences on birds that depend on larval fish for feeding young chicks. Long-term, indirect impacts of ocean acidification include interference with the formation of coralline keys where several shorebird and seabird species nest, which may be hindered by the disappearance of reef-building calcareous corals and algae (Wootton et al., 2008).
- Surface sea temperature change can affect forage fish distributions and composition, leading to reduced bird productivity and survival (Shields, 2002; Weimerskirch, 2002; Montevecchi et al., 2013).

1.3.5 Predation

While some level of natural predation is to be expected, unchecked predation has the potential to significantly limit population growth and/or lead to localized species extirpation. Several studies have identified predation to be the principal cause of nest failure and/or chick mortality among shorebirds (Davis et al., 2001; McGowan et al., 2005; Saalfeld et al., 2011) and wading bird species (Baker, 1940; Rodgers, 1987; Gonzalez, 1999; Kelly et al., 2007). Effects of introduced, non-native predators (e.g., rats, feral cats) on birds, particularly within breeding colonies, are especially well-documented (McChesney and Tershy, 1998; Towns et al., 2011). Some principal species of concern include raccoons (*Procyon lotor*), coyotes (*Canis latrans*), and non-native predators such as fire ants (*Solenopsis invicta*), feral house cats (*Felis catus*), Norway and roof rats (*Rattus norvegicus* and *R. rattus*), feral hogs (*Sus scrofa*), non-native red foxes (*Vulpes vulpes*), and free-ranging domestic dogs (*Canus lupus familiaris*). Effects from introduced predators are most significant on islands, where birds evolved with few or no natural terrestrial predators.

1.3.6 Declines in Forage Base

Relationships between forage base and bird fitness are well-documented. Within the northern GOM coast, for example, clapper rail preferentially use habitat based on the presence of emergent vegetation and fiddler crabs (Clark and Lewis, 1983; Rush et al., 2010a, 2010b), their primary prey item. Declines in specialized prey bases like these will directly impact bird species that rely on them. Several factors have been identified that significantly influence declines in localized prey availability, thereby directly impacting bird species: pollution (Krebs et al., 1974; Krebs, 1976; Krebs and Burns, 1977; Krebs and Valiela, 1978), food chain dynamics (Tasker et al., 2000), and the anthropogenic harvest of forage fish. Reduced prey availability can cause shifts in seabird diets and behavior, which can negatively affect breeding

success and survival (Montevecchi and Myers, 1995; Barrett and Krasnov, 1996; Tasker et al., 2000; Furness, 2003; Montevecchi et al., 2012).

1.3.7 Pollution

Pollution has the potential to substantially affect birds using the GOM. Fertilizers, oil, and wastewater produced during oil and gas activities, pesticides, metals, and industrial chemicals have added large nutrient and toxic burdens to marine waters, potentially affecting bird health and productivity (Kushlan and Hafner, 2000). Extensive field and laboratory research has documented a host of avian toxicological effects related to oil spills and other contaminant exposures (Blus et al., 1979; Stoneburner et al., 1980; Blus, 1982; Ohlendorf and Harrison, 1986; Votier et al., 2005; Mellink et al., 2009; Ziccardi, 2015; PDARP Section 4.7, DWH NRDA Trustees, 2016). However, limited seasonal demographic information, for pelagic seabirds in particular, results in uncertainty about exposure to and effects from chronic, non-point pollution sources (Dunnet et al., 1982). Avian prey items can also be directly affected by pollution, drastically reducing their populations (Krebs et al., 1974; Krebs, 1976; Krebs and Burns, 1977; Krebs and Valiela, 1978). Furthermore, after exposure and feeding in contaminated areas, fiddler crabs can concentrate certain toxicants and then transfer them through food webs as they are consumed as prey, exposing birds to the accumulated toxicants.

Oil spill events have the potential to not only directly affect adults, chicks, and eggs, but also cause long-lasting effects on nesting habitat. Oil from the DWH oil spill, for example, washed ashore on rookery islands in Barataria Bay, Louisiana, where the oil coated mangrove roots and substrate, killing vegetation, and exacerbating losses in vegetative cover (i.e., nesting habitat) and subsequent land loss.

1.3.8 Marine Debris

Negative effects to birds from entanglement in or ingestion of marine debris, such as discarded recreational fishing gear, are well-documented. Birds die from becoming entangled in hooks and monofilament fishing line, and ingesting lead fishing gear (e.g., sinkers, jigheads). Gulf bird species known to be affected include the brown pelican (Schreiber and Mock, 1988), common loon (*Gavia immer*), northern gannet (*Morus bassanus*), double-crested cormorant (*Phalacrocorax auritus*), and multiple species of terns and gulls (Laist, 1997; Franson et al., 2003; Hunter et al., 2006).

1.3.9 Human Disturbance

Human disturbance has been recognized as a substantial threat affecting nesting shorebirds (McGowan and Simons, 2006; Brown and Brindock, 2011), terns (Molina and Erwin, 2006; Elliot et al., 2007; Heath and Servello, 2008; Ratcliffe et al., 2008; Angulo-Gastelum et al., 2011; Ward et al., 2011), and wading birds (Carney and Sydeman, 1999; Stolen, 2003). Disturbance to these species negatively affects nesting behavior (Lafferty, 2001; Ruhlen et al., 2003; Hunter et al., 2006; Sabine et al., 2008; Wilson and Colwell, 2010; Rochelle et al., 2011) and overall fitness (Cornelius et al., 2001; Goss-Custard et al., 2006): for example, increased flushing leaves eggs and chicks vulnerable to predation or death from exposure to sun or rain. Collectively, these aspects have been attributed to localized population declines (Foster et al., 2009; Catry et al., 2011; Milton and Harding, 2011). Examples of human disturbance include vehicular traffic (e.g., automobiles, off-road vehicles), pedestrians, cyclists, horseback riders, and water recreationalists (e.g., anglers, personal watercraft, kite surfers).

1.3.10 Artificial Marine Lighting/Collision with At-Sea Structures

Millions of birds annually migrate across the GOM, primarily at night (Hebrard, 1971; Able, 1972; Gauthreaux, 1972, 1999). At-sea vessels, lighthouses, oil and gas platforms, and alternative energy production facilities (e.g., wind turbines, 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 (Poot et al., 2008), causing collision with structures and subsequent mortality, including species injured by the DWH oil spill (Evans Ogden, 1996; Wiese et al., 2001). Most collisions occur during inclement weather when birds may be either disoriented due to poor visibility, attracted to artificial lighting, or simply exhausted.

1.3.11 Fisheries Bycatch

Notable threats to seabirds include becoming fisheries bycatch, or the incidental injury or mortality in fisheries operations. Recent estimates of bycatch in fisheries in the southeastern United States were highest for great shearwaters (*Puffinus gravis*), gulls, northern gannets, and Wilson's storm-petrels (*Oceanites oceanicus*; National Marine Fisheries Service, 2011; Spiegel, 2012). Despite gaps in observer data, bycatch estimates for Atlantic fisheries indicate that an annual average of more than 4,000 seabirds are killed in fishery operations each year in the United States. Specifically, bycatch in submerged nets and pelagic longline fisheries is a significant source of mortality for a number of bird species (Hata, 2006). Other non-seabird species affected by the DWH oil spill, such as common loon, also incur annual mortality as bycatch in fisheries (Warden, 2010).

2. Distribution, Life History, and Habitat Information

The following sections discuss group, subgroup, and species-specific information about birds that use GOM habitats. For purposes of this framework, bird species with documented injury are organized into the following subgroups:

- Northern GOM Nesting Birds
  - Colonial Waterbirds
  - Solitary Beach Nesting Birds[3]
  - Marsh Birds
  - Ospreys
- Non-GOM Nesting Birds
  - Northern Nesting Birds
  - Northern Nesting Shorebirds
  - Prairie Pothole Nesting Species
  - Boreal Forest Nesting Species
  - Caribbean Nesting Species
  - Pelagic Birds.

3. Species within this group are primarily beach nesters, but may be found nesting in non-beach habitats.

Sections 2.1 and 2.2 below provide a brief discussion on biology, threats, and DWH impacts related to each group. Several high-quality resources are otherwise available for more detailed biological information about subgroups herein or their individual species, including:

- Birds of North America (requires a subscription): https://birdsna.org/Species-Account/bna/home
- The Cornell Lab of Ornithology: http://www.birds.cornell.edu/Page.aspx?pid = 1478
- PDARP and Final Programmatic Environmental Impact Statement (PEIS): http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan
- DWH Administrative Record: https://www.doi.gov/deepwaterhorizon/adminrecord (e.g., https://www.fws.gov/doiddata/dwh-ar-documents/788/DWH-AR0300053a.pdf).

2.1 Northern GOM Nesting Birds

The DWH oil spill occurred during the breeding and nesting season for many species of birds that nest in the northern GOM. The location and timing of this release impacted many species of birds that are collectively grouped and referred to as Northern GOM Nesting Birds. This large group is broken down into the following smaller subgroups: Colonial Nesting Birds (brown pelicans, wading birds, terns, and black skimmers), Solitary Beach Nesting Birds (plovers, American oystercatchers, and willets), Marsh Birds (rails, gallinules, pied-billed grebes), and Ospreys. This group of birds nests along the northern GOM from Texas to Florida, as well as other locations. This section describes the distribution, life history, habitat information, and threats for these bird subgroups that nest in the GOM.

2.1.1 Colonial Waterbirds

A substantial number of birds injured by the DWH oil spill nest in large aggregations, or colonies, within the GOM. These species are grouped here as Colonial Waterbirds. Species within this subgroup include wading birds (e.g., herons, egrets, ibises, spoonbills) and ground-nesting species (e.g., terns, gulls, brown pelicans, black skimmers).

Black skimmer colony flight.
Credit: Woody Woodrow.

2.1.1.1 Biology

The location and size of nesting Colonial Waterbird colonies have been shown to be directly dependent on key environmental factors such as the presence of predators, suitable nesting habitat, and adequate food availability (Duke and Kruczynski, 1992). Species within this

subgroup utilize a host of different substrates (e.g., trees, shrubs, bare rock, burrows, sandy beaches) in which to nest. In addition, ground nesters have also been shown to utilize opportunistic habitats as rookery sites (e.g., rooftops, gravel parking lots). Species within this subgroup are highly adapted in their ability to gather food resources in varied habitats (Terres, 1991). Colonial Waterbirds feed mostly on aquatic organisms. Species such as cormorants, gulls, terns, and pelicans feed in pelagic habitats by actively pursuing prey (generally fish) by plucking them from the surface or diving underwater. Shorebirds feed in open shoreline habitats, probing or actively capturing fish, frogs, aquatic insects, crustaceans, and other prey (Terres, 1991).

2.1.1.2 Threats

Habitat loss and alteration, predation, and human disturbance are the primary threats to Colonial Waterbirds in the GOM. Refer to Section 1.3 for more detail.

Reddish egret. Credit: James Leupold, USFWS.

2.1.1.3 DWH Impacts

Colonial Waterbirds represent one of the most broadly impacted subgroups associated with the DWH oil spill. Significant numbers of these birds (i.e., adults, juveniles, and chicks) were congregated at nesting colonies during the DWH oil spill. Several species nest on coastal islands over flooded wetlands in trees and shrubs, and forage in adjacent shallow waters. These behaviors made them vulnerable to significant and repeated oiling events and associated response activities (e.g., booming around colonies, beach cleanup) within and adjacent to colonies. Collectively, these conditions caused extensive habitat degradation and disturbance, and aggressively accelerated ongoing erosion processes, all of which caused an extensive number of nest losses. These factors likely combined to cause species in this subgroup to incur some of the highest quantified mortality estimates. Bird injury was principally documented through surveys taken from colony perimeters to limit additional disturbance. The Trustees recognize that these access restrictions limited their ability to more fully characterize the extent of the true avian injury (PDARP Sections 4.2 and 4.7.5, DWH NRDA Trustees, 2016).

2.1.2 Solitary Beach Nesting Birds

The Gulf Coast is an important breeding area for Solitary Beach Nesting Birds. Species in this subgroup, such as Wilson’s plovers, snowy plovers, American oystercatchers, and willets

(*Tringa semipalmata*), do not nest in groups or colonies. Pairs prefer to nest alone, away from other nesting birds.

2.1.2.1 Biology

Solitary Beach Nesting Birds can be found in a variety of coastal habitats, including sand or shell beaches, dunes, saltmarshes, marsh islands, mudflats, and dredge spoil islands made of sand or gravel. Species in this subgroup are attracted to and rely upon stochastic disturbances (e.g., hurricanes) to develop productive habitats (e.g., overwash deposits and pools, shell and wrack deposition, inlet shorelines, spits and swash bars) to support their foraging and nesting activities (Convertino et al., 2011). These species forage for invertebrates in shallow water habitats or on wet sand or mud. Solitary Beach Nesting Birds nest on the ground, typically in shallow depressions scraped into the sand in the supratidal zone. Nests may also be associated with clumps of vegetation on the beach, along the shoreline of marshes or lakes, or near sand dunes.

Wilson's plover. Credit: iStockphoto.com.

2.1.2.2 Threats

Much of the shoreline along the northern GOM consists of sandy beach with the potential to provide services to Solitary Beach Nesting Birds. As a highly dynamic system, the shoreline is continuously affected by seasonal erosion patterns, winds, storms, and pulse events such as hurricanes and tropical storms. Habitat loss and alteration, predation, and human disturbance are the primary threats to Solitary Beach Nesting Birds in the GOM. Refer to Section 1.3 for more detail.

2.1.2.3 DWH Impacts

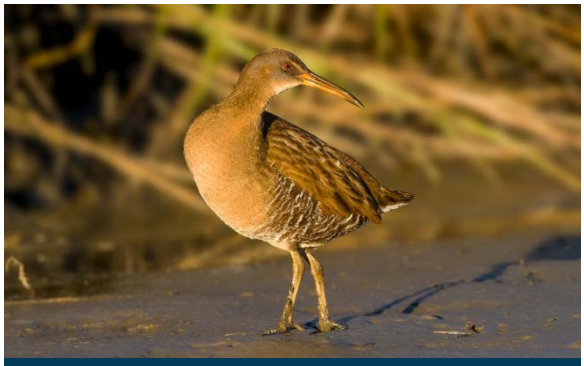
Oil was present in areas where Solitary Beach Nesting Birds nest or forage, including on beaches, in marsh waters, on marsh surfaces, and in other coastal habitats (PDARP Section 4.2, DWH NRDA Trustees, 2016). Species in this subgroup were exposed to oil in multiple ways, including physical contact with oil in the environment and/or ingestion of external oil during preening or while foraging; and consuming contaminated prey, water, or sediment (PDARP Section 4.2, DWH NRDA Trustees, 2016).

2.1.3 Marsh Birds

Marsh Birds include northern GOM residents that nest and forage predominantly in coastal salt or freshwater marshes. Species in this subgroup include both salt marsh birds [e.g., clapper rails, boat-tailed grackles (*Quiscalus major*), red-winged blackbirds (*Agelaius phoeniceus*), seaside sparrows] and freshwater marsh birds (e.g., pied-billed grebe, mottled duck, least bitterns). These species are considered habitat quality indicators for a suite of wetland functions, specifically contaminant exposure (Cumbee et al., 2008) and saltmarsh health (Novak et al., 2006).

2.1.3.1 Biology

Marsh Birds are generally secretive, cryptically colored, and associated with freshwater and saltwater wetlands. Because these wetlands are diverse, consisting of a mosaic of open water and emergent vegetation, foraging and nesting strategies are also diverse. Nests are built out of emergent or submerged vegetation at a sufficient elevation to avoid flooding. Some species in this subgroup, such as clapper rails, build a nesting platform under a deep cover of emergent vegetation and marsh grasses. Other species, like the black-necked stilt (*Himantopus mexicanus*), build a scrape lined with marsh grass in a dense vegetative cover. Foraging strategies for these species include wading and surface feeding on plants or invertebrates or diving underwater for submerged vegetation, fish, and crustaceans.



Clapper rail. Credit: Mike Gray.

2.1.3.2 Threats

Habitat loss and alteration, predation, declines in forage base, pollution, and human disturbance are the primary threats to Marsh Birds in the GOM. Refer to Section 1.3 for more detail.

2.1.3.3 DWH Impacts

Marsh Birds injured by the DWH oil spill include species that specialize in saltwater and freshwater marsh habitats. Species in this subgroup were exposed to oil through physical contact with oil in the environment; ingestion of external oil during preening; and while foraging and consuming contaminated prey, water, or sediment. Marsh habitats, which provide year-round resources (e.g., nesting habitat, foraging habitat, other services) for resident and migratory bird species, experienced prolonged and geographically expansive oiling and response injury from the DWH oil spill. Collectively, these impacts accelerated existing deleterious coastal processes (e.g., erosion, subsidence, land loss), further impacting Marsh

Birds. Given the magnitude of the DWH oil spill, both acute and chronic injuries to this subgroup had the potential to be significant and long-lasting. Though limited in field injury information, the Trustees utilized available information (e.g., oiling maps, marsh bird life history, response and pre-assessment information) to generate potential injury estimates for Marsh Birds beyond documented injury (Wiebe et al., 2015; PDARP Sections 4.2 and 4.7.5, DWH NRDA Trustees, 2016).

2.1.4 Ospreys

The northern GOM supports three classifications of Ospreys (*Pandion haliaetus*): (1) summer residents that breed in the GOM and winter in South America, (2) winter residents that breed in more northern areas, and (3) transient birds that stage in the northern GOM during migration (Bierregaard et al., 2016).

2.1.4.1 Biology

Ospreys are apex predators in coastal areas (e.g., shorelines, open marshes) throughout the northern GOM. Unlike other raptors that primarily nest in trees, forested habitat is not a limiting factor for this species. Ospreys have adapted to a changing landscape and now nest in any type of elevated, manmade structure in the vicinity of fresh, estuarine, and marine water bodies (Bierregaard et al., 2016). Ospreys feed predominantly on live fish captured within the upper meter of the water column.

Osprey. Credit: istockphoto.com.

2.1.4.2 Threats

Habitat loss and alteration, predation, declines in forage base, and pollution are the primary threats to Ospreys in the GOM. Refer to Section 1.3 for more detail.

2.1.4.3 DWH Impacts

The Trustees documented oiling exposure within several Osprey nests throughout the GOM. Ospreys were likely exposed to oil during open-feeding activities, either directly through contact with oil on surface water; or indirectly by consuming contaminated prey, water, or sediment (PDARP Section 4.2, DWH NRDA Trustees, 2016).

2.2 Non-GOM Nesting Birds

A number of bird species injured by the DWH oil spill do not breed within the GOM. These species, grouped here as Non-GOM Nesting Birds, include a diversity of species including shorebirds, gulls, seabirds, rails, terns, waterfowl, loons, grebes, pelagic birds, and Caribbean nesting species. In addition, while a small number of American white pelicans (*Pelecanus erythrorhynchos*) nest on the Texas coast and in Mexico, the majority of the North American population that winters in the GOM nests in the Midwestern United States. Because of the diversity in life histories, threats, and migratory routes, these species were grouped even further into subgroups based on common breeding areas to help maximize efficiencies in restoration planning and implementation.

2.2.1 Biology

2.2.1.1 Northern Nesting Birds

This subgroup includes five bird species that winter in the northern GOM, but nest farther north in the United States and Canada. The injury incurred by these species during the DWH oil spill, the specialized needs of these species, and the endangered species status of the piping plover justify additional consideration compared with the other bird subgroups. Species-specific information is provided below.

Northern gannet.
Credit: William Montevecchi.

