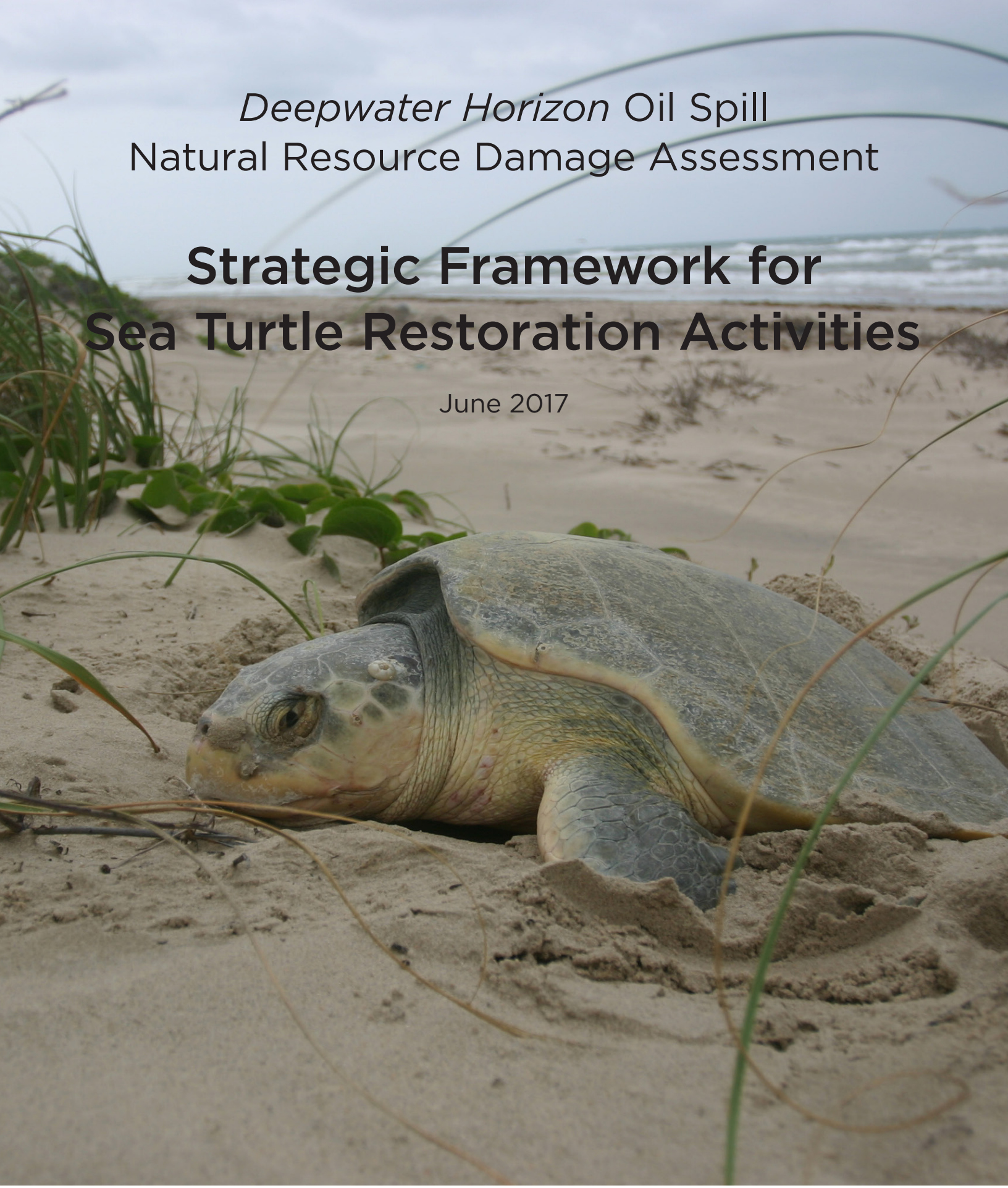
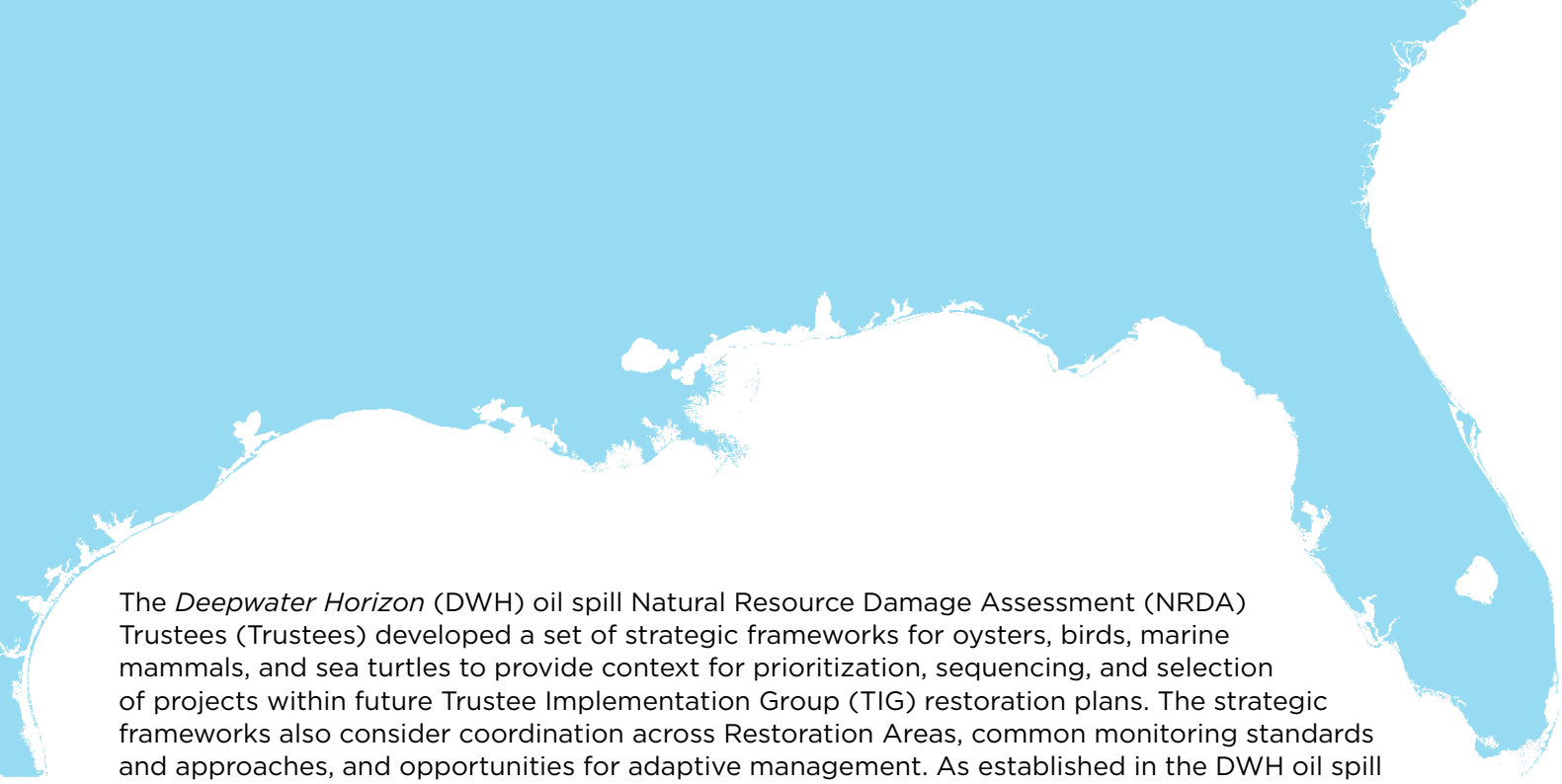
Deepwater Horizon Oil Spill
Natural Resource Damage Assessment

Strategic Framework for Sea Turtle 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 Sea Turtle Restoration Activities. June. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

Module 1

Summary of Information from the PDARP – Sea Turtles

KEY ASPECTS OF SEA TURTLE INJURY THAT INFORMED RESTORATION PLANNING

Four of the five species of sea turtles that inhabit the GOM were injured by the DWH oil spill: loggerhead, Kemp's ridley, green, and hawksbill. All are listed as threatened or endangered under the Endangered Species Act, are long-lived, travel widely, and use a variety of habitats across the GOM and beyond.

Sea turtles were injured by oil or response activities in the open ocean, nearshore, and shoreline environments. Resulting mortalities spanned multiple life stages:

- Between 4,900 and 7,600 large juvenile and adult sea turtles were killed
- Between 56,000 and 166,000 small juvenile sea turtles were killed
- Nearly 35,000 hatchling sea turtles were injured by response activities, and thousands more Kemp's ridley and loggerhead hatchlings