Piping plovers

Piping plovers nest in distinct and separate population units along the Northeast U.S. Coast, the upper Midwestern United States, and Central Canada. The different populations of piping plover are federally listed as threatened (Atlantic Coast and northern Great Plains) and endangered (Great Lakes) under the Endangered Species Act [16 U.S.C. §§ 1531–44(2015)]. The GOM is vital wintering habitat for this species; at least 70% of all piping plovers winter along the Gulf Coast. In 2001, the U.S. Fish and Wildlife Service designated critical habitat for

wintering piping plover in target coastal areas, including coastal Texas, Louisiana, Mississippi, Alabama, and Florida (designations in Texas were revised in 2009).

Northern gannets

Northern gannets breed at only six colonies in North America, all of which are in Eastern Canada. However, the GOM is an important wintering area: 25% of North America's northern gannet population forages in the GOM during the winter, and immature and juvenile gannets remain in the GOM for most of the year (Nettleship and Chapdelaine, 1988; Montevecchi et al., 2011).

Common loons

Common loons nest in the northern Unites States (e.g., Minnesota, Wisconsin, Maine, Alaska) and Canada, primarily on lakes in coniferous forests. Recent migration data identify the GOM as the primary wintering area for common loons within the Mississippi Flyway. The Eastern Seaboard also appears to serve as important migratory and wintering habitats, especially for juveniles initially reared in the Central United States.

American white pelicans and double-crested cormorants

American white pelicans occur mainly in western and southern portions of North America, breeding inland in colonies on remote islands (including specific islands in the Upper Mississippi River, and specific locations in Canada, Utah, Montana, Texas, and Mexico). White pelicans winter along warm southern coasts (Knopf and Evans, 2004) – the northern GOM, particularly Louisiana and Mississippi delta regions are some of the most important wintering areas in North America (King and Michot, 2002) – and are commonly seen at foraging and loafing sites. Similar to other colonial breeding birds, white pelicans are sensitive to disturbance in nesting colonies, and may desert or leave eggs and young exposed to predators if approached (Knopf and Evans, 2004).

Double-crested cormorants are a long-lived, colonial-nesting waterbird native to North America. Cormorants are opportunistic feeders that prey on a wide diversity of fish species (USFWS, 2003). This species nests in the northern United States and Canada primarily in bushes or trees along fresh or brackish tidal waters, protected estuaries, lakes, ponds, rivers, or on coastal islands. American white pelicans and double-crested cormorants often nest together in the same location.

2.2.1.2 Northern Nesting Shorebirds

Species in this subgroup, such as sanderlings (*Calidris alba*), dunlins (*Calidris alpine*), and ruddy turnstones (*Arenaria interpres*), primarily breed in Northern and Central Canada or northern Alaska and winter in the GOM. Wintering and migrating shorebirds use GOM sandy beaches for loafing, roosting, and foraging. These species use a variety of nearshore habitats, primarily sandy beaches, but also mudflats, lagoons, and man-made rock jetties. Species of this subgroup probe the sand with their bills, feeding mainly on aquatic and terrestrial invertebrates (Macwhirter et al., 2002).

2.2.1.3 Prairie Pothole Nesting Species

This subgroup consists of nine species that nest across several ecological regions, but primarily in wetland areas (e.g., freshwater prairie wetlands, lakes, rivers) in the Prairie Pothole Region of the upper Midwestern United States and Canada. This subgroup includes the American coots (*Fulica americana*), black terns (*Chlidonias niger*), mallards (*Anas platyrhynchos*), and blue-winged teals (*Anas discors*). This region was once part of the largest grassland-wetland ecosystems on the Earth, consisting of over seven million acres of wetlands supporting nesting and migratory waterbirds. A number of anthropogenic activities, namely conversion of grassland and wetland to row crop agriculture, have drastically reduced the availability of these habitats (Ringelman et al., 2005).

2.2.1.4 Boreal Forest Nesting Species

Boreal forest nesting species consist of five bird species: surf scoters (*Melanitta perspicillata*), buffleheads (*Bucephala albeola*), green-winged teals (*Anas carolinensis*), red-breasted mergansers (*Mergus serrator*), and lesser scaups (*Aythya affinis*). Species of this subgroup that were injured by the DWH oil spill breed predominantly in the Canadian western boreal forest region and migrate to the GOM to winter. Surf scoters incurred the highest estimated losses of this subgroup.

2.2.1.5 Caribbean Nesting Species

This subgroup includes several types of seabirds, including shearwaters, terns, frigatebirds, boobies, tropicbirds, and noddys. Caribbean nesting species forage in the GOM, but their closest breeding grounds are located in the Florida Keys, the Dry Tortugas, or the Caribbean. These birds typically nest on cliffs or beneath the slopes or flat interiors of islands. Many prefer to nest on offshore islands, away from large land masses, and generally occur at moderate to relatively low densities. Caribbean nesting species normally feed at sea great distances from breeding colonies and typically produce just one slow-growing chick per year (Schreiber and Lee, 2000; Weimerskirch, 2002). The combined result is that seabirds are more vulnerable to environmental stressors on their breeding sites than many land birds. Audubon's shearwater comprises approximately 61% of the total quantified losses to this group.

2.2.1.6 Pelagic Birds

Bird species within this subgroup are pelagic, which means they spend most or all of their time in the GOM in open water (i.e., vs. loafing or roosting on land) feeding in flight on fish and zooplankton. Like other Non-GOM Nesting Birds, this subgroup represents a wide range of life histories with the unifying factor being that they are typically pelagic and nest outside of the GOM. Species in this subgroup are highly migratory and breed in areas more removed from the GOM compared to other subgroups, including Western Europe, remote islands in the Eastern and Southern Atlantic, or remote islands in the Pacific. Therefore, nesting areas, nesting habitats, and migratory routes vary.

American coot flock. Credit: USFWS.

2.2.2 Threats

This section discusses primary threats of subgroups within the Non-GOM Nesting Birds group. Refer to Section 1.3 for more detail regarding threat descriptions.

2.2.2.1 Northern Nesting Birds

Piping plovers

Habitat loss and alteration, predation, human disturbance, and declines in forage base are the primary threats to piping plovers on breeding grounds and in the GOM. Significant causes of habitat loss include human development, shoreline stabilization, modifications to river and wetland hydrology, local habitat modification, vegetation encroachment, disturbance by humans and pets, predation, and catastrophic weather. Beach nourishment may also be a short-term threat, as invertebrate populations can be reduced following this type of action.

Northern gannets

Because of their limited number, threats to North American gannet colonies constitute significant potential impacts to the species. Declines in forage fish near nesting colonies, driven in part by overfishing and changing sea surface temperatures, have been identified as significant threats of concern. Other primary threats include bycatch and collision with at-sea vessels, lighthouses, oil and gas platforms, and alternative energy production facilities.

Common loons

Habitat loss and alteration and human disturbance in nesting areas are primary threats to common loons. Other primary threats include human disturbance (particularly from water-based recreational activities), toxicosis from ingested lead fishing equipment (e.g., sinkers, jigheads), and becoming bycatch during commercial fishing operations in nesting, migratory, and wintering areas.

American white pelicans and double-crested cormorants

Habitat loss and alteration, human disturbance, and predation on breeding grounds are the primary threats to American white pelicans and double-crested cormorants that winter in the GOM.

2.2.2.2 Northern Nesting Shorebirds, Prairie Pothole Nesting Species, and Boreal Forest Nesting Species

Habitat loss, alteration, and human disturbance on breeding grounds are the primary threats to species in these three subgroups that winter in the GOM.

2.2.2.3 Caribbean Nesting Species and Pelagic Birds

Habitat loss and alteration, predation, declines in forage base, marine debris, human disturbance, artificial marine lighting/collision with at-sea structures, and fisheries bycatch are the primary threats to species in these two subgroups on breeding grounds and in the GOM.

2.2.3 DWH Impacts

Species in the Non-GOM Nesting Birds group use a wide range of GOM habitats for non-nesting activities, including beach, shoreline, marsh, offshore, and open water areas, all of which were affected by the DWH oil spill. Thus, species of this group incurred a wide range of injuries and some of the highest quantified mortality estimates. These species were exposed to oil in several ways, including physical contact with oil in the environment; ingestion of external oil during preening; and ingestion of oil while foraging and consuming contaminated prey, water, or sediment (PDARP Section 4.2, DWH NRDA Trustees, 2016).

Brown pelican. Credit: Janell Brush.

References

Able, K.P. 1972. Fall migration in coastal Louisiana and the evolution of migration patterns in the Gulf Region. *The Wilson Bulletin* 84:231–242.

Angulo-Gastelum, U.T., J.A. Castillo-Guerrero, and E. Mellink. 2011. Breeding ecology of the royal tern (*Thalasseus maximus*) at Isla El Rancho, Mexico: Colony size and nest location affect predation. *Ornitologia Neotropical* 22:131–142.

Baker, R.A. 1940. Crow depredation on heron nesting colonies. *Wilson Bulletin* 52:124–125.

Baker, T.D. 2015. *Deepwater Horizon* NRDA Technical Memorandum: Impacts to Southeast Louisiana Coastal Bird Colonies from the 2010 *Deepwater Horizon* Oil Spill Technical Report.

Barrett, RAT. and Y.V. Krasnov. 1996. Recent responses to changes in stocks of prey species by seabirds breeding in the southern Barents Sea. *Ices Journal of Marine Science* 53:713–722.

Bierregaard, R.O., A.F. Poole, M.S. Martell, P. Pyle and M.A. Patten. 2016. Osprey (*Pandion haliaetus*). *The Birds of North America*, P.G. Rodewald (ed.). Cornell Lab of Ornithology, Ithaca, NY. Available: https://birdsna.org/Species-Account/bna/species/osprey.

Blus, L., E. Cromartie, L. McNease, and T. Joanen. 1979. Brown pelican: Population status, reproductive success, and organochlorine residues in Louisiana, 1971–1976. *Bulletin of Environmental Contamination and Toxicology* 22:128–135.

Blus, L.J. 1982. Further interpretation of the relation of organochlorine residues in brown pelican eggs to reproductive success. *Environmental Pollution Series A, Ecological and Biological* 28:15–33.

Brown, A.C. and K. Brindock. 2011. Breeding success and nest site selection by a Caribbean population of Wilson's plovers. *Wilson Journal of Ornithology* 123:814–819.

Carney, K.M. and W.J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. *Waterbirds* 22:68–79.

Catry, T., J.A. Alves, J. Andrade, H. Costa, M.P. Dias, P. Fernandes, A. Leal, P.M. Lourenco, R.C. Martins, F. Moniz, S. Pardal, A. Rocha, C.D. Santos, V. Encarnaca, and J.P. Granadeiro. 2011. Long-term declines of wader populations at the Tagus Estuary, Portugal: A response to global or local factors? *Bird Conservation International* 21:438–453.

Clark, J.D. and J.C. Lewis. 1983. A validity test of a habitat suitability index model for clapper rail. *Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies* 37:95–102.

Convertino, M., J.B. Elsner, R. Munoz-Carpena, G.A. Kiker, C.J. Martinez, R.A. Fischer, and I. Linkov. 2011. Do tropical cyclones shape shorebird habitat patterns? Biogeoclimatology of snowy plovers in Florida. *Plos One* 6.

Cornelius, C., S.A. Navarette, and P.A. Marquet. 2001. Effects of human activity on the structure of coastal marine bird assemblages in central Chile. *Conservation Biology* 15:1396–1404.

CPRA. 2012. Louisiana's Comprehensive Master Plan for a Sustainable Coast. Coastal Protection and Restoration Authority of Louisiana, Baton Rouge, LA.

Cumbee Jr., J.C., K.F. Gaines, G.L. Mills, N. Garvin, W.L. Stephens Jr., J.M. Novak, and I.L. Brisbin Jr. 2008. Clapper rails as indicators of mercury and PCB bioavailability in a Georgia saltmarsh system. *Ecotoxicology* 17(6):485–494.

Davis, M.B., T.R. Simons, M.J. Groom, J.L. Weaver, and J.R. Cordes. 2001. The breeding status of the American oystercatcher on the East Coast of North America and breeding status in North Carolina. *Waterbirds* 24:195–202.

Davis, R.W., W.E. Evans, and B. Würsig. 2000. Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Vol. II: Technical Report. OCS Study MMS 2000-003; USGS/BRD/CR-1999-0006. U.S. Geological Survey, Biological Resources Division, & Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Doran, K.S., H.F. Stockdon, N.G. Plant, A.H. Sallenger, K.K. Guy, and K.A. Serafin. 2009. Hurricane Gustav: Observations of Coastal Change. U.S. Geological Survey Open-File Report 2009-1279. Reston, VA.

Dugan, J.E., D.M. Hubbard, M.D. McCrary, and M.O. Pierson. 2003. The response of macrofauna communities and shorebirds to macrophyte wrack subsidies on exposed sandy beaches of southern California. *Estuarine Coastal and Shelf Science* 58:25–40.

Duke, T.W. and W.L. Kruczynski (eds.). 1992. *Status and Trends of Emergent and Submerged Vegetated Habitats of the Gulf of Mexico*. Gulf of Mexico Program, U.S. Environmental Protection Agency, Stennis Space Center, MS.

Dunnet, G.M., D.J. Crisp, G. Conan, and W.R.P. Bourne. 1982. Oil pollution and seabird populations (and discussion). *Philosophical Transactions of the Royal Society* 297:413–427.

DWH NRDA Trustees. 2016. *Deepwater Horizon* Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement. *Deepwater Horizon* Natural Resource Damage Assessment Trustees. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

Elliot, M.L., R. Hurt, and W.J. Sydeman. 2007. Breeding biology and status of the California least tern *Sterna antillarum browni* at Alameda Point, San Francisco Bay, California. *Waterbirds* 30:317–325.

Esslinger, C.G. and B.C. Wilson. 2001. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Chenier Plain Initiative. Revised 2003. Albuquerque, NM.

Evans Ogden, L.J. 1996. Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds. ResearchGate. Available: https://www.researchgate.net/publication/265157017_Collision_Course_The_Hazards_of_Lighted_Structures_and_Windows_to_Migrating_Birds.

Flemming, S.P., R.D. Chasson, P.C. Smith, and P.J. Austin-Smith. 1988. Piping plover status in Nova Scotia related to its reproductive and behavioural responses to human disturbance. *Journal of Field Ornithology* 61:310–319.

Foster, C.R., A.F. Amos, and L.A. Fuiman. 2009. Trends in abundance of coastal birds and human activity on a Texas barrier island over three decades. *Estuaries and Coasts* 32:1079–1089.

Franson, J.C., S.P. Hansen, T.E. Creekmore, C.J. Brand, D.C. Evers, A.E. Duerr, and S. DeStefano. 2003. Lead fishing weights and other fishing tackle in selected waterbirds. *Waterbirds* 26:345–352.

Frid, A. and L. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. *Conservation Ecology* 6:11.

Furness, R.W. 2003. Impacts of fisheries on seabird communities. *Scientia Marina* 67:33–45.

Gauthreaux Jr., S.A. 1972. Behavioral responses of migrating birds to daylight and darkness: A radar and direct visual study. *The Wilson Bulletin* 84:136–148.

Gauthreaux Jr., S.A. 1999. Neotropical migrants and the Gulf of Mexico: The view from aloft. In *Gatherings of Angels: Migrating Birds and their Ecology*, K.P. Able (ed.). Cornell University, Ithaca, NY. pp. 27–44.

Gonzalez, J.A. 1999. Nesting success in two wood stork colonies in Venezuela. *Journal of Field Ornithology* 70.

Goss-Custard, J.D., P. Triplet, F. Sueur, and A.D. West. 2006. Critical thresholds of disturbance by people and raptors in foraging wading birds. *Biological Conservation* 127:88–97.

Haney, J.C. 1986. Seabird patchiness in tropical oceanic waters: The influence of Sargassum "reefs." *The Auk* 103:141–151.

Hata, D.N. 2006. Incidental Captures of Seabirds in the U.S. Atlantic Pelagic Longline Fishery, 1986–2005. Report to NOAA Fisheries Service Southeast Fisheries Science Center, Miami, FL.

Heath, S.R. and F.A. Servello. 2008. Effects of predation and food provisioning on black tern chick survival. *Wilson Journal of Ornithology* 120:167–175.

Hebrard, J.J. 1971. The nightly initiation of passerine migration in spring: A direct visual study. *Ibis* 113:8–18.

Hunter, W.C., W. Golder, S. Melvin, and J. Wheeler. 2006. Southeast United States Regional Waterbird Conservation Plan. U.S. Fish and Wildlife Service, Atlanta, GA.

Kelly, J.P., K. Etienne, C. Strong, and M. McCaustland. 2007. Status, trends, and implications for the conservation of heron and egret nesting colonies in the San Francisco Bay area. *Waterbirds* 30:455–478.

King, D.T. and T.C. Michot. 2002. Distribution, abundance and habitat use of American White Pelicans in the Delta Region of Mississippi and along the Western Gulf of Mexico Coast. *Waterbirds* 25(4):410–416. Available: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1505&context=icwdm_usdanwrc.

Knopf, F.L. and R.M. Evans. 2004. American white pelican (*Pelecanus erythrorhynchos*). *The Birds of North America*, P.G. Rodewald (ed.). Cornell Lab of Ornithology, Ithaca, NY. Available: https://birdsna.org/Species-Account/bna/species/amwpel.

Krebs, C.T. 1976. Population Dynamics and Energetics of the Fiddler Crab *Uca pugnax* and the Effect of Contamination with Chlorinated Hydrocarbons from Sewage. PhD thesis, Boston University.

Krebs, C.T. and I. Valiela. 1978. Effect of experimentally applied chlorinated hydrocarbons on the biomass of the fiddler crab, *Uca pugnax* (Smith). *Estuarine and Coastal Marine Science* 6:375–386.

Krebs, C.T. and K.A. Burns. 1977. Long-term effects of an oil spill on populations of the salt-marsh crab *Uca pugnax*. *Science* 197:484–487.

Krebs, C.T., I. Valiela, G.R. Harvey, and J.R. Teal. 1974. Reduction in field populations of fiddler crabs by the uptake of chlorinated hydrocarbons. *Marine Pollution Bulletin* 5:140–142.

Kushlan, J.A. and H. Hafner. 2000. *Heron Conservation.* Academic Press, London, UK.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. *Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1.* Waterbird Conservation for the Americas, Washington, DC.

Lafferty, K.D. 2001. Disturbance to wintering western snowy plover. *Biological Conservation* 101:785–792.

Laist, D.W. 1997. Impacts of marine debris: Entanglement of marine life in marine debris including a comprehensive list of species with entanglement and ingestion records. In *Marine Debris: Sources, Impacts, and Solutions*, J.M. Coe and D.B. Rogers (eds.). Springer, NY. pp. 99–139.

Macwhirter, R.B., P. Austin-Smith Jr., and D.E. Kroodsma. 2002. Sanderling (*Calidris alba*). *The Birds of North America*, P.G. Rodewald (ed.). Cornell Lab of Ornithology, Ithaca, NY. Available: https://birdsna.org/Species-Account/bna/species/sander.

McChesney, G.J. and B.R. Tershy. 1998. History and status of introduced mammals and impacts to breeding seabirds on the California channel and northwestern Baja California islands. *Colonial Waterbirds* 21:335–347.

McGowan, C.P. and T.R. Simons. 2006. Effects of human recreation on the incubation behavior of American oystercatchers. *Wilson Journal of Ornithology* 118:485–493.

McGowan, C.P., T.R. Simons, W. Golder, and J. Cordes. 2005. A comparison of American oystercatcher reproductive success on barrier beach and river island habitats in coastal North Carolina. *Waterbirds* 28:150–155.

Mellink, E., M.E. Riojas-López, and J. Luévano-Esparza. 2009. Organchlorine content and shell thickness in brown booby (*Sula leucogaster*) eggs in the Gulf of California and the southern Pacific Coast of Mexico. *Environmental Pollution* 157:2184–2188.

Milton, D.A. and S.B. Harding. 2011. Death by a thousand cuts – the incremental loss of coastal high tide roosts for shorebirds in Australia: Sandfly Creek Environmental Reserve, central Queensland. *Stilt* 60:22–33.

Molina, K.C. and R.M. Erwin. 2006. The distribution and conservation status of the gull-billed tern (*Gelochelidon nilotica*) in North America. *Waterbirds* 29:271–295.

Montevecchi, W.A. and R.A. Myers. 1995. Prey harvests of seabirds reflect pelagic fish and squid abundance on multiple spatial and temporal scales. *Marine Ecology-Progress Series* 117:1–9.

Montevecchi, W.A., D. Fifield, C. Burke, S. Garthe, A. Hedd, J.-F. Rail, and G.J. Robertson. 2011. Tracking long-distance migration to assess marine pollution impact. *Biology Letters* 8:218–221.

Montevecchi, W.A., A. Hedd, L.A. McFarlane Tranquilla, D.A. Fifield, C.M. Burke, P.M. Regular, G.K. Davoren, S. Garthe, A.J. Gaston, G.J. Robertson, and R.A. Phillips. 2012. Tracking seabirds to identify ecologically important and high risk marine areas in the western North Atlantic. *Biological Conservation* 156:62–71.

Montevecchi, W.A., J.W. Chardine, J.F. Rail, S. Garthe, D. Pelletier, P.M. Regular, C. Burke, A. Hedd, L.M. Tranquilla, S. Bennett, C. Mooney, K. Power, T. Power, H. Hogan, P.-Y. Daoust, J. Lawson, L. Rogers, S.I. Wilhelm, M. Montevecchi, and A. Lang. 2013. Extreme event in a changing ocean climate: Warm-water perturbation of 2012 influences breeding gannets and other marine animals in the northwest Atlantic and Gulf of St. Lawrence. *The Osprey* 44:14–19.

Moorhead, K.K. and M.M. Brinson. 1995. Response of wetlands to rising sea level in the lower coastal plain of North Carolina. *Ecological Applications* 5:261–271.

National Marine Fisheries Service. 2011. U.S. National Bycatch Report. U.S. Department of Commerce.

National Research Council. 1987. Responding to Changes in Sea Level – Engineering Implications. Committee on Engineering Implications of Changes in Relative Mean Sea Level, Marine Board, Commission on Engineering and Technical Systems, Washington, DC.

Nettleship, D.N. and G. Chapdelaine. 1988. Population size and status of the northern gannet *Sula bassanus* in North America. *Journal of Field Ornithology* 59:120–127.

Novak, J.N., K.F. Gaines, J.C. Cumbee Jr., G.L. Mills, A. Rodriguez-Navarro, and C.S. Romanek. 2006. The clapper rail as an indicator species of estuarine marsh health. *Studies in Avian Biology* 270.

Ohlendorf, H.M. and C.S. Harrison. 1986. Mercury, selenium, cadmium and organochlorines in eggs of three Hawaiian seabird species. *Environmental Pollution Series B, Chemical and Physical* 11:169–191.

Osland, M.J., R.H. Day, C.T. Hall, M.D. Brumfield, J.L. Dugas, and W.R. Jones. 2017. Mangrove expansion and contraction at a poleward range limit: Climate extremes and land-ocean temperature gradients. *Ecology* 98(1):125–137.

Poot, H., B.J. Ens., H. de Vries, M.A.H. Donners, M.R. Wernand, and J.M. Marquenie. 2008. Green light for nocturnally migrating birds. *Ecology and Society* 13:47.

Ratcliffe, N., S. Schmitt, A. Mayo, J. Tratalos, and A. Drewitt. 2008. Colony habitat selection by little terns *Sternula albifrons* in East Anglia: Implications for coastal management. *Seabird* 21:55–63.

Remsen Jr., J.V., M.J. Seymour, D.T. Baker, D. O'Malley, and B.P. Wallace. 2015. *Deepwater Horizon* NRDA Technical Memorandum: The Regional, National, and International Importance of Louisiana's Coastal Avifauna.

Ribic, C.A., R. Davis, N. Hess, and D. Peake. 1997. Distribution of seabirds in the northern Gulf of Mexico in relation to mesoscale features: Initial observations. *ICES Journal of Marine Science* 54:545–551.

Rijnsdorp, A.D., M.A. Peck, G.H. Engelhard, C. Möllmann, and J.K. Pinnegar. 2009. Resolving the effect of climate change on fish populations. *ICES Journal of Marine Science: Journal du Conseil* 66:1570–1583.

Ringelman, J.K., R.E. Reynolds, and R.R. Johnson. 2005. Prairie Pothole Joint Venture – 2005 Implementation Plan: Section II – Waterfowl Plan. Available: http://ppjv.org/assets/pdf/2005_Implementation_Plan_Upfront.pdf.

Rochelle, S., C. Pickering, and J.G. Castley. 2011. A review of the impacts of nature based recreation on birds. *Journal of Environmental Management* 92:2287–2294.

Rodgers Jr., J.A. 1987. On the antipredator advantages of coloniality: A word of caution. *Wilson Bulletin* 99:269–271.

Ruhlen, T.D., S. Abbott, L.E. Stenzel, and G.W. Page. 2003. Evidence that human disturbance reduces snowy plover chick survival. *Journal of Field Ornithology* 74:300–304.

Rush, S.A., R. Mordecai, M.S. Woodrey, and R.J. Cooper. 2010a. Prey and habitat influences the movement of clapper rails in northern Gulf Coast estuaries. *Waterbirds* 33:389–396.

Rush, S.A., J.A. Olin, A.T. Fisk, M.S. Woodrey, and R.J. Cooper. 2010b. Trophic relationships of a marsh bird differ between Gulf Coast estuaries. *Estuaries and Coasts* 33:963–970.

Saalfeld, S.T., W.C. Conway, D.A. Haukos, and W.P. Johnson. 2011. Nest success of snowy plovers (*Charadrius nivosus*) in the southern high plains of Texas. *Waterbirds* 34:389–399.

Sabine III, J.B., M.J. Meyers, C.A. Moore, and S.H. Schweitzer. 2008. Effects of human activity on behavior of breeding American oystercatchers, Cumberland Island National Seashore, Georgia, USA. *Waterbirds* 31:70–82.

Salafsky, N., D. Salzer, A.J. Stattersfield, C. Hilton-Taylor, R. Neugarten, S.H.M. Butchart, B. Collen, N. Cox, L.L. Master, S. O'Connor, and D. Wilkie. 2008. A standard lexicon for biodiversity conservation: Unified classifications of threats and actions. *Conservation Biology* 22:897–911.

Schreiber, E.A. and D.S. Lee. 2000. West Indian seabirds, a disappearing natural resource. *Status and Conservation of West Indian Seabirds Special Publication No.* 1:1–10.

Schreiber, R.W. and P.J. Mock. 1988. Eastern brown pelicans: What does 60 years of banding tell us? *Journal of Field Ornithology* 59:171–182.

Schulte, S. 2016. Florida Beach-Nesting Bird Plan. Draft. Manomet, Plymouth, MA.

Shields, M. 2002. Brown pelican (*Pelecanus occidentalis*). In *Florida Beach-Nesting Bird Plan.* The Birds of North America, Inc., Philadelphia, PA.

Spiegel, C.S. 2012. Business Plan for Addressing and Reducing Marine Bird Bycatch in U.S. Atlantic Fisheries. Focal Target Project: Bycatch of Greater Shearwaters in the New England Groundfish Fishery. Draft. U.S. Fish and Wildlife Service, Division of Migratory Birds, Hadley, MA.

Stolen, E.D. 2003. The effects of vehicle passage on foraging behavior of wading birds. *Waterbirds* 26:429–436.

Stoneburner, D.L., P.C. Patty, and W.B. Robertson. 1980. Evidence of heavy metal accumulations in sooty terns. *Science of the Total Environment* 14:147–152.

Tasker, M.L., C.J. Camphuysen, J. Cooper, S. Garthe, W.A. Montevecchi, and S.J.M. Blaber. 2000. The impacts of fishing on marine birds. *Ices Journal of Marine Science* 57:531–547.

Terres, J.K. 1991. *The Audubon Society Encyclopedia of North American Birds.* Wings Books, New York.

Towns, D.R., G.V. Byrd, H.P. Jones, M.J. Rauzon, J.C. Russell, and C. Wilcox. 2011. Impacts of introduced predators on seabirds. In *Seabird Islands: Ecology, Invasion, and Restoration,* C.P.H. Mulder, W.B. Anderson, D.R. Towns, and P.J. Bellingham (eds.). Oxford University Press, New York. pp. 56–90.

Turner, R.E. 1997. Wetland loss in the Northern Gulf of Mexico: Multiple working hypotheses. *Estuaries* 20:1–13.

USFWS. 2003. The National Strategy for Management of Invasive Species. National Wildlife Refuge System. Fulfilling the Promise. National Invasive Species Management Strategy Team. April 23. Available: https://www.fws.gov/invasives/pdfs/NationalStrategyFinalRevised05-04.pdf.

USFWS. 2013. Birding in the United States: A Demographic and Economic Analysis Addendum to the 2011 National Survey of Fishing, Hunting, and Wildlife Associated Recreation. U.S. Fish and Wildlife Service.

USFWS. 2016. Recovery Plan for the Northern Great Plains Piping Plover (*Charadrius melodus*). Volume II: Draft Revised Recovery Plan for the Wintering Range of the Northern Great Plains Piping Plover (*Charadrius melodus*) and Comprehensive Strategy for the Piping Plover (*Charadrius melodus*) in its Coastal Migration and Wintering Range in the Continental United States. U.S. Fish and Wildlife Service, Denver, CO.

Votier, S.C., B.J. Hatchwell, A. Beckerman, R.H. McCleery, F.M. Hunter, J. Pellatt, M. Trinder, and T.R. Birdhead. 2005. Oil pollution and climate have wide-scale impacts on seabird demographics. *Ecology Letters* 8:1157–1164.

Ward, M.P., B. Semel, C. Jablonski, C. Deutsch, V. Giammaria, S.B. Miller, and B.M. Mcguire. 2011. Consequences of using conspecific attraction in avian conservation: A case study of endangered colonial waterbirds. *Waterbirds* 34:476–480.

Warden, M.L. 2010. Bycatch of wintering common and red-throated loons in gillnets off the USA Atlantic Coast, 1996–2007. *Aquatic Biology* 10:167–180.

Watson, A., J. Reece, B.E. Tirpak, C.K. Edwards, L. Geselbracht, M. Woodrey, M. LaPeyre, and P.S. Dalyander. 2015. The Gulf Coast Vulnerability Assessment: Mangrove, Tidal Emergent Marsh, Barrier Islands, and Oyster Reef. Available: https://gulfcoastprairielcc.org/media/28948/gcva_11162015_final-2.pdf.

Weimerskirch, H. 2002. Seabird demography and its relationship with the marine environment. In *Biology of Marine Birds*, E.A. Schreiber, and J. Burger (eds.). CRC Press. pp. 115–135.

Wiebe, J.J., M.J. Seymour, D.T. Baker, D. O'Malley, B.P. Wallace, and K. Ritter. 2015. *Deepwater Horizon* NRDA Technical Memorandum: Quantifying Potential Exposures of Birds to *Deepwater Horizon* Oil in Louisiana Coastal Marsh Habitats.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettmann, A.W. Diamond, and J. Linke. 2001. Seabirds at risk around offshore oil platforms in the North-West Atlantic. *Marine Pollution Bulletin* 42:1285–1290.

Wilson, B.C. and C.G. Esslinger. 2002. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Texas Mid-Coast Initiative. Albuquerque, NM.

Wilson, B.C., C.A. Manlove, and C.G. Esslinger. 2002. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Mississippi River Coastal Wetlands Initiative. Albuquerque, NM.

Wilson, C.A. and M.A. Colwell. 2010. Movements and fledging success of snowy plover (*Charadrius alexandrinus*) chicks. *Waterbirds* 33:331–340.

Woodrey, M.S., S.A. Rush, J.A. Cherry, B.L. Nuse, R.J. Cooper, and A.J.J. Lehmicke. 2012. Understanding the potential impacts of global climate change on marsh birds in the Gulf of Mexico region. *Wetlands* 32:35–49.

Wootton, J.T., C.A. Pfister, and J.D. Forester. 2008. Dynamic patterns and ecological impacts of declining ocean pH in a high-resolution multi-year dataset. *Proceedings of the National Academy of Sciences* 105:18848–18853.

Ziccardi, M. 2015. Expert assistance – *Deepwater Horizon* Oil Spill Bird Injury. Final Report. Prepared for Department of the Interior/U.S. Fish and Wildlife Service.

Appendix A. Bird Groups, Subgroups, and Species Injured by the *Deepwater Horizon* Oil Spill

Bird group	Subgroup	Species
Northern GOM Nesting Birds	Colonial Waterbirds	Laughing gull (*Leucophaeus atricilla*)
		Brown pelican (*Pelacanus occidentalis*)
		Royal tern (*Thalasseus maximus*)
		Black skimmer (*Rynchops niger*)
		Least tern (*Sternula antillarum*)
		Sandwich tern (*Thalasseus sandvicensis*)
		White ibis (*Eudocimus albus*)
		Cattle egret (*Bubulcus ibis*)
		Great blue heron (*Ardea herodias*)
		Forster's tern (*Sterna forsteri*)
		Common tern (*Sterna hirundo*)
		Roseate spoonbill (*Platalea ajaja*)
		Tricolored heron (*Egretta tricolor*)
		Caspian tern (*Hudroprogne caspia*)
		Great egret (*Ardea alba*)
		Snowy egret (*Egretta thula*)
		Black-crowned night-heron (*Nycticorax nycticorax*)
		Green heron (*Butorides virescens*)
		Yellow-crowned night-heron (*Nyctanassa violacea*)
		Little blue heron (*Egretta caerulea*)
		Gull-billed tern (*Gelochelidon nilotica*)
		Reddish egret (*Egretta rufescens*)
		Neotropic cormorant (*Phalacrocorax brasilianus*)
		Glossy ibis (*Plegadis falcinellus*)

Bird group	Subgroup	Species
	Solitary Beach Nesting Birds	American oystercatcher (*Haematopus pallliatus*)
		Killdeer (*Charadrius vociferous*)
		Wilson's plover (*Charadrius wilsonia*)
		Snowy plover (*Charadrius nivosus*)
		Willet (*Tringa semipalmata*)
Northern GOM Nesting Birds	Marsh Birds	Clapper rail (*Rallus crepitans*)
		Pied-billed grebe (*Podilymbus podiceps*)
		Mottled duck (*Anas fulvigula*)
		Least bittern (*Ixobrychus exilis*)
		Black-necked stilt (*Himantopus mexicanus*)
		Purple gallinule (*Porphyrio martinicus*)
		Common gallinule (*Gallinula galeata*)
		Black-bellied whistling-duck (*Dendrocygna autumnalis*)
		Boat-tailed grackle (*Quiscalus major*)
		Red-winged blackbird (*Agelaius phoeniceus*)
		Seaside sparrow (*Ammodramus maritimus*)
		Fulvous whistling-duck (*Dendrocygna bicolor*)
		Belted kingfisher (*Megaceryle alcyon*)
	Ospreys	Osprey (*Pandion haliaetus*)
Non-GOM Nesting Birds	Northern Nesting Birds	Northern gannet (*Morus bassanus*)
		American white pelican (*Pelecanus erythrorhynchos*)
		Common loon (*Gavia immer*)
		Double-crested cormorant (*Phalacrocorax auritus*)
		Piping plover (*Charadrius melodus*)
	Northern Nesting Shorebirds	Sanderling (*Calidris alba*)
		Dunlin (*Calidris alpine*)
		Ruddy turnstone (*Arenaria interpres*)
		Semipalmated sandpiper (*Calidris pusilla*)
		Short-billed dowitcher (*Limnodromus griseus*)
		Black-bellied plover (*Pluvialis squatarola*)
		Semipalmated plover (*Charadrius semipalmatus*)

Bird group	Subgroup	Species
		Long-billed dowitcher (*Limnodromus scolopaceus*)
		Least sandpiper (*Calidris minutilla*)
		Spotted sandpiper (*Actitis macularius*)
		Western sandpiper (*Calidris mauri*)
Non-GOM Nesting Birds	Prairie Pothole Nesting Species	Black tern (*Chlidonias niger*)
		Mallard (*Anas platyrhynchos*)
		Blue-winged teal (*Anas discors*)
		Ring-billed gull (*Larus delawarensis*)
		Sora (*Porzana carolina*)
		Canada goose (*Branta canadensis*)
		Ruddy duck (*Oxyura jamaicensis*)
		Virginia rail (*Rallus limicola*)
		American avocet (*Recurvirostra americana*)
		American coot (*Fulica americana*)
	Boreal Forest Nesting Species	Surf scoter (*Melanitta perspicillata*)
		Bufflehead (*Bucephala albeola*)
		Green-winged teal (*Anas carolinensis*)
		Red-breasted merganser (*Mergus serrator*)
		Lesser scaup (*Aythya affinis*)
	Caribbean Nesting Species	Audubon's shearwater (*Puffinus lherminieri*)
		Sooty tern (*Onychoprion fuscatus*)
		Magnificent frigatebird (*Fregata magnificens*)
		Bridled tern (*Onychoprion anaethetus*)
		Masked booby (*Sula dactylatra*)
		Brown noddy (*Anous stolidus*)
		Red-billed tropicbird (*Phaethon aethereus*)
		White-tailed tropicbird (*Phaethon lepturus*)
		Brown booby (*Sula leucogaster*)

Bird group	Subgroup	Species
	Pelagic Birds	Herring gull (*Larus argentatus*)
		Great shearwater (*Puffinus gravis*)
		Lesser black-backed gull (*Larus fuscus*)
		Cory's shearwater (*Calonectris borealis*)
		Band-rumped storm-petrel (*Oceanodroma castro*)
		Wilson's storm-petrel (*Oceanites oceanicus*)
		Leach's storm-petrel (*Hydrobates leucorhous*)
		Sooty shearwater (*Puffinus griseus*)
		Manx shearwater (*Puffinus puffinus*)[a]
		Parasitic jaeger (*Stercorarius parasiticus*)

a. Manx shearwater is primarily a remote nesting, pelagic bird; primary nesting colonies are in the North Atlantic Ocean. The only known North American breeding colony exists on Middle Lawn Island, Newfoundland.

Module 3
Overview of Related Activities – Birds

1. Background

This module is intended to summarize available information on existing acts, programs, *Deepwater Horizon* (DWH*)* Natural Resource Damage Assessment (NRDA) Early Restoration projects, and other funding mechanisms related to the conservation, management, and/or restoration of birds within the northern Gulf of Mexico (GOM). It does not contain a comprehensive list of all individual bird conservation projects, but does include links to individual programs that provide more details. This module can be used to identify and leverage existing opportunities; incorporate inherent efficiencies; and evaluate potential cumulative benefits and project synergies. Further, it has the potential to limit project selection redundancy, promote wise stewardship of available resources, and promote the sharing of monitoring data among programs (see DWH NRDA Trustees, 2016, pp. 5-379, and 7-16 to 7-17).

2. Existing Conservation, Management, and Monitoring Acts and Programs

The following section is intended to provide a high-level overview of conservation, management, and monitoring acts and programs relevant to birds in the northern GOM. This section is not an exhaustive list but is collectively intended to highlight key international, federal, state, and nongovernmental organization (NGO) acts and programs contributing to bird conservation and restoration in the northern GOM.

2.1 International and Federal Acts and Programs

2.1.1 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) of 1918 makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird, except under the terms of a valid permit issued pursuant to federal regulations.

Black skimmers. Credit: Woody Woodrow.

Birds of Management Concern are a subset of MBTA-protected species that pose special management challenges because of documented or apparent population declines, small or restricted populations, dependence on restricted or vulnerable habitats, or overabundance to the point of causing ecological and economic harm.

2.1.2 Migratory Bird Conservation Act

The Migratory Bird Conservation Act of 1929 established the Migratory Bird Conservation Commission (MBCC). The MBCC was created and authorized to consider and approve any areas of land and/or water recommended by the Secretary of the Interior for fee purchase, easement, or lease by the U.S. Fish and Wildlife Service (USFWS) with monies from the Migratory Bird Conservation Fund. In 1989, the MBCC acquired the additional responsibility to approve project funding under the North American Wetlands Conservation Act (NAWCA). The North American Wetlands Conservation Council submits project recommendations to the MBCC for funding approval. MBCC has approved funding for over 1,900 high priority projects since its establishment, representing a total of $1 billion for the protection of wetland habitat.

2.1.3 Endangered Species Act

The Endangered Species Act (ESA) of 1973 is intended to protect and recover imperiled species and the ecosystems upon which they depend. The ESA is administered by two federal agencies: the USFWS for terrestrial and freshwater organisms and the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) for marine wildlife, such as whales, and anadromous fish such as salmon. Under the ESA, all species[1] may be listed as endangered or threatened. "Endangered" is defined as a species that is in danger of extinction throughout all or a significant portion of its range. "Threatened" is defined as a species that is likely to become endangered within the foreseeable future. Of the 11 ESA-listed bird species in the northern GOM, two species were included in the DWH Programmatic Damage Assessment and Restoration Plan (PDARP; DWH NRDA Trustees, 2016), indicated with an asterisk (*) in the list below.

- Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), Endangered
- Red knot (*Calidris canutus*), Threatened
- Piping plover* (*Charadrius melodus*), Threatened
- Whooping crane (*Grus americana*), Endangered
  (note that Louisiana has an experimental population of whooping crane that is not regulated as Endangered under the ESA)
- Mississippi sandhill crane (*G. canadensis pulla*), Endangered
- Wood stork (*Mycteria americana*), Endangered
- Red-cockaded woodpecker (*Picoides borealis*), Endangered
- Everglades snail kite (*Rostrhamus sociabilis plumbeus*), Endangered
- Least tern* (*Sterna antillarum*), Endangered
  (note that the subspecies of least tern in Florida, Mississippi, and Alabama is not a part of the interior Endangered population)
- Roseate tern (*S. dougallii*), Threatened
- Bachman's warbler (*Vermivora bachmanii*), Endangered.

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1. The term "species" includes subspecies, varieties, and, for vertebrates, distinct population segments, except pest insects.

Sources:

- https://www.fws.gov/endangered/species/index.html
- https://www.fws.gov/home/dhoilspill/pdfs/FedListedBirdsGulf.pdf

2.1.4 USFWS Wild Bird Conservation Act

The USFWS Wild Bird Conservation Act (WBCA) of 1992 was enacted to ensure that exotic bird species are not harmed by international trade and encourage wild bird conservation programs in countries of origin. The USFWS may issue permits to allow the import of listed birds for scientific research, zoological breeding or display, or personal pet purposes when the applicant meets certain criteria.

2.1.5 Agreement on the Conservation of Albatrosses and Petrels

Although not a member, the United States actively participates in the Agreement on the Conservation of Albatrosses and Petrels (ACAP), a multilateral agreement among 13 member countries to coordinate international fishing activities that result in seabird bycatch which threaten 31 species of albatrosses, petrels, and shearwaters. Four species covered by ACAP breed or forage in the United States, including the black-footed albatross (*Phoebastria nigripes*), the laysan albatross (*Phoebastria immutabilis*), the federally endangered short-tailed albatross (*Phoebastria albatrus*), and the pink-footed shearwater (*Puffinus creatopus*).

Source: http://www.nmfs.noaa.gov/ia/species/seabirds/seabirds.html

2.1.6 North American Wetlands Conservation Act

The North American Wetlands Conservation Act (NAWCA) of 1989 provides matching grants to organizations and individuals to carry out wetland conservation projects in the United States, Canada, and Mexico for the benefit of migratory birds and other wildlife. NAWCA encourages the formation of public-private partnerships to develop and implement projects consistent with the North American Waterfowl Management Plan, a visionary initiative designed to conserve continental waterfowl populations and associated habitats. By extension, these projects generate overarching benefits for other migratory birds, fish, and wildlife species. In addition, NAWCA established the North American Wetlands Conservation Council to review and recommend perspective proposals to the MBCC for funding (e.g., North American Wetlands Conservation Fund).

2.1.7 USFWS Programs

Migratory Bird Program

The Migratory Bird Program is charged with conserving migratory bird populations through protection, restoration, and management. To manage birds and their habitats, the program works with bird conservation partnerships comprising federal and state agencies, tribes, NGOs, universities, corporations, individuals with bird expertise, and private landowners. These partnerships develop and implement management plans that provide the necessary conservation actions to return and maintain species to healthy and sustainable levels. The program also provides helpful resources, such as best management practices, project assessment and decision support tools, and guidance documents. In addition, the program provides biological and management information on hunted and non-hunted species, such as survey data, which helps regulate migratory bird harvest throughout the four migration flyways. To better measure success in achieving identified bird conservation priorities and mandates, the

program developed a Focal Species Strategy to increase accountability and return species to healthy and sustainable levels.

- Birds of Conservation Concern are species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA.
- The USFWS role supporting the MBTA and Birds of Management Concern is also a part of this program.

As a part of the program, the USFWS collaborates with other federal and state agencies, tribes, and other organizations, including:

- Council for the Conservation of Migratory Birds.
- North American Bird Conservation Initiative.
- The Urban Conservation Treaty for Migratory Birds (Urban Bird Treaty) is a program working with cities and partners to conserve migratory birds through education, hazard reductions, citizen science, conservation actions, and conservation and habitat improvement strategies in urban and suburban areas. Urban areas can become effective sanctuaries for birds and, by restoring and conserving green space, Urban Bird Treaty cities enhance urban areas for migratory birds that nest, overwinter, or migrate through municipal and urban/suburban neighborhoods as well as for citizens.
- Shorebird Conservation.
- Waterbird Conservation.
- Waterfowl Conservation.
- Partners in Flight (PIF).
- Migratory Bird Flyways.
- Migratory Bird Joint Ventures (JVs) are collaborative, regional partnerships that conserve habitat for the benefit of priority bird species, other wildlife, and people. JVs bring diverse partners together under the guidance of bird management plans to design and implement landscape-scale conservation efforts. JV actions include biological planning, conservation design, prioritization project development and implementation monitoring, evaluation, research communications, education, and outreach funding support for projects and activities. In the United States, there are 18 habitat-based JVs, some of which stretch into Canada or Mexico. In addition, there are three species-based JVs, all with an international scope, to effectively manage specific bird species. JVs have a long history of success in leveraging public and private resources to focus on regional conservation needs. Since the first JV was established in 1987, partnerships have helped conserve 24 million acres of critical habitat for birds and other wildlife. There are three JVs along the northern GOM: the Gulf Coast JV, the East Gulf Coastal Plain JV, and the Atlantic Coast JV. Within this collective group of JVs are 12 separate coastal focal areas referred to as initiative team areas, coastal communities, or coastal habitats from Texas to Florida. These focal areas are identified for future protection and restoration to benefit birds and other wildlife.

The Migratory Bird Program also provides matching grants to partnerships of organizations, governments, and individuals to carry out bird habitat conservation projects throughout the Western Hemisphere. Collectively, these bird habitat grant programs have affected well over 30 million acres of bird habitat in more than 36 countries throughout the hemisphere.

- NAWCA grant programs fund projects in the United States, Canada, and Mexico that involve long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats. In Mexico, partners may also conduct projects involving technical training,

environmental education and outreach, organizational infrastructure development, and sustainable-use studies.

- The Neotropical Migratory Bird Conservation Act (NMBCA) Grant Program funds projects promoting the conservation of neotropical migratory birds in the United States, Canada, Latin America, and the Caribbean. Grants funded under the NMBCA program help partners to protect, research, monitor, and manage bird populations and habitat throughout birds' entire migratory life cycle; as well as to conduct law enforcement and community outreach and education.

Source: https://www.fws.gov/birds/management/bird-conservation-partnership-and-initiatives.php

Landscape Conservation Cooperatives

Landscape Conservation Cooperatives (LCCs) were established in 2010 as a network of public-private partnerships focused on using science to ensure the sustainability of our land, water, wildlife, and cultural resources. Partners define science needs and jointly address broad-scale conservation issues (e.g., sea-level rise) in an ecologically defined geographic area. The USFWS is an active member and supporter of these and the other 18 LCCs in the network. Four LCCs cover parts of the Gulf landscape: the Gulf Coast Prairie, the Gulf Coastal Plains and Ozarks, the South Atlantic, and Peninsular Florida.

These four Gulf LCCs and two others in the Southeast and Caribbean are collaborating to create a Southeast Conservation Adaptation Strategy that stitches together the conservation and restoration priorities of Southeast LCC partners into one unifying map. This effort will provide a regional context for a wide variety of local decisions, highlighting common ground for conservation. The four Gulf LCCs also partnered with the Gulf of Mexico Alliance (GOMA) to conduct a Gulf Coast Vulnerability Assessment (GCVA), which was focused on determining which ecosystems and species are most vulnerable in the region, where they are most vulnerable, and why. The GCVA is now being used to guide future conservation and restoration efforts by helping natural resource managers, scientists, regional planners, and others to identify vulnerable areas where they can focus critical resources to achieve the most effective outcomes.

Coastal Program

The Coastal Program is one of the USFWS' most effective resources for restoring and protecting fish and wildlife habitat on public and privately owned lands. The program promotes the USFWS' mission and priorities by using non-regulatory and voluntary conservation partnerships to deliver landscape-scale conservation, and implement strategic habitat conservation for federally listed species, migratory birds, and interjurisdictional fisheries.

National Wildlife Refuge System

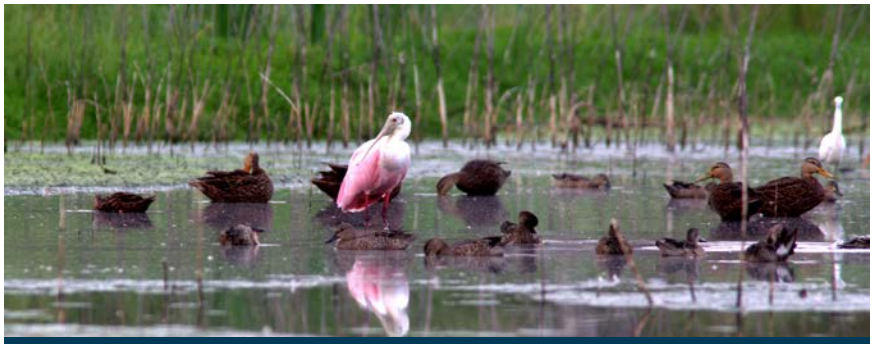
The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

2.1.8 NOAA Programs

NOAA manages coastal and oceanic habitats (e.g., wetlands and intertidal zones) that are vitally important for coastal waterfowl, wading birds, and shorebirds such as albatrosses,

petrels, shearwaters, storm-petrels, pelicans, cormorants, murrelets, puffins, and skimmers. NOAA manages these habitats in cooperation with the USFWS, the National Park Service, and the Bureau of Land Management.

Source: http://www.stateofthebirds.org/2011/agencies/noaa



Roseate spoonbill, mottled duck, and blue-winged teal.
Credit: Woody Woodrow.

NOAA Fisheries or NMFS

NOAA Fisheries, also known as NMFS, works to mitigate the incidental catch of seabirds in fisheries by working closely with many domestic and international partners. NOAA works internationally through regional fishery management organizations and with countries to promote seabird conservation. For example, the United States played a significant role in the adoption of international binding measures at several regional fisheries management organizations to reduce seabird bycatch in international waters. In these programs, the United States emphasizes the need for improved bycatch data via onboard observer programs, targeted approaches to reducing bycatch, and risk-adverse decision-making based on the conservation needs of many affected species. NOAA's Office of Protected Resources (OPR), an office under NMFS, is charged with protecting endangered or threatened marine life. OPR works to conserve, protect, and recover species under the ESA in conjunction with regional offices, science centers, and various partners.

2.1.9 U.S. Department of Agriculture Programs

Agricultural Conservation Easement Program

The Agricultural Conservation Easement Program provides financial and technical assistance to help conserve agricultural lands and wetlands, and their related benefits. Under the Agricultural Land Easements component, the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) helps tribal, state, and local governments and NGOs protect working agricultural lands and limit non-agricultural uses of these lands. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect, and enhance enrolled wetlands.

Migratory Bird Habitat Initiative

Under the Migratory Bird Habitat Initiative (MBHI), NRCS works with agricultural producers to create and enhance habitat for wetland-dependent migratory birds. Through a number of Farm Bill conservation programs, producers can flood farm fields to create temporary habitat, or they can place lands under a conservation easement, restoring and protecting wetland habitat for the long-term. These conservation efforts are especially important in a time of need. For example,

after the 2010 DWH oil spill, MBHI helped landowners create more than 470,000 acres of alternative habitat along the Mississippi River Flyway.

2.1.10 Bureau of Ocean Energy Management

Gulf of Mexico Marine Assessment Program for Protected Species

The Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS) is a partnership program to improve information about protected species and provide a comprehensive assessment of marine mammal, marine turtle, and seabird abundance and spatial distribution in Gulf offshore waters. The program will conduct repeated, broad-scale surveys over multiple years and seasons using various methods, including aerial surveys, ship-based surveys, and tag telemetry work. The Seabird Science Plan, developed to guide GoMMAPPS seabird activities, identifies a framework to reduce uncertainty related to seabird abundance and distribution within the GOM with respect to oil and gas activities. The data collected will be used by the Bureau of Ocean Energy Management to inform National Environmental Policy Act analyses, oil spill risk assessment models, and Section 7 consultations during the planning of activities in the Outer Continental Shelf to reduce or mitigate associated impacts.

2.2 State Programs

This section identifies programs in each of the GOM states related to bird restoration, monitoring, conservation, and management. In addition to these programs, the states work closely with federal partners and NGOs to conduct restoration planning and implement projects that benefit birds. In many cases, these partnerships provide the primary sources of funding for bird projects within the states. The federal and NGO programs are described elsewhere in this document and are not duplicated here (see Sections 2.1.7–2.1.10 and 2.3, respectively).

2.2.1 Florida Fish and Wildlife Conservation Commission

The Florida Fish and Wildlife Conservation Commission (FWC) uses a variety of tools to address conservation, management, and monitoring of avifauna in Florida:

In 2016, FWC developed an Imperiled Species Management Plan. The plan includes 21 avian species and outlines integrated conservation strategies benefiting multiple species and shared environments. It focuses on improving Florida's imperiled wildlife by maintaining sufficient habitat and improving public and partner support of conservation efforts. The plan also focuses on working cooperatively with private landowners to sustain imperiled species found on their property.

Source: http://myfwc.com/media/4149481/Floridas-Imperiled-Species-Management-Plan-2016to2026.pdf

Florida's Wildlife Legacy Initiative is a program designed to combine effective statewide planning with regional partnership development to implement actions at the local level. The goal of the program is to sustain Florida's diverse array of native wildlife and their habitats for future generations through implementing the State Wildlife Action Plan (SWAP), developing partnerships, and using funding sources effectively. The Cooperative Conservation Blueprint is a multi-partner strategic conservation process initiated in 2006 as a part of implementing Florida's SWAP. The process has brought together landowners, businesses, and governmental and conservation organizations to collectively build broad agreement on both voluntary and non-

regulatory conservation incentives, along with a comprehensive vision of wildlife habitat and connectivity priorities to which existing and new incentive ideas can be applied.

Source: http://myfwc.com/conservation/special-initiatives/fwli/action-plan/

The Coastal Wildlife Conservation Initiative is an integrative approach to the long-term conservation of native wildlife in coastal ecosystems throughout Florida. This initiative addresses threats to coastal wildlife and habitats, while considering human interests and uses of coastal areas. The program's goal is to protect coastal wildlife populations, conserve and manage coastal ecosystems, and achieve balance among conservation, recreation, and commercial activities; and responsible development.

Source: http://myfwc.com/conservation/special-initiatives/cwci/

2.2.2 Florida Shorebird Alliance

The Florida Shorebird Alliance (FSA) is an FWC-coordinated statewide partnership of government and NGOs. The FSA is committed to advancing shorebird and seabird conservation in Florida through collaborative work that helps to identify and address important needs with regard to research, management, education, outreach, and public policy. Partners use standardized shorebird and seabird monitoring protocols developed by the FWC to inform adaptive management and conservation actions. Partners enter data into an FWC-maintained online central data repository, called the Florida Shorebird Database.

Source: http://flshorebirdalliance.org/

2.2.3 Florida Critical Wildlife Areas

Critical Wildlife Areas (CWAs) are established by the FWC under the Florida Administrative Code to protect important wildlife concentrations from human disturbance during critical periods of their life cycles, such as nesting or migration. For each CWA, the boundaries and periods of time when portions of the area may be posted are defined in the CWA establishment order. Public access is restricted within CWAs where posted. Almost all active CWAs on the Gulf Coast support listed species, the most notable of which include Alafia Banks (wading birds, oystercatchers, and pelican rookeries), ABC Islands (wading birds and pelican rookeries), St. George Causeway (least terns), and Big Marco Pass (least terns, black skimmers, plovers, and wintering shorebirds).

Source: http://www.myfwc.com/conservation/terrestrial/cwa/

2.2.4 Mississippi Department of Marine Resources Coastal Preserves Program

The Mississippi Department of Marine Resources (MDMR) Coastal Preserves Program's objective is to acquire, protect, and manage sensitive coastal wetland habitats along the Mississippi Gulf Coast, therefore ensuring the ecological health of Mississippi's coastal wetland ecosystems. The state currently has title to approximately 30,000 acres of the designated 72,000 acres of crucial coastal wetland habitat within Mississippi's 20 coastal preserve sites.

Source: http://www.dmr.ms.gov/index.php/wildlife-a-plants/coastal-preserves

2.2.5 Mississippi Department of Wildlife Fisheries and Parks Natural Heritage Program

The Mississippi Department of Wildlife Fisheries and Parks (MDWFP) Natural Heritage Program coordinates the development of the SWAP for the State of Mississippi. The SWAP identifies species, including birds and habitats in greatest conservation need, key threats, and

conservation actions needed to prevent endangered species listings and spur recovery. This plan is a requirement for states to receive federal funding through the State Wildlife Grants (SWG) Program. The overall purpose of the SWAP is to provide a guide to effective and efficient long-term conservation of Mississippi's biological diversity as part of a nationwide effort. The 2015–2025 revision of this science-based, landscape level plan was focused on making it more useable by resource managers; decision-makers; organizations; local, state, and federal agencies; and individuals working to keep common species common and to conserve rare species in Mississippi.

Source: View the 2015-2025 Mississippi State Wildlife Action Plan

2.2.6 Alabama Nongame Wildlife Program

The mission of the Alabama Nongame Wildlife Program is to manage, protect, and enhance the populations of nongame wildlife that make Alabama so unique. Nongame wildlife are those species that are not legally hunted, which make up more than 95% of the native species that Alabama has to offer.

This program is working on many ongoing bird specific projects, including:

- Colonial and solitary shorebird surveys,
- Secretive marsh bird surveys,
- Endangered species projects,
- Management of Gaillard Island, an important brown pelican colony.

Source: http://www.outdooralabama.com/non-game-wildlife

2.2.7 Alabama State Wildlife Action Plan and State Wildlife Grants

The Alabama Department of Conservation and Natural Resources (ADCNR) Wildlife and Freshwater Fisheries (WFF) Division revised Alabama's Comprehensive Wildlife Conservation Strategy or State Wildlife Action Plan (SWAP) in 2015. This SWAP is critical to helping Alabama fulfill its responsibility to conserve its abundant fish and wildlife and natural habitats for future generations.

The ADCNR WFF Division coordinated with key conservation partners to ensure that the revised plan was integrated, accessible, and meets the national requirements and components. Broad public, partner, and stakeholder input was requested and welcomed throughout the SWAP revision process.

State Wildlife Grants (SWGs) are federally funded state matched grants that are utilized to fulfill the goals and objectives of the SWAP and to manage and conserve declining species to avoid their potential listing under the Endangered Species Act. A requirement of a SWG is that each state completes a Comprehensive Wildlife Conservation Strategy (CWCS).

The Alabama CWCS (or SWAP) was approved by the USFWS in November 2005. The SWAP defines those wildlife species in greatest need of conservation in Alabama and describes the actions necessary for their restoration. It is through this tool that Alabama has the opportunity to work with conservation partners and the greater public to best utilize available resources to ensure that declining species are restored and common species remain common.

Sources:

- Wildlife Conservation Strategy: http://www.outdooralabama.com/al-comprehensive-wildlife-conservation-strategy

- State Wildlife Grants: http://www.outdooralabama.com/state-wildlife-grants-0

2.2.8 Louisiana Natural Heritage Program

The Louisiana Natural Heritage Program (LNHP) is responsible for the conservation of Louisiana's rare, threatened, and endangered species; nongame birds; and habitats. It also conducts environmental project review and public education.

Clapper rail. Credit: Mike Gray.

In 2015, the LNHP updated the Louisiana State Wildlife Action Plan (SWAP) which includes 69 avian species of greatest conservation need. The purpose of this SWAP is to develop a blueprint for guiding LDWF and conservation partners in the development and implementation of management actions for Louisiana's fish and wildlife species, with an emphasis on rare and declining species and their associated habitats. This plan identifies threats to these species as well as strategies for conserving them. Wildlife Action Plans are a requirement for each state by Congress in order to receive funding through the State Wildlife Grants (SWG) program. This funding aids in the implementation of the SWAP and allows for conservation actions to preclude the need to list species under the Endangered Species Act. The SWAP has allowed for LDWF to pursue crucial research and stewardship needs regarding Louisiana's bird species.

Sources:

- LNHP: http://www.wlf.louisiana.gov/wildlife/louisiana-natural-heritage-program
- SWAP: http://www.wlf.louisiana.gov/wildlife/wildlife-action-plan-details

2.2.9 Texas Parks and Wildlife Department

The Texas Parks and Wildlife Department (TPWD) manages wildlife species for the state, including birds and endangered species. This includes the Bird Behavior and Conservation program that aims to educate the public about how to conserve Texas' native bird populations.

Sources:

- TPWD: http://tpwd.texas.gov/
- Bird behavior and conservation: http://tpwd.texas.gov/huntwild/wild/birding/birding_behavior/index.phtml

2.2.10 Texas Parks and Wildlife Department (TPWD) Waterfowl Strategic Plan

The goals of the TPWD Waterfowl Strategic Plan are to maintain waterfowl populations in Texas for their intrinsic value, sustain or increase the current levels of waterfowl hunter participation,

increase or maintain public and political support for waterfowl and habitat management, maintain or increase ecosystem goods and services for the benefit of waterfowl and wetland systems, and increase support of non-consumptive users for waterfowl conservation. The plan is an attempt to address each goal and factor of waterfowl management. It is a commitment of the TPWD to the management, research, and surveys of waterfowl populations; and the development and acquisition of wetland habitats for the benefit of migrating, wintering, and breeding waterfowl. Habitat issues are addressed on an ecoregion or JV level. Specific guidance and action items are listed by ecoregion or JV; however, many of the key points are interchangeable with other regions in the state.

Source: http://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_1691_07_11.pdf

2.2.11 Texas General Land Office Coastal Erosion Planning and Response Act

The Texas General Land Office Coastal Erosion Planning and Response Act (CEPRA) Program partners with local, state, and federal entities as well as nonprofit organizations to restore wetland and beach/dune habitats, create bird habitat, and protect sensitive coastal areas from shoreline erosion. The state-funded program leverages resources as a non-federal cost share for a variety of federal restoration and conservation grant programs.

Source: http://www.glo.texas.gov/coast/grant-projects/cepra/

2.3 NGO Programs

NGOs are extremely important to bird management, restoration, and conservation in the northern GOM, as well as nationally and internationally. These organizations support a wide range of activities, from on-the-ground restoration to legal support and community advocacy, all of which are instrumental in successful bird restoration and conservation. Many NGOs that benefit bird species using the northern GOM have already been active participants in the DWH restoration process, including submitting comments to Early Restoration plans and to the PDARP. The Trustees will continue to engage with NGOs as they move forward with restoration planning and implementation.

3. Additional Gulf-Wide Partnerships and Networks

3.1 GOMA

GOMA was established in 2004 by the Governors of the Gulf States in response to the U.S. Ocean Action Plan. GOMA is comprised of and led by representatives of the five Gulf States. GOMA also includes a network of partners, including 13 federal agencies (led by the U.S. Environmental Protection Agency and NOAA), academic institutions, industry, and many NGOs. GOMA is actively addressing the region's priority issues as well as managing the Gulf of Mexico Research Initiative (GOMRI).

Source: http://www.gulfofmexicoalliance.org/

3.1.1 GOMRI

GOMRI investigates the impacts of oil, dispersed oil, and dispersant on the ecosystems of the GOM and affected coastal states to improve fundamental understanding of the dynamics of such events, their environmental stresses, and public health implications. GOMRI also develops improved spill mitigation, oil and gas detection, and characterization and remediation technologies.

3.2 Gulf of Mexico Avian Monitoring Network

The Gulf of Mexico Avian Monitoring Network is a group of avian scientists and land managers working collectively to develop a coordinated and comprehensive approach to avian monitoring that will provide solutions to contemporary and long-term conservation needs within the GOM. The network provides a forum by which conservation partners can collaborate and implement a coordinated monitoring system that recognizes and builds upon established monitoring programs to connect, leverage, and integrate existing efforts into a comprehensive Gulf-wide avian monitoring program to address contemporary and long-term conservation needs of avian populations and their habitats within the GOM.

3.3 Restore the Mississippi River Delta

Restore the Mississippi River Delta partners with the State of Louisiana and the U.S. Army Corps of Engineers to provide technical expertise on proposed projects, plans, and restoration priorities. The group provides decision-makers with information on the evolving threats to the delta and the feasibility of solutions, conducts original research, synthesizes existing research to provide critical analyses, and helps guide the academic scientific community to research questions that have an applied purpose in restoration decisions.

4. DWH NRDA Early Restoration

On April 20, 2011, the first anniversary of the DWH oil spill, BP and the DWH Trustees signed a "Framework Agreement" for Early Restoration under the NRDA. The agreement provided a $1 billion down payment on restoration and required BP and the Trustees to work together to identify Early Restoration projects that would provide "meaningful benefits to accelerate restoration in the Gulf as quickly as practicable." The agreement also set out criteria for project design and selection (Framework for Early Restoration, 2011).

As of January 2016, approximately $866 million and 68 projects have been identified across several restoration types (including birds) for Early Restoration in 5 phases across all restoration types. Bird restoration projects were included within Phase II, Phase III, and Phase IV, and are summarized below.

4.1 Enhanced Management of Avian Breeding Habitat Injured by Response Activities in the Florida Panhandle, Alabama, and Mississippi Project

This project will reduce disturbance to nesting and foraging habitat for beach-nesting birds by (1) placing symbolic fencing around sensitive nesting sites of beach-nesting birds to indicate the site as off-limits to people, pets, and other sources of disturbance; (2) increasing predator control to reduce disturbance and loss of eggs, chicks, and adult beach-nesting birds at nesting sites; and (3) increasing surveillance and monitoring of posted nesting sites to minimize disturbance to nesting habitat in posted areas. Project locations include the Panhandle Florida counties (i.e., Escambia, Santa Rosa, Okaloosa, Walton, Bay, Gulf, and Franklin), the Bon Secour National Wildlife Refuge in Baldwin and Mobile counties in Alabama, and the Gulf Islands National Seashore – Mississippi District.

4.2 Louisiana Outer Coast Restoration Project

"The goal of the project is to restore beach, dune, and back-barrier marsh habitats in Louisiana, as well as brown pelicans, terns, skimmers, and gulls to help compensate the public for spill-related injuries to these habitats and species. The restoration work at each island involves placement of appropriately sized sediments to create beach, dune, and back-barrier marsh

areas; installation of sand fencing to trap and retain wind-blown sediments and foster dune development; and revegetation of appropriate native species in dune and back-barrier marsh habitat. Sediment will be pumped from appropriate borrow area locations specific to each island and conveyed to the restoration sites through temporary pipeline corridors."

4.3 Texas Rookery Islands Project

"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 partially compensate for injuries to birds by increasing nesting pairs of colonial waterbirds, which include the following species: brown pelican, laughing gull, royal tern, sandwich tern, great blue heron, roseate spoonbill, reddish egret, great egret, snowy egret, tricolored heron, and black-crowned night heron. Restoration actions at each rookery island will increase the amount of available nesting habitat by expanding the size of the island and enhancing the quality of habitat for nesting birds. Habitat longevity will be increased by raising the island elevation and constructing protective features, such as breakwaters or armoring levees."

5. Funding Opportunities Related to the DWH Oil Spill

5.1 Introduction

The following section is intended to provide a high-level overview of potential DWH funding streams across the GOM. For more in-depth details on project and research funded through the programs below, please visit the links provided or the *Deepwater Horizon* Project Tracker, a tool maintained by GOMA that tracks restoration, research, and recovery projects resulting from the DWH oil spill.

5.2 RESTORE Act

The RESTORE Act was established in 2012 and dedicates 80% of all administrative and civil penalties related to the DWH spill to a Gulf Coast Restoration Trust Fund. There are five distinct components of RESTORE Act funding: (1) funding divided equally among the five GOM states for ecological restoration, economic development, and promoting tourism; (2) funding dedicated to the Gulf Coast Ecosystem Restoration Council for ecosystem restoration; (3) funding allocated to the five GOM states to implement state expenditure plans; (4) funding allocated to NOAA's Gulf Coast Ecosystem Restoration Science, Observation, Monitoring and Technology Program; and (5) funding for the Centers of Excellence Research grants.

5.2.1 RESTORE Act Direct Component

The Department of the Treasury-administered Direct Component (i.e., Pot 1) makes 35% of the DWH civil penalties ($1.86 billion) available to four Gulf Coast states (Texas, Louisiana, Mississippi, and Alabama), 23 Florida Gulf coastal counties, and 20 Louisiana parishes. Funds are available after state, county, and parish applicants prepare multi-year implementation plans that prioritize eligible activities and obtain broad-based participation from individuals, businesses, tribes, and nonprofit organizations.

5.2.2 RESTORE Council

The Gulf Coast Ecosystem Restoration Council (Council)-administered Comprehensive Plan Component (i.e., Pot 2) makes 30% of the DWH civil penalties ($1.6 billion) available to restore

the ecosystem and economy of the Gulf Coast region by developing and overseeing implementation of a comprehensive restoration plan. The Council, through its initial Funded Priorities List (FPL) in 2015, is using funds to provide near-term, on-the-ground ecosystem benefits, while also conducting planning activities designed to build a foundation for future success as additional funds become available.

5.2.3 RESTORE Act Spill Impact Component

The Gulf Coast Ecosystem Restoration Council-administered Spill Impact Component (i.e., Pot 3) makes 30% of the DWH civil penalties ($1.6 billion) available to Alabama, Florida, Louisiana, Mississippi, and Texas via a three-phase process, which includes (1) development of State Expenditure Plans (SEPs) by the entities identified in the RESTORE Act, (2) submission of SEPs by the Governors to the Council for review and approval, and (3) submission of the grant applications once the SEP is approved by the Council.

5.2.4 NOAA RESTORE Act Science Program

The NOAA-administered RESTORE Act Science Program (i.e., Pot 4) makes 2.5% of the DWH civil penalties ($133 million) available to carry out research, observation, and monitoring to support, to the maximum extent practicable, the long-term sustainability of the ecosystem, fish stocks, fish habitat, and the recreational, commercial, and charter-fishing industry in the northern GOM.

5.2.5 RESTORE Act Centers of Excellence Research Grant Programs

The Department of the Treasury-administered Centers of Excellence Research Grants Program, (i.e., Pot 5) makes 2.5% of the DWH civil penalties ($133 million) available for competitive grants used for science, technology, and monitoring to NGOs and consortia in the Gulf Coast region. Administering organizations in each state include:

Alabama Gulf Coast Recovery Council or its designated administrative agent
Florida Institute of Oceanography
Louisiana Coastal Protection and Restoration Authority
Mississippi Department of Environmental Quality
Texas One Gulf and Subsea Systems Institute Centers of Excellence for Texas.

5.3 National Fish and Wildlife Foundation

5.3.1 National Fish and Wildlife Foundation Gulf Response Grants

From 2010 to 2012, the National Fish and Wildlife Foundation (NFWF) invested $22.9 million in conservation actions in the northern GOM to minimize the effects of the DWH oil spill on key fish and wildlife species. Projects focused on the species most at risk, including shorebirds, waterfowl and marsh birds, seabirds, sea turtles, marine mammals, oysters, and others.

5.3.2 NFWF Gulf Environmental Benefit Fund

Between 2013 and 2018, NFWF's Gulf Environmental Benefit Fund (GEBF) will receive $2.54 billion from the settlement of criminal cases that arose from the 2010 DWH oil spill. These funds will support barrier island and river diversion projects in Louisiana ($1.27 billion) and natural resource projects in Alabama ($356 million), Florida ($356 million), Mississippi ($356 million), and Texas ($203 million). To date, NFWF has worked closely with key state and federal resource agencies to award over $880 million of GEBF funds for projects designed to protect, restore, and enhance natural and living resources across the Gulf Coast.

5.3.3 NFWF Gulf Coast Conservation Grants Program

NFWF's Gulf Coast Conservation Grants Program supports conservation projects that enhance coastal habitats of the northern GOM and bolster priority fish and wildlife populations, while strengthening resilience within the coastal region. The program supports priority conservation needs of the Gulf that are not otherwise expected to be funded under GEBF or other funding opportunities associated with the DWH oil spill. This program's overall annual funding level is approximately $3–5 million and individual grant awards range typically between $50,000 and $250,000.

5.4 The National Academies of Science Gulf Research Program

The Gulf Research Program works to enhance oil system safety and the protection of human health and the environment in the GOM and other United States outer continental shelf areas. The program seeks to improve understanding of the region's interconnecting human, environmental, and energy systems; and foster application of these insights to benefit GOM communities and ecosystems.

References

DWH NRDA Trustees. 2016. *Deepwater Horizon* Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement. *Deepwater Horizon* Natural Resource Damage Assessment Trustees. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

Framework for Early Restoration. 2011. Framework for Early Restoration Addressing Injuries Resulting from the *Deepwater Horizon* Oil Spill. Available: https://www.restorethegulf.gov/sites/default/files/documents/pdf/framework-for-early-restoration-04212011.pdf.

Brown pelican. Credit: Kimberly Middlebrooks.

Module 4

Considerations for Restoration – Birds

1. Introduction

The large number of individuals, diversity of species, broad geographic range, and specific life-history requirements of birds injured by the *Deepwater Horizon* (DWH) oil spill necessitates a portfolio of restoration approaches to appropriately compensate the public for those injuries (see Modules 1 and 2). Therefore, bird restoration will likely take place in areas across the Gulf of Mexico (GOM) and in areas outside of the northern GOM where injured bird species migrate to and breed, such as the upper Midwest, Canada, northeast Atlantic, Mexico, and Caribbean. Conservation actions for birds often address threats to different species and/or guilds, as described in several available restoration and conservation planning documents (e.g., Hunter, 2000; Granfors and Niemuth, 2005; Ringelman et al., 2005; Hunter et al., 2006; Vermillion and Wilson, 2009; Schulte, 2016; USFWS, 2016a, 2016b), or regionally limiting factors for species and/or guilds, such as available nesting or foraging habitat (e.g., marsh, coastal island, dune, grassland, etc.). The Trustees intend to take full advantage of existing programs and previous research – including but not limited to those mentioned above – when selecting and implementing restoration actions.

The PDARP/PEIS identifies potential approaches and techniques to enhance bird reproductive success and survival, which are central elements in restoration (DWH NRDA Trustees, 2016, Section 5.5.12 and Appendix 5.D.6). The purpose of Module 4 is to augment this information by identifying the techniques that may individually or collectively restore for bird injuries across different bird groups, and to provide example project concepts for each approach.

Module 4 may be updated based on additional knowledge obtained by DWH NRDA Trustee efforts or the broader science community as well as changes to relevant species recovery or management plans. Where applicable, restoration planning will be coordinated with existing statutes and entities charged with managing protected and managed resources, such as the Endangered Species Act, the Migratory Bird Treaty Act, species recovery teams, and federal and state agencies or offices.

Many of the habitat, water quality, oyster, or recreational-focused restoration projects implemented under the other NRDA DWH restoration types have the potential to provide ecosystem services that could benefit bird resources. Coordination between restoration types can influence planning and design in order to protect, enhance, or create bird species and their habitats. For example, bird-friendly features can be incorporated into a marsh restoration project or a recreational enhancement project.

Least Tern. Credit: Marc Rivadeneyra, FWC.

The Trustees intend to coordinate across resource groups to integrate critical bird features into restoration projects. This will be particularly important with the Wetlands, Coastal and Nearshore Habitats resource groups as they construct habitat projects throughout the GOM

that have the potential to benefit many of the bird species affected by the spill, as identified in the PDARP (DWH NRDA Trustees, 2016).

1.1 How to Use this Document

For the purposes of considering potential restoration activities to benefit the diversity of bird species injured by DWH, this document is arranged by distinct bird groups and subgroups described in Section 1.2 below and in Module 2. Section 2 describes the restoration approaches and techniques listed in the PDARP (see Module 1) and provides an overview of the potential restoration portfolio by bird subgroup. Section 3 (Northern GOM Nesting Birds) and Section 4 (Non-GOM Nesting Birds) outline potential approaches and techniques for each bird subgroup. These sections also include example project concepts and project-specific performance monitoring metrics as well as considerations for geographic scope. Section 5 focuses on potential project-specific and resource-level monitoring factors that could be considered during restoration of injured bird species.

This document is not intended to exhaustively present all possible restoration techniques and project concepts, nor to prescriptively describe the complete restoration plan for birds across all TIGs. This document provides relevant and helpful information for the Trustees and other stakeholders, including the public, to consider when evaluating and planning restoration projects. Readers are encouraged to submit restoration projects to the Trustee Project Portal and/or to state-specific project portals, as available.

1.2 Species Organization

For restoration planning purposes, bird species injured by DWH were organized into two principal groups: Northern GOM Nesting Birds (i.e., species that nest in the northern GOM) and Non-GOM Nesting Birds (i.e., species that, for the most part, nest outside the northern GOM). To maximize efficiencies in restoration planning and implementation, species within these groups were further organized into subgroups based on additional factors, such as life history parameters, habitat use, and breeding areas. The subgroups include:

- **Northern GOM Nesting Birds**
  - Colonial Waterbirds
  - Solitary Beach Nesting Birds[1]
  - Marsh Birds
  - Osprey
- **Non-GOM Nesting Birds**
  - Northern Nesting Birds
  - Northern Nesting Shorebirds
  - Prairie Pothole Nesting Species
  - Boreal Forest Nesting Species
  - Caribbean Nesting Species
  - Pelagic Birds

Module 2 provides a list of species for each subgroup above (see Module 2, Appendix A) as well as relevant biological and ecological supporting information (e.g., distribution, life history traits, threats, and DWH impacts).

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1. Species within this subgroup are primarily beach nesters, but may be found nesting in non-beach habitats (e.g., shell rakes).

2. Restoration Activities for Birds

This section describes the restoration approaches and techniques listed in the PDARP and provides a summary table to illustrate potential restoration benefits to different bird subgroups. These approaches and techniques can be used as restoration planning tools, used independently or in combination, to maximize benefits to injured resources and the northern GOM ecosystem.

The PDARP identifies several restoration approaches for various restoration types. Some approaches were bird-specific while other were habitat-focused. This framework reiterates the eight approaches included in the PDARP that will provide both direct and indirect benefits to birds, including reduced bird mortality, increased reproductive potential, and restored habitat to enhance bird fitness and survival.

Bird Restoration Approaches (Chapter 5, Appendix 5.D.6 and Appendix 5.D.1)

1. Restore and conserve bird nesting and foraging habitat
2. Establish or re-establish breeding colonies
3. Prevent incidental bird mortality
4. Create, restore, and enhance coastal wetlands
5. Restore and enhance dunes and beaches
6. Create, restore, and enhance barrier and coastal islands and headlands
7. Restore and enhance submerged aquatic vegetation (SAV)
8. Protect and conserve marine, coastal, estuarine, and riparian habitats.

All approaches are expected to benefit birds either directly and/or indirectly. Approaches 4–8 are habitat-based approaches and not specific to bird restoration. For purposes of this document, they have been incorporated into the three bird-specific approaches (1–3 in the list above). This section presents some examples of benefits.

2.1 Bird Restoration Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

This approach includes conserving, restoring, and managing habitat for the benefit of birds, and could employ, but is not limited to, the techniques described below.

- **Enhance habitat through vegetation management**

Managing vegetation is a common restoration technique to create or enhance habitat for specific bird species. For example, reducing vegetation on beaches 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, prescribed fire, and active planting.

- **Restore or create riverine islands**

This technique would restore or create habitat on islands in lakes or rivers for bird species that winter along the northern GOM and migrate to areas outside of the northern GOM to nest. This technique 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**

Oyster shell rake creation or enhancement would increase nesting and foraging habitat for birds. Shell rakes, build-ups of oyster and other shells found along beaches and the edges of marshes, constitute important nesting and roosting habitat for shorebirds. Methods include, but are not limited to, 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 focuses on protecting bird nesting and foraging habitat through increased stewardship in important bird areas to reduce disturbance, limit predator access, reduce predation, or otherwise improve habitat quality. Stewardship may be implemented in several ways, including, but not limited to: placement of exclusion devices and vegetated buffers, raised boardwalks over or fences around dunes, maintaining beach wrack and distance buffers, lethal and nonlethal predator control, reduced vehicle speed limits or vehicular access, patrols by wildlife stewards or law enforcement, and targeted outreach and education.

- **Provide or enhance artificial nest sites**

The lack of suitable nesting sites, such as those provided by tree cavities or shrub or tree platforms, can limit local bird densities. Providing or enhancing artificial nest sites, such as nest platforms, nest boxes, and rooftops, can help mitigate this limitation and facilitate breeding for certain bird species.

- **Increase availability of foraging habitat at managed moist-soil impoundments, agricultural fields, and aquaculture ponds**

This technique would manage water depth, salinity, and timing of shallowly-flooded impoundments, fields, ponds, and agricultural fields to provide foraging habitat for shorebirds, wading birds, and waterfowl and provide suitable prey or food items, especially during migration and periods of drought.

- **Create or enhance coastal wetlands through placement of dredged material**

This technique would restore or enhance wetlands used by birds by utilizing dredged sediments to create new lands or enhance the elevation of existing wetlands to conditions that are conducive to re-establishing wetland habitats that support affected species. Examples include creating or enhancing deteriorating marshes, and creating sand flats and intertidal mud flats.

- **Backfill canals**

This technique would restore vegetated habitat and appropriate tidal flux to coastal wetlands used by birds that have been 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 recreational or residential purposes. In most cases, canals would be filled using sediment derived from the adjacent spoil bank (Turner et al., 1994; Baustian and Turner, 2006).

- **Restore hydrologic connections to enhance coastal habitats**

This technique would restore or improve salinity gradients across the estuarine landscape by re-establishing natural hydrologic flow regimes to enhance existing coastal habitats, including estuaries, marshes, mangroves, and pine savannahs used by birds.

- **Construct groins, breakwaters, or use sediment bypass methods**

This technique would protect coastal wetland habitat used by birds through the construction of offshore and nearshore groins or breakwaters parallel to the shoreline for the purpose of reducing shoreline erosion. These structures can increase the lifespan of beaches near passes, inlets, or in areas where erosion rates are high and sediment supply is limited.

- **Renourish beaches through sediment addition**

Beach renourishment or replenishment involves placing additional suitable sediment from outside sources to supplement the natural sources of sediment feeding the eroding beach used by birds.

- **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 used by birds. Passive restoration techniques could include, but are not limited to, placing sand fencing, hay bales, and recycled Christmas trees to capture sand.

- **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 used by birds. Restoration can occur on existing barrier and coastal islands, or through the creation of new islands.

- **Plant vegetation on dunes and back-barrier marsh**

Essential components of barrier or coastal island restoration or creation can include planting vegetation on the newly created dunes and in back-barrier marshes used by birds. Vegetative root structure stabilizes marsh and 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 and back-barrier marshes, providing habitat for fish and invertebrates, birds, and other shoreline wildlife.

Evia Island Terns. Credit: Woody Woodrow, USFWS.

- **Backfill scars with sediment**

Healthy SAV provides habitat and foraging areas for invertebrates, sea turtles, fish, waterfowl, and birds**.** Minimizing further sediment deterioration and erosion and enhancing vegetation communities can improve stability and colonization in SAV beds. 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.

- **Revegetate SAV beds via propagation and/or transplanting**

Revegetating SAV beds used by birds can reduce deterioration of beds and stabilize sediments, thus preventing erosion. SAV beds can be revegetated through broadcast seeding

and transplanting whole plants (Fonseca, 1994; Fonseca et al., 1994, 1998; Treat and Lewis, 2006; Farrer, 2010).

- **Protect and enhance SAV through wave attenuation structures**

Segmented living shorelines or permeable barriers (e.g., oyster reefs) that dissipate wave energy and enable SAV to naturally regenerate behind them have been previously used in northern GOM coastal areas. This technique could also include maintaining the integrity of existing living barriers used by birds, such as barrier islands (Thomson et al., 2010).

- **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.

- **Develop and implement management actions in conservation areas**

Developing and implementing management actions for existing and proposed conservation areas can directly enhance habitats through activities such as debris removal, invasive species control, fire management, and vegetative management. Habitat management activities can also provide for the enhancement of nesting and foraging areas for various bird species across the northern GOM.

2.2 Bird Restoration Approach 2: Establish or Re-Establish Breeding Colonies

This approach focuses on establishing or re-establishing bird breeding colonies in areas where historical breeding sites have been abandoned (e.g., due to predators or human disturbance). This approach would most likely be implemented following restoration actions, such as predator removal, vegetation management, or disturbance reducing actions. This approach could employ, but is not limited to, the following techniques:

- **Use acoustic vocalization playbacks and decoys to attract breeding adults to restoration sites**

This technique uses playback of species-specific acoustic vocalizations (e.g., breeding adult calls, chick calls) and decoy birds to attract nesting pairs to restored nesting sites. This technique is best-suited for social colonial nesters (e.g., seabirds, skimmers, terns), especially those species with nesting site fidelity.

2.3 Bird Restoration Approach 3: Prevent Incidental Bird Mortality

This approach focuses on mitigating anthropogenic activities that can lead to incidental bird mortality. This approach could employ, but is not limited to, the following techniques:

- **Remove derelict fishing gear**

Fishing line and commercial fishing gear entanglement can be a significant source of mortality for birds. Methods for implementing this technique include, but are not limited to: removing derelict fishing gear, providing receptacles for disposal of fishing line at recreational fishing areas (boat ramps, piers, etc.); providing education, such as ways to avoid entanglements and release techniques; and providing support for rescue and release of entangled birds.

- **Support bird rehabilitation centers**

This technique would support targeted enhancements in sick or injured bird recovery and rehabilitation efforts to increase the number of birds rehabilitated and released, thereby decreasing preventable mortality. Sick, injured, or disoriented birds are often found by members of the 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.

- **Reduce collisions by modifying lighting and/or lighting patterns on oil and gas platforms**

Red and white lights used by offshore oil and gas platforms and alternative energy production structures (e.g., wind turbines, kinetic energy facilities) can disrupt magnetic and visual cues used by migrating birds, causing collision and circulation events (Evans Ogden, 1996; Montevecchi et al., 2006; Wiese et al., 2001; Russell, 2005; Poot et al., 2008). 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 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**

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.

2.4 Summary of Bird Approaches and Techniques by Bird Group and Subgroup

The bird restoration approaches and techniques described above have the potential to directly benefit individual or multiple bird groups, subgroups, or species. Therefore, restoration planning and implementation should consider the specific threats and restoration needs across these levels, as appropriate. Table 1 below presents potential approaches and techniques that are relevant for each bird group and subgroup injured by DWH (see Section 1.2 and Appendix A of Module 2). All approaches may not be applicable to each bird subgroup.

Table 1. Potential restoration approaches and techniques for bird subgroups described in Section 1.2. An "X" denotes subgroups that will likely benefit from the corresponding approaches and techniques.

		Northern GOM nesting birds				Non-GOM nesting birds					
Approach	Technique	Colonial waterbirds	Solitary beach nesting birds	Marsh birds	Osprey	Northern nesting birds	Northern shorebirds	Prairie pothole nesting birds	Boreal forest nesting birds	Caribbean nesting birds	Pelagic birds
Restore and conserve bird nesting and foraging habitat	Enhance habitat through vegetation management	X	X	X		X	X	X	X	X	X
	Restore or create riverine islands	X				X					
	Create or enhance oyster shell rakes and beds	X	X				X				
	Nesting and foraging area stewardship	X	X	X	X	X	X	X	X	X	X
	Provide or enhance artificial nest sites	X			X	X		X	X	X	X
	Increase availability of foraging habitat at inland, managed moist-soil impoundments, agricultural fields, aquaculture ponds, and wetlands	X		X	X		X	X	X		
	Create, restore, or enhance coastal wetlands through placement of dredged material	X		X			X	X	X		
	Backfill canals			X				X			
	Restore hydrologic connections to enhance coastal habitats	X	X	X	X		X	X	X		
	Construct groins, breakwaters, or use sediment bypass methods	X	X	X		X		X	X		
	Renourish beaches through sediment addition	X	X			X					
	Restore dune and beach systems through the use of passive techniques to trap sand	X	X			X	X				
	Restore or construct barrier and coastal islands and headlands via placement of dredged sediments	X	X			X	X		X		
	Plant vegetation on dunes and back-barrier marsh	X		X							
	Backfill scars with sediment							X			
	Revegetate SAV beds via propagation and/or transplanting							X	X		
	Protect SAV beds with buoys, signage, and/or other protective measures							X	X		

		Northern GOM nesting birds				Non-GOM nesting birds					
Approach	Technique	Colonial waterbirds	Solitary beach nesting birds	Marsh birds	Osprey	Northern nesting birds	Northern shorebirds	Prairie pothole nesting birds	Boreal forest nesting birds	Caribbean nesting birds	Pelagic birds
	Protect and enhance SAV through wave attenuation structures							X	X		
	Acquire lands for conservation (habitat acquisition through fee-title and/or easement purchases	X	X	X		X	X	X	X	X	
	Develop and implement management actions in conservation areas and/or restoration projects	X	X	X	X	X	X	X	X	X	X
Establish or re-establish breeding colonies	Use acoustic vocalization playbacks and decoys to attract breeding adults to restoration sites	X				X				X	
Prevent incidental bird mortality	Remove derelict fishing gear	X	X		X	X				X	X
	Support bird rehabilitation centers	X	X		X	X	X			X	X
	Reduce collisions by modifying lighting and/or lighting patterns on oil and gas platforms					X				X	X
	Reduce seabird bycatch through voluntary fishing gear and/or technique modification					X				X	X

3. Northern GOM Nesting Birds

3.1 Colonial Waterbirds

Module 2 provides biological and ecological supporting information as well as a comprehensive list and explains how species subgroups were created (see Module 2, Appendix A).

Species within this subgroup include wading birds (e.g., herons, egrets, ibises, spoonbills), ground-nesting species (e.g., terns, gulls, black skimmers), and brown pelicans. These species utilize a host of different substrates (e.g., trees, shrubs, bare rock, burrows, sandy beaches, rooftops, gravel parking lots) in which to nest. Bird species in this group are affected by human disturbance, predation in nesting areas, erosion and subsidence to nesting substrate, and loss or decline of high quality shallow-water foraging habitat adjacent to nesting areas. Restoration actions in nesting areas are an effective option to restore injuries to this subgroup.

Potential restoration approaches, techniques, project concepts, and project-specific performance monitoring metrics for this subgroup are presented in the tables below. These tables are not intended to be an exhaustive or exclusive list of restoration actions that can be implemented by the Trustees.

Huguenot Royal Tern Colony. Credit: Marc Rivadeneyra, FWC.

3.1.1 Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

Colonial Waterbirds

Potential techniques	Example project concepts	Potential geographic scope

• Enhance habitat through vegetation management
• Restore or create riverine islands
• Create or enhance oyster shell rakes and beds
• Nesting and foraging area stewardship
• Provide or enhance artificial nest sites
• Increase availability of foraging habitat at inland, managed moist-soil impoundments, agricultural fields, aquaculture ponds, and wetlands
• Create, restore, or enhance coastal wetlands through placement of dredged material
• Restore hydrologic connections to enhance coastal habitats
• Construct groins, breakwaters, or use sediment bypass methods
• Renourish beaches through sediment addition
• Restore dune and beach systems through the use of passive techniques to trap sand
• Restore or construct barrier and coastal islands and headlands via placement of dredged sediments
• Plant vegetation on dunes and back-barrier marshes
• Acquire lands for conservation (habitat acquisition through fee-title and/or easement purchases)
• Develop and implement management actions in conservation areas and/or restoration projects
	• Create, enhance, and manage islands with suitable habitat for waterbird nesting
	• Control and maintain invasive and non-native species
	• Conduct and maintain predator control at active or historic nesting sites
	• Manage disturbances via stewardship, such as increased resources to law enforcement and education/outreach
	• Manage habitat on riverine islands
	• Create and manage intertidal oyster reefs to provide foraging habitat
	• Provide, enhance, and manage artificial nest sites, e.g., rooftops, floating barges, derelict bridges, nesting platforms
	• Install and maintain breakwaters to slow erosion and conserve habitat for nesting birds
	• Work with non-profit and land management groups to identify and preserve intact valuable habitat
	• Install and maintain segmented breakwaters and groins around existing colonies to trap sand and protect shoreline from wind driven wave erosion
	• Establish and maintain protected nesting and foraging areas with focused management, conservation, and stewardship activities
	• Restore and maintain hydrologic connections to enhance estuarine health
		• GOM
		  – Island colonies
		  – Nearshore habitats/waters

		Example project-specific performance monitoring metrics
		• Presence/absence or abundance of focal species • Presence/absence or # of nesting pairs • Reproductive success (e.g., # of nests, fledglings, etc.) • Survival (adults, juveniles, and/or chicks) • # of nests protected • # of sites with targeted predation management • # of acres of habitat created, restored, managed, and/or under increased stewardship • Density, abundance, and/or availability of prey species • # of education/ outreach materials distributed or people reached

3.1.2 Approach 2: Establish or Re-Establish Breeding Colonies

Colonial Waterbirds

Potential techniques	Example project concepts	Potential geographic scope
• Use acoustic vocalization playbacks and decoys to attract breeding adults to restoration sites	• Place and manage bird decoys and use acoustic vocalization playbacks to entice colonial nesters (e.g., terns and black skimmers) to created or restored areas	• GOM – Island colonies – Nearshore habitats/waters **Example project-specific performance monitoring metrics** • Presence/absence or abundance of focal species • Presence/absence or # of nesting pairs • Reproductive success (e.g., # of nests, fledglings, etc.) • Survival (adults, juveniles, and/or chicks) • # of established/re-established colonies

3.1.3 Approach 3: Prevent Incidental Bird Mortality

Colonial Waterbirds

Potential techniques	Example project concepts	Potential geographic scope
• Remove derelict fishing gear • Support bird rehabilitation centers	• Support, fund, and maintain marine debris removal (including derelict fishing gear) in/around nesting/foraging areas • Conduct beach combing on remote beaches or beaches near nesting colonies • Provide and maintain receptacles at recreational fishing areas (e.g., boat ramps, piers) • Conduct outreach and education aimed at avoiding bird entanglements, capture, and release techniques • Provide resources to local rehabilitation centers and support for die-off or mortality investigations	• GOM – Island colonies – Nearshore habitats/waters – Marsh edge – Interior marsh **Example project-specific performance monitoring metrics** • Units of marine debris removed • # of receptacles provided • Mortality, injury, or survival related to gear entrapment • # of birds rehabbed/released • # of mortality cases investigated • # of education/outreach materials distributed or people reached

3.2 Solitary Beach Nesting Birds

Module 2 provides biological and ecological supporting information as well as a comprehensive list and explains how species subgroups were created (see Module 2, Appendix A).

Species in this subgroup (e.g., plovers, American oystercatchers, willets) do not nest in groups or colonies. Pairs prefer to nest alone, away from other nesting birds. Species can be found in a variety of coastal habitats, including sand or shell beaches, dunes, saltmarshes, marsh islands, mudflats, and dredge spoil islands made of sand or gravel. Habitat loss and alteration, predation, and human disturbance are the primary threats to this subgroup in the northern GOM.

Potential restoration approaches, techniques, project concepts, and project-specific performance monitoring metrics for this subgroup are presented in the tables below. These tables are not intended to be an exhaustive or exclusive list of restoration actions that can be implemented by the Trustees.

3.2.1 Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

Solitary Beach Nesting Birds

Potential techniques	Example project concepts	Potential geographic scope

• Enhance habitat through vegetation management
• Create or enhance oyster shell rakes and beds
• Nesting and foraging area stewardship
• Restore hydrologic connections to enhance coastal habitats
• Construct groins, breakwaters, or use sediment bypass methods
• Renourish beaches through sediment addition
• Restore dune and beach systems through the use of passive techniques to trap sand
• Restore or construct barrier and coastal islands and headlands via placement of dredged sediments
• Acquire lands for conservation (habitat acquisition through fee-title and/or easement purchases
• Develop and implement management actions in conservation areas and/or restoration projects
	• Create or enhance and manage coastal islands
	• Enhance, stabilize, and manage oyster rakes to maintain breeding and foraging habitat of birds
	• Renourish and manage beaches to historic footprints using beneficial use and shoreline protection
	• Acquire and manage beach habitat areas adjacent to conservation areas to enhance shorebird nesting
	• Create, enhance, and manage habitat (e.g., oyster shell beaches, construct elevated features, vegetative management, etc.)
	• Construct and manage groins and segmented breakwaters to passively trap sand and preserve beach shorelines for nesting birds
	• Establish and maintain protected nesting and foraging areas with focused management, conservation, and stewardship activities (e.g., limited human access/disturbance, law enforcement, and predator control)
	• Restore and maintain hydrologic connections to enhance estuarine health
	• Conduct and maintain predator control at active or historic nesting sites
		• GOM
		  – Beaches
		  – Nearshore habitats/waters
		
		Example project-specific performance monitoring metrics
		
		• Presence/absence or abundance of focal species
		• Presence/absence or # of nesting pairs
		• Reproductive success (e.g., # of nests, fledglings, etc.)
		• Survival (adults, juveniles, and/or chicks)
		• # of nests protected/# of sites with targeted predation management
		• # of acres of habitat created, restored, managed, and/or under increased stewardship
		• Nest location/ habitat preference(s) of nesting pairs
		• # of education/outreach materials distributed or people reached

3.2.2 Approach 3: Prevent Incidental Bird Mortality

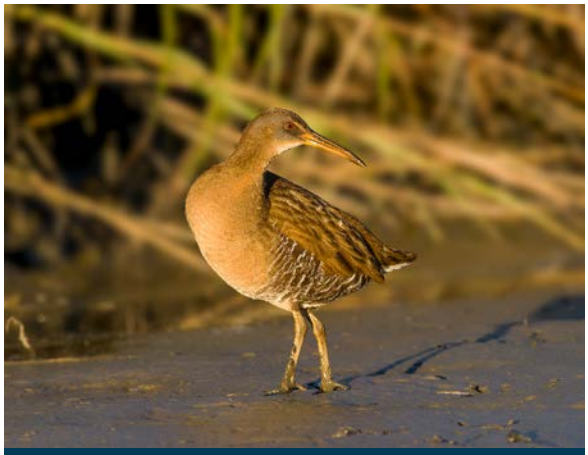
Solitary Beach Nesting Birds

Potential techniques	Example project concepts	Potential geographic scope
• Remove derelict fishing gear • Support bird rehabilitation centers	• Support, fund, and maintain marine debris removal (including derelict fishing gear) in/around nesting/foraging areas • Conduct beach combing on remote beaches or beaches near nesting areas • Provide and maintain receptacles at recreational fishing areas (boat ramps and piers) • Provide resources to local rehabilitation centers and support for die-off or mortality investigations.	• GOM – Island colonies – Nearshore habitats/waters – Marsh edge **Example project-specific performance monitoring metrics** • Units of marine debris removed • # of receptacles provided • Mortality, injury, or survival related to gear entrapment • # of birds rehabbed/released • # of mortality cases investigated

3.3 Marsh Birds

Module 2 provides biological and ecological supporting information as well as a comprehensive list and explains how species subgroups were created (see Module 2, Appendix A).

The Marsh Birds subgroup includes species that live and forage predominantly in coastal salt or freshwater marshes. Species in this subgroup include rails, grackles, blackbirds, seaside sparrow, grebes, mottled duck, and least bittern. Habitat loss and alteration, predation, declines in forage base, pollution, and human disturbance are the primary threats to Marsh Birds in the northern GOM.



Clapper Rail. Credit: Mike Gray.

Potential restoration approaches, techniques, project concepts, and project-specific performance monitoring metrics for this subgroup are presented in the table below. This table is not intended to be an exhaustive or exclusive list of restoration actions that can be implemented by the Trustees.

3.3.1 Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

Marsh Birds

Potential techniques	Example project concepts	Potential geographic scope

• Enhance habitat through vegetation management
• Nesting and foraging area stewardship
• Increase availability of foraging habitat at managed moist-soil impoundments, agricultural fields, aquaculture ponds, and wetlands
• Create, restore, or enhance coastal wetlands through placement of dredged material
• Backfill canals
• Restore hydrologic connections to enhance coastal habitats
• Construct groins, breakwaters, or use sediment bypass methods
• Plant vegetation on dunes and back-barrier marshes
• Acquire lands for conservation (habitat acquisition through fee-title and/or easement purchases
• Develop and implement management actions in conservation areas and/or restoration projects
	• Acquire and manage lands to enhance nesting activities
	• Restore and manage hydrologic and estuarine health of coastal wetlands, including marsh
	• Incorporate and manage habitat features (e.g., water availability, habitat connectivity, vegetation management) within new and existing marsh creation projects that benefits nesting, foraging and survival
	• Create, restore, and manage tidal and supratidal wetlands with dredged sediment
	• Construct and manage shoreline breakwaters to preserve existing marsh from wind driven wave erosion
		• GOM
		  – Nearshore habitats/waters
		  – Marsh edge
		  – Interior marsh
		Example project-specific performance monitoring metrics
		• Presence/absence or abundance of focal species
		• Presence/absence or # of nesting pairs
		• Reproductive success (e.g., # of nests, fledglings, etc.)
		• Survival (adults, juveniles, and/or chicks)
		• # of acres of habitat created, restored, managed, and/or under increased stewardship

3.4 Osprey

Ospreys are apex predators in coastal areas throughout the northern GOM. Ospreys have adapted to a changing landscape and now nest in any type of elevated, manmade structure in the vicinity of fresh, estuarine, and marine water bodies. Habitat loss and alteration, predation, declines in forage base, and pollution are the primary threats to Ospreys in the northern GOM. Osprey breeding and foraging habitat will likely be enhanced by other restoration actions, such as restoring, enhancing, and creating wetlands, or restoring dunes and beaches.

Potential restoration approaches, techniques, project concepts, and project-specific performance monitoring metrics for this subgroup are presented in the tables below. These tables are not intended to be an exhaustive or exclusive list of restoration actions that can be implemented by the Trustees.

3.4.1 Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

Osprey

Potential techniques	Example project concepts	Potential geographic scope
• Nesting and foraging area stewardship • Increase availability of foraging habitat at managed moist-soil impoundments, agricultural fields, aquaculture ponds, and wetlands • Develop and implement management actions in conservation areas and/or restoration projects • Restore hydrologic connections to enhance coastal habitats • Provide or enhance artificial nest sites	• Conduct and maintain predator control at active or historic nesting sites • Install and maintain predator guards on trees and/or nesting structures • Maintain existing and construct and manage additional artificial nest platforms • Provide and manage resources for increased stewardship (e.g., law enforcement, education) • Restore and maintain hydrologic connections to enhance estuarine health	• GOM – Nearshore habitats/waters – Marsh edge – Interior marsh **Example project-specific performance monitoring metrics** • Presence/absence or abundance • Presence/absence or # of nesting pairs • Reproductive success (e.g., # nests, fledglings, etc.) • Survival (adults, juveniles, and/or chicks) • # of artificial nest platforms • # of nests protected • # of acres of habitat created, restored, managed, and/or under increased stewardship • # of sites with targeted predation management • # of education/outreach materials distributed or people reached

3.4.2 Approach 3: Prevent Incidental Bird Mortality

Osprey

Potential techniques	Example project concepts	Potential geographic scope
• Remove derelict fishing gear • Support bird rehabilitation centers	• Support, fund, and maintain marine debris removal (including derelict fishing gear) in/around nesting/foraging areas • Provide and maintain receptacles at recreational fishing areas (boat ramps and piers) • Provide resources to local rehabilitation centers and support for die-off or mortality investigations	• GOM – Island colonies – Nearshore habitats/waters – Marsh edge – Interior marsh **Example project-specific performance monitoring metrics** • Units of marine debris removed • # of receptacles provided • # of birds rehabbed/released • # of mortality cases investigated

4. Non-GOM Nesting Birds

4.1 Northern Nesting Birds

Module 2 provides biological and ecological supporting information as well as a comprehensive list and explains how species subgroups were created (see Module 2, Appendix A).

This subgroup includes five bird species: the piping plover, northern gannet, common loon, American white pelican, and double-crested cormorant. Species in this subgroup winter in the northern GOM, but nest further north in the United States and Canada.

A number of restoration approaches and techniques may be used to address injury to this subgroup, given their specialized needs. Activities that reduce disturbance at their northern nesting areas and foraging sites throughout their range may aid restoration of all species in this group. Many techniques employed in the northern GOM will provide benefits to these species as well.

Potential restoration approaches, techniques, project concepts, and project-specific performance monitoring metrics for this subgroup are presented in the tables below. These tables are not intended to be an exhaustive or exclusive list of restoration actions that can be implemented by the Trustees.

4.1.1 Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

Northern Nesting Birds

Potential techniques	Example project concepts	Potential geographic scope
• Enhance habitat through vegetation management • Restore or create riverine islands • Nesting and foraging area stewardship • Provide or enhance artificial nest sites • Construct groins, breakwaters, or use sediment bypass methods • Renourish beaches through sediment addition • Restore dune and beach systems through the use of passive techniques to trap sand • Restore or construct barrier and coastal islands and headlands via placement of dredged sediments • Acquire lands for conservation (habitat acquisition through fee-title and/or easement purchases) • Develop and implement management actions in conservation areas and/or restoration projects	• Implement and manage beach nourishment utilizing beneficial dredge sediment to enhance and manage foraging opportunities • Support and manage stewardship of critical nesting sites, migratory stopover, and wintering habitats (e.g., predator control, education, law enforcement) • Protect and manage critical nesting habitats to avoid future land conversion (e.g., acquisition) • Install and manage floating artificial nesting platforms (loons) • Create, enhance, and manage riverine islands for nesting birds • Control and maintain invasive and non-native plant species to enhance nest sites • Conduct and maintain predator control at active or historic nesting sites	• GOM – Nearshore habitats/waters – Marsh edge • GOM Offshore • Outside GOM: U.S. • Outside GOM: international
		Example project-specific performance monitoring metrics
		• Presence/absence or abundance of focal species • Presence/absence or # of nesting pairs • Reproductive success (e.g., # of nests, fledglings, etc.) • Survival (adults, juveniles, and/or chicks) • # of nests protected • # of sites with targeted predation management • # of acres of habitat created, restored, managed, and/or under increased stewardship • # of artificial platforms • Density, abundance, and availability of prey species • # of education/outreach materials distributed or people reached

4.1.2 Approach 2: Establish or Re-Establish Breeding Colonies

Northern Nesting Birds

Potential techniques	Example project concepts	Potential geographic scope
• Use acoustic vocalization playbacks and decoys to attract breeding adults to restoration sites	• Use and manage decoys or acoustic playbacks of breeding vocalizations to entice nesting pairs to use restored or created nesting sites	• Outside GOM: U.S. • Outside GOM: international **Example project-specific performance monitoring metrics** • Presence/absence or abundance of focal species • Presence/absence or # of nesting pairs • Reproductive success (e.g., # of nests, fledglings, etc.) • Survival (adults, juveniles, and/or chicks) • # of established/re-established colonies

4.1.3 Approach 3: Prevent Incidental Bird Mortality

Northern Nesting Birds

Potential techniques	Example project concepts	Potential geographic scope

• Remove derelict fishing gear
• Support bird rehabilitation centers
• Reduce collisions by modifying lighting and/or lighting patterns on oil and gas platforms
• Reduce bycatch through voluntary fishing gear and/or techniques
	• Support, fund, and maintain marine debris removal (including derelict fishing gear) in/around nesting/foraging areas
	• Provide and maintain receptacles at recreational fishing areas (boat ramps and piers)
	• Provide resources to local rehabilitation centers and support for die-off or mortality investigations.
	• Develop partnerships and implement agreements with energy companies to change lighting patterns/retrofit lighting types on existing offshore structures/platforms
	• Develop partnerships with other state and federal regulatory agencies to implement public outreach/meetings to provide information about voluntary fishing gear or techniques that reduces bird bycatch
		• GOM
		  – Nearshore habitats/waters
		  – Marsh edge
		• GOM: offshore
		• GOM: offshore waters
		• Outside GOM: U.S.
		• Outside GOM: international
		Example project-specific performance monitoring metrics
		• Units of marine debris removed
		• # of receptacles provided
		• Mortality, injury, or survival related to gear entrapment
		• # of birds rehabbed/released
		• # of mortality cases investigated
		• # of lighting retrofit projects or pattern modifications
		• # of birds killed by bycatch
		• # of education/outreach materials distributed or people reached

4.2 Northern Nesting Shorebirds

Module 2 provides biological and ecological supporting information as well as a comprehensive list and explains how species subgroups were created (see Module 2, Appendix A).

Species in this subgroup (e.g., sanderlings, dunlins, ruddy turnstones) primarily breed in northern and central Canada or northern Alaska and winter in the northern GOM. These species use a variety of nearshore habitats, primarily sandy beaches, but also mudflats, lagoons, and man-made rock jetties.

Restoration actions on nesting grounds are potentially difficult to implement, though the Trustees may choose to implement actions at nesting grounds where feasible. Alternatively, restoration approaches and techniques focused on inland and coastal migratory stopover areas and northern GOM wintering areas have the potential to benefit multiple species within this subgroup and the Trustees expect to implement these types of projects where appropriate. Many techniques employed in the northern GOM will provide benefits to these species as well.

Potential restoration approaches, techniques, project concepts, and project-specific performance monitoring metrics for this subgroup are presented in the tables below. These tables are not intended to be an exhaustive or exclusive list of restoration actions that can be implemented by the Trustees.

4.2.1 Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

Northern Nesting Shorebirds

Potential techniques	Example project concepts	Potential geographic scope

• Enhance habitat through vegetation management
• Create or enhance oyster shell rakes and beds
• Nesting and foraging area stewardship
• Increase availability of foraging habitat at managed moist-soil impoundments, agricultural fields, aquaculture ponds, and wetlands
• Create, restore, or enhance coastal wetlands through placement of dredged material
• Restore hydrologic connections to enhance coastal habitats
• Restore dune and beach systems through the use of passive techniques to trap sand
• Restore or construct barrier and coastal islands and headlands via placement of dredged sediments
• Acquire lands for conservation (habitat acquisition through fee-title and/or easement purchases
• Develop and implement management actions in conservation areas and/or restoration projects
	• Construct and manage moist-soil areas to create forage habitat in flyways
	• Implement and manage beach nourishment actions utilizing beneficial dredge sediment to enhance foraging opportunities
	• Support and manage stewardship of critical nesting sites, migratory stopover, and wintering habitats (e.g., predator control, education, law enforcement)
	• Protect and manage critical nesting habitats to avoid future land conversion (e.g., acquisition)
	• Construct and maintain segmented breakwaters to trap sand and protect shorelines that provide shorebird foraging habitat.
	• Conduct and maintain predator control at active or historic nesting sites
		• GOM
		  – Nearshore habitats/waters
		  – Marsh edge
		  – Interior marsh
		• Outside GOM: U.S.
		• Outside GOM: international

Example project-specific performance monitoring metrics
• Presence/absence or abundance of focal species • Presence/absence or # of nesting pairs • Reproductive success (e.g., # nests, fledglings, etc.) • Survival (adults, juveniles, and/or chicks) • # of nests protected • # of sites with targeted predation management • Species abundance • Density, abundance, and availability of prey species • # of acres of habitat created, restored, managed, and/or under increased stewardship • # of education/outreach materials distributed or people reached

4.2.2 Approach 3: Prevent Incidental Bird Mortality

Northern Nesting Shorebirds

Potential techniques	Example project concepts	Potential geographic scope
• Support bird rehabilitation centers	• Provide resources to local rehabilitation centers and support for die-off or mortality investigations	• GOM – Nearshore habitats/waters – Marsh edge – Interior marsh • Outside GOM: U.S.

Example project-specific performance monitoring metrics
• # of birds rehabbed/released • # of mortality cases investigated

4.3 Prairie Pothole Nesting Species

Module 2 provides biological and ecological supporting information as well as a comprehensive list and explains how species subgroups were created (see Module 2, Appendix A).

Birds in this subgroup (e.g., mallards, blue-winged teal) nest primarily in the Prairie Pothole wetlands (upper Midwest and Canada), but are dependent on northern GOM wetlands, bays, impoundments, flooded fields, and ponds for migratory stopover and wintering habitat. SAV in both estuarine and freshwater wetlands is a target foraging resource for these birds.

Many techniques employed in the northern GOM will provide benefits to these species as well. Potential restoration approaches, techniques, project concepts, and project-specific performance monitoring metrics for this subgroup are presented in the tables below. These tables are not intended to be an exhaustive or exclusive list of restoration actions that can be implemented by the Trustees.

American Coot Flock. Credit: USFWS.

4.3.1 Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

Prairie pothole nesting birds

Potential techniques	Example project concepts	Potential geographic scope

• Enhance habitat through vegetation management
• Nesting and foraging area stewardship
• Provide or enhance artificial nest sites
• Increase availability of foraging habitat at managed moist-soil impoundments, agricultural fields, aquaculture ponds, and wetlands
• Create, restore, or enhance coastal wetlands through placement of dredged material
• Backfill canals
• Restore hydrologic connections to enhance coastal habitats
• Construct groins, breakwaters, or use sediment bypass methods
• Backfill scars with sediment
• Re-vegetate SAV beds via propagation and/or transplanting
• Protect SAV beds with buoys, signage, and/or protective structures
• Protect and enhance SAV through wave attenuation structures
• Acquire lands for conservation (habitat acquisition through fee-title and/or easement purchases)
• Develop and implement management actions in conservation areas and/or restoration projects
	• Construct and manage moist-soil areas to create forage habitat in flyways
	• Incorporate and manage habitat features (e.g., water availability, habitat connectivity, vegetation management) within new and existing marsh creation projects that benefits foraging and survival
	• Construct and maintain structures (e.g., terraces, crevasse splays) that increase hydrologic connections in habitat benefits increased forage base (e.g., SAV, inverts) and overall marsh lifespan (e.g., wave attenuation)
	• Protect and manage critical nesting habitats to avoid future land conversion (e.g., acquisition)
		• GOM
		  – Nearshore habitats/waters
		  – Marsh edge
		  – Interior marsh
		• Outside GOM: U.S.
		
		Example project-specific performance monitoring metrics
		• Presence/absence or abundance of focal species
		• Presence/absence or # of nesting pairs
		• Reproductive success (e.g., # of nests, fledglings, etc.)
		• Survival (adults, juveniles, and/or chicks)
		• Species presence/absence or abundance
		• # of acres of habitat created, restored, managed, and/or under increased stewardship
		• # of structures

4.4 Boreal Forest Nesting Species

Module 2 provides biological and ecological supporting information as well as a comprehensive list and explains how species subgroups were created (see Module 2, Appendix A).

Bird species in this subgroup (e.g., scoters, green-winged teal, bufflehead) nest predominantly in the Canadian Western Boreal Forest Region and migrate to the northern GOM to winter. Species in this subgroup rely on the foraging and roosting habitats provided by northern GOM coastal wetlands while wintering in the area. Modified hydrology in many southeastern river basins, through channelization, levees, draining, or impoundment, has negatively affected natural water regimes supporting these wetlands.

Many techniques employed in the northern GOM will provide benefits to these species as well. Potential restoration approaches, techniques, project concepts, and project-specific performance monitoring metrics for this subgroup are presented in the tables below. These tables are not intended to be an exhaustive or exclusive list of restoration actions that can be implemented by the Trustees.

4.4.1 Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

Boreal forest nesting birds

Potential techniques	Example project concepts	Potential geographic scope
• Enhance habitat through vegetation management • Nesting and foraging area stewardship • Provide or enhance artificial nest sites • Increase availability of foraging habitat at managed moist-soil impoundments, agricultural fields, aquaculture ponds, and wetlands • Create, restore, or enhance coastal wetlands through placement of dredged material • Restore hydrologic connections to enhance coastal habitats • Construct groins, breakwaters, or use sediment bypass methods • Restore or construct barrier and coastal islands and headlands via placement of dredged sediments • Re-vegetate SAV beds via propagation and/or transplanting • Protect SAV beds with buoys, signage, and/or protective structures • Protect and enhance SAV through wave attenuation structures • Acquire lands for conservation (habitat acquisition through fee-title and/or easement purchases) • Develop and implement management actions in conservation areas and/or restoration projects	• Construct and manage moist-soil areas to create forage habitat in flyways to encourage SAV growth and attractive foraging areas (e.g., using pumps and water control structures to meet target habitat conditions) • Construct and maintain structures (e.g., terraces, crevasse splays) which increase hydrologic connections in habitat benefits increased forage base (e.g., SAV, inverts) and overall marsh lifespan (e.g., wave attenuation) • Construct and maintain breakwaters to preserve coastal marsh which provides habitat for waterfowl using interior marsh and nearby off-shore areas	• GOM – Nearshore habitats/waters – Marsh edge – Interior marsh • Outside GOM: U.S. • Outside GOM: international **Example project-specific performance monitoring metrics** • Presence/absence or abundance of focal species • Presence/absence or # of nesting pairs • Reproductive success (e.g., # of nests, fledglings, etc.) • Survival (adults, juveniles, and/or chicks) • # of acres of habitat created, restored, managed, and/or under increased stewardship • % of vegetative cover/density of marsh edge • % SAV density behind structures • # of structures

4.5 Caribbean Nesting Species

Module 2 provides biological and ecological supporting information as well as a comprehensive list and explains how species subgroups were created (see Module 2, Appendix A).

Masked Booby. Credit: USFWS.

Species in this subgroup include seabird species (e.g., frigate birds, boobies) that forage in the northern GOM waters, but nest primarily on islands in the Florida Keys, Dry Tortugas, or Caribbean. Habitat enhancement may involve management of invasive plant species by various means to restore species and habitat structure preferred by target seabird species. Species in this subgroup may benefit from management actions which create ideal nesting substrate such as shrubs, cacti, and bare ground.

Potential restoration approaches, techniques, project concepts, and project-specific performance monitoring metrics for this subgroup are presented in the tables below. These tables are not intended to be an exhaustive or exclusive list of restoration actions that can be implemented by the Trustees.

4.5.1 Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

Caribbean nesting birds

Potential techniques	Example project concepts	Potential geographic scope
• Enhance habitat through vegetation management • Nesting and foraging area stewardship • Provide or enhance artificial nest sites • Acquire lands for conservation (habitat acquisition through fee-title and/or easement purchases) • Develop and implement management actions in conservation areas and/or restoration projects	• Control and maintain invasive and non-native plant species to enhance nest sites for bare ground nesters • Plant and maintain native vegetation to enhance nesting areas for deep-cover ground nesters • Place and maintain artificial nest boxes for burrow nesters • Conduct and maintain predator control at active or historic nesting sites • Conduct public outreach to reduce human disturbance in and around active or historic nesting sites	• Outside northern GOM: U.S. • Outside GOM: international **Example project-specific performance monitoring metrics** • Presence/absence or abundance of focal species • Presence/absence or # of nesting pairs • Reproductive success (e.g., # of nests, fledglings, etc.) • Survival (adults, juveniles, and/or chicks) • # of nests protected • # of sites with targeted predation management • # of acres of habitat created, restored, managed, and/or under increased stewardship • % vegetative cover in nesting sites • # of nest boxes used by nesting pairs • # of education/outreach materials distributed or people reached

4.5.2 Approach 2: Establish or Re-Establish Breeding Colonies

Caribbean Nesting Birds

Potential techniques	Example project concepts	Potential geographic scope
• Use acoustic vocalization playbacks and decoys to attract breeding adults to restoration sites	• Place and manage bird decoys to entice colonial nesters to use created or restored areas	• Outside GOM: U.S. • Outside GOM: international **Example project-specific performance monitoring metrics** • Presence/absence or abundance of focal species • Presence/absence or # of nesting pairs • Reproductive success (e.g., # of nests, fledglings, etc.) • Survival (adults, juveniles, and/or chicks) • # of established/re-established colonies

4.5.3 Approach 3: Prevent Incidental Bird Mortality

Caribbean Nesting Birds

Potential techniques	Example project concepts	Potential geographic scope
• Remove derelict fishing gear • Support bird rehabilitation centers • Reduce collisions by modifying lighting and/or lighting patterns on oil and gas platforms • Reduce bycatch through voluntary fishing gear and/or techniques	• Support, fund, and maintain marine debris removal (including derelict fishing gear) in/around nesting/foraging areas • Conduct beach combing on remote beaches or beaches near nesting areas • Provide and maintain receptacles at recreational fishing areas (boat ramps and piers) • Provide resources to local rehabilitation centers and support for die-off or mortality investigations. • Develop partnerships and implement agreements with energy companies to change lighting patterns/retrofit lighting types on existing offshore structures/platforms • Develop partnerships with other state and federal regulatory agencies to implement public outreach/meetings to provide information about voluntary fishing gear or techniques that reduce bird bycatch	• GOM: nearshore • GOM: offshore waters • Outside GOM: U.S. • Outside GOM: international **Example project-specific performance monitoring metrics** • Units of marine debris removed • # of receptacles provided • Mortality, injury, or survival related to gear entrapment • # of birds rehabbed/released • # of mortality cases investigated • # of lighting retrofit projects or pattern modifications • # of birds killed by bycatch • # of education/outreach materials distributed or people reached

4.6 Pelagic Species

Module 2 provides biological and ecological supporting information as well as a comprehensive list and explains how species subgroups were created (see Module 2, Appendix A).

Bird species in this subgroup (e.g., storm-petrels, great shearwaters) are highly migratory and breed in areas more removed from the northern GOM, including Western Europe, remote islands in the eastern and southern Atlantic, or remote islands in the Pacific. Due to their broad range, focusing on enhancing reproductive output by reducing threats in breeding colonies may be the most cost-effective and sustainable technique to restore injuries from the Spill (NFWF, 2012).

Potential restoration approaches, techniques, project concepts, and project-specific performance monitoring metrics for this subgroup are presented in the tables below. These tables are not intended to be an exhaustive or exclusive list of restoration actions that can be implemented by the Trustees.

4.6.1 Approach 1: Restore and Conserve Bird Nesting and Foraging Habitat

Pelagic Birds

Potential techniques	Example project concepts	Potential geographic scope
• Enhance habitat through vegetation management • Nesting and foraging area stewardship • Provide or enhance artificial nest sites • Develop and implement management actions in conservation areas and/or restoration projects	• Control and maintain invasive and non-native plant species to enhance nest sites for bare ground nesters • Plant and maintain native vegetation to enhance nesting areas for deep-cover ground nesters • Place and maintain artificial nest boxes for burrow nesters • Conduct and maintain predator control at active or historic nesting sites • Conduct public outreach to reduce human disturbance in and around active or historic nesting sites	• Outside GOM: U.S. • Outside GOM: international

Example project-specific performance monitoring metrics
• Presence/absence or abundance of focal species • Presence/absence or # of nesting pairs • Reproductive success (e.g., # of nests, fledglings, etc.) • Survival (adults, juveniles, and/or chicks) • # of nests protected • # of sites with targeted predation management • # of acres of habitat created, restored, managed, and/or under increased stewardship • % vegetative cover in nesting sites • # of nest boxes used by nesting pairs • # of education/outreach materials distributed or people reached

4.6.2 Approach 3: Prevent Incidental Bird Mortality

Pelagic Birds

Potential techniques	Example project concepts	Potential geographic scope
• Remove derelict fishing gear • Support bird rehabilitation centers • Reduce collisions by modifying lighting and/or lighting patterns on oil and gas platforms • Reduce bycatch through voluntary fishing gear and/or techniques	• Support, fund, and maintain marine debris removal (including derelict fishing gear) in/around nesting/foraging areas • Conduct beach combing on remote beaches or beaches near nesting areas • Provide and maintain receptacles at recreational fishing areas (boat ramps and piers) • Provide resources, including funding agreements, to local rehabilitation centers and support for die-off or mortality investigations • Develop partnerships and implement agreements with energy companies to change lighting patterns/retrofit lighting types on existing offshore structures/platforms • Develop partnerships with other state and federal regulatory agencies to implement public outreach/meetings to provide information about voluntary fishing gear or techniques that reduces bird bycatch	• GOM: offshore waters • Outside GOM: U.S. • Outside GOM: international **Example project-specific performance monitoring metrics** • Units of marine debris removed • # of receptacles provided • Mortality, injury, or survival related to gear entrapment • # of birds rehabbed/released • # of mortality cases investigated • # of lighting retrofit projects or pattern modifications • # of birds killed by bycatch • # of education/outreach materials distributed or people reached

5. Monitoring and Adaptive Management Considerations

5.1 Project-Specific Monitoring and Adaptive Management of Restoration Targeting Injured Bird Species

As is being done for bird-related projects implemented in Early Restoration, project-specific monitoring will be conducted for all bird restoration projects developed under the PDARP. The intent of project-specific monitoring is to document whether projects have met their established restoration objectives and determine the need for corrective actions or (15 CFR § 990.55(b)(1)(vii)). Project-specific monitoring should include pre-implementation monitoring and incorporation of existing data to document initial conditions as well as post-implementation monitoring to gauge restoration progress and success. Monitoring information collected at the project-level can also inform adaptive management of that individual project, as well as similar restoration approaches and/or restoration types, by informing the selection, design, and implementation of future restoration projects. Where gaps in scientific understanding exist, an adaptive management approach to bird restoration may involve additional science support activities such as targeted data collection to reduce key uncertainties and/or other analyses that inform the selection, design, and optimization of restoration projects.

As discussed in Sections 3 and 4, project-specific monitoring would track key performance metrics, such as reproductive success; nesting abundance and densities; juvenile and adult survival of target bird species; habitat characteristics supporting target species; prey abundance; etc. Standardization of project-specific performance metrics, to the extent practicable, will facilitate comparisons across similar project approaches and techniques. Standardization of monitoring and reporting will also enable characterization of collective benefits across multiple projects, which would facilitate resource-level monitoring (see Section 5.2 below).

5.2 Resource-Level Monitoring

Resource-level monitoring can fulfill data and information needs to support adaptive management and inform restoration planning, implementation, and evaluation. As described in Chapter 5, Appendix E of the PDARP, resource-level monitoring is intended to support bird restoration by fulfilling data and information needs common across groups of projects. Where gaps in scientific understanding exist, an adaptive management approach to bird restoration may involve additional science support activities such as targeted data collection to reduce key uncertainties and/or modeling; and analyses that inform the selection, design, and optimization of a portfolio of projects (DWH NRDA Trustees, 2016). Effective resource-level monitoring built around that foundation will help guide restoration of injuries and will inform restoration planning, implementation, and evaluation of the collective bird restoration portfolio.

Monitoring and scientific support is necessary to address key information needs and data gaps, and to help inform the temporal and spatial implementation of future restoration projects. This resource-level monitoring strategy may evolve over time as the Trustees gain insight from restoration activities.

Sections 3 and 4 (above) present example project-specific performance monitoring metrics that could be used to:

- Track project success and modify projects, where applicable, to maximize success in restoring birds through their implementation;
- Inform future project development; and
- Track the overall success in restoring injuries to birds and adjust the avian restoration strategic framework to meet ongoing needs of associated birds groups, subgroups, or species.

Many species that will be targets for restoration activities have broad distributions that extend beyond potential project boundaries. These broad distributions require coordinated monitoring across sites, states, and potentially beyond the northern GOM to enable characterization of overall restoration success. For example, coordinated Gulf-wide monitoring of waterbird colonies would provide important context for changes in breeding bird abundance observed at specific sites where restoration is implemented. Further, implementation of standardized monitoring protocols for particular bird subgroups (e.g., callback surveys for marsh birds) would enable comparisons of potential effects of restoration across multiple project sites.

5.3 Monitoring Coordination

Collaboration with other entities conducting ecological monitoring in project areas would maximize (1) the usefulness of data collected under the DWH NRDA program; and (2) the capability to incorporate the data collected by other programs into their analyses. Data from pre-established, system-wide monitoring networks (e.g., Steyer et al., 2003; Watson et al., 2014; Hijuelos and Hemmerling, 2015) could be used to augment information gained from project-specific monitoring efforts. Partnering opportunities with third parties (e.g., non-governmental organizations, private parties) could be pursued to maximize efficiencies in compiling and sharing data. For example, the Gulf of Mexico Avian Monitoring Network (GoMAMN) is developing a standardized set of priorities and monitoring guidelines to enable consistent data collection and reporting regionally. In addition, the Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS) will conduct broad-scale surveys to assess seabird distribution and abundance from nearshore areas to the U.S. Exclusive Economic Zone in the GOM. These approaches, and the resulting guidelines and data, could provide useful tools for the Trustees when developing specific monitoring goals.

Coordination across resource categories and Trustee Implementation Groups may help identify opportunities to provide and enhance benefits to other injured resource categories in the design, implementation, and monitoring and adaptive management for all bird restoration projects.

References

Baustian, J.J. and R.E. Turner. 2006. Restoration success of backfilling canals in coastal Louisiana marshes. *Restoration Ecology* 14:636–644.

DWH NRDA Trustees. 2016. *Deepwater Horizon* Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement. *Deepwater Horizon* Natural Resource Damage Assessment Trustees. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

Evans Ogden, L.J. 1996. Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds. ResearchGate. Available:

https://www.researchgate.net/publication/265157017_Collision_Course_The_Hazards_of_Lighted_Structures_and_Windows_to_Migrating_Birds.

Farrer, A.A. 2010. *N-Control.* Seagrass Restoration Monitoring Report. Monitoring Events 2003–2008. Florida Keys National Marine Sanctuary, Monroe County, Florida. Marine Sanctuaries Conservation Series ONMS-10-06. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. Available: http://sanctuaries.noaa.gov/science/conservation/pdfs/ncontrol.pdf.

Fonseca, M.S. 1994. A Guide to Planting Seagrasses in the Gulf of Mexico: Galveston, Texas. (TAMU-SG94-601). Texas A&M University Sea Grant College Program.

Fonseca, M.S., W.J. Kenworthy, and G.W. Thayer. 1998. Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters. NOAA Coastal Ocean Program Decision Analysis Series No. 12. NOAA Coastal Ocean Office, Silver Spring, MD. Available: http://www.seagrassrestorationnow.com/docs/Fonseca%20et%20al%201998.pdf.

Fonseca, M.S., W.J. Kenworthy, F.X. Courtney, and M.O. Hall. 1994. Seagrass transplanting in the southeastern United States: Methods for accelerating habitat development. *Restoration Ecology* 2(3):198–212. doi:10.1111/j.1526-100X.1994.tb00067.x.

Granfors, D.A. and N.D. Niemuth. 2005. Prairie Pothole Joint Venture 2005 Implementation Plan: Section III – Shorebird Plan. 22 pp.

Hijuelos, A.C. and S.A. Hemmerling. 2015. Coastwide and Barataria Basin Monitoring Plans for Louisiana's System-Wide Assessment and Monitoring Program (SWAMP). The Water Institute of the Gulf, Baton Rouge, LA.

Hunter, W.C. 2000. Southeastern Coastal Plains-Caribbean Region Report: U.S. Shorebird Conservation Plan. U.S. Fish and Wildlife Service, Atlanta, GA.

Hunter, W.C., W. Golder, S. Melvin, and J. Wheeler. 2006. Southeast United States Regional Waterbird Conservation Plan. U.S. Fish and Wildlife Service, Atlanta, GA.

Montevecchi, W.A., C. Rich, and T. Longcore. 2006. Influences of artificial light on marine birds. In *Ecological Consequences of Artificial Night Lighting,* C. Rich and T. Longcore (eds.). Island Press, Washington, DC. pp. 94–113.

NFWF. 2012. Toward a Healthy Gulf of Mexico: Re-Establishing Viability of Pelagic Seabird Populations in the Gulf of Mexico/Northern Caribbean Ecoregion. National Fish and Wildlife Foundation.

Poot, H., B.J. Ens., H. de Vries, M.A.H. Donners, M.R. Wernand, and J.M. Marquenie. 2008. Green light for nocturnally migrating birds. *Ecology and Society* 13:47.

Ringelman, J.K., R.E. Reynolds, and R.R. Johnson. 2005. 005 Implementation Plan: Section II – Waterfowl Plan. Prairie Pothole Joint Venture 2. September. Available: http://ppjv.org/assets/pdf/7_Section2_Waterfowl_Plan.pdf.

Russell, R.W. 2005. Interactions between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico. Final Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009. Available: http://www.fwspubs.org/doi/suppl/10.3996/062015-JFWM-050/suppl_file/10.3996_062015-jfwm-050.s6.pdf?code=ufws-site.

Schulte, S. 2016. Florida Beach-Nesting Bird Plan. Draft. Manomet. Available: http://www.flshorebirdalliance.org/media/55868/Florida_beach_nesting_bird_plan_FINAL.pdf.

Steyer, G.D., C.E. Sasser, J.M. Visser, E.M. Swenson, J.A. Nyman, and R.C. Raynie. 2003. A proposed coast-wide reference monitoring system for evaluating wetland restoration trajectories in Louisiana. *Environmental Monitoring and Assessment* 81:107–117.

Thomson, G., M. Miner, A. Wycklendt, M. Rees, and D. Swigler, D. 2010. *MRGO Ecosystem Restoration Feasibility Study – Chandeleur and Breton Islands.* Report prepared for USACE under contract to URS, Coastal Planning & Engineering, Inc., Boca Raton, FL.

Treat, S.F. and R.R. Lewis III (eds.). 2006. Seagrass Restoration: Success, Failure, and the Costs of Both. Selected Papers Presented at a Workshop, Mote Marine Laboratory, Sarasota, FL, March 11–12, 2003. Lewis Environmental Services, Valrico, FL. Available: http://www.seagrassrestorationnow.com/docs/Treat%20and%20Lewis%202006%20Seagrass%20Restoration-6.pdf.

Turner, R.E., E.M. Swenson, and J.M. Lee. 1994. A rationale for coastal wetland restoration through spoil bank management in Louisiana, USA. *Environmental Management* 18:271–282.

USFWS. 2016a. Recovery Plan for the Northern Great Plains Piping Plover (*Charadrius melodus*) in Two Volumes. Volume I: Draft Breeding Recovery Plan for the Northern Great Plains Piping Plover (*Charadrius melodus*). U.S. Fish and Wildlife Service, Denver, CO. 132pp.

USFWS. 2016b. Recovery Plan for the Northern Great Plains Piping Plover (*Charadrius melodus*) in Two Volumes. Volume II: Draft Revised Recovery Plan for the Wintering Range of the Northern Great Plains Piping Plover (*Charadrius melodus*) and Comprehensive Strategy for the Piping Plover (*Charadrius melodus*) in its Coastal Migration and Wintering Range in the Continental United States. U.S. Fish and Wildlife Service, Denver, CO. 166pp.

Vermillion, W.G. and B.C. Wilson. 2009. Gulf Coast Joint Venture Conservation Planning for Reddish Egret. Gulf Coast Joint Venture, Lafayette, LA. 18 pp.

Watson, S., L. Bernard, B. Kirkpatrick, C. Simoniello, and S. Howden. 2014. A Long-Term, Stakeholder-Based Strategy for Gulf of Mexico Observing and Monitoring: The GCOOS build-out Plan (BOP) v. 2.0. Presented at Bays to Bayous 2014, Mobile, AL.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettmann, A.W. Diamond, and J. Linke. 2001. Seabirds at risk around offshore oil platforms in the North-west Atlantic. *Marine Pollution Bulletin* 42:1285–1290.

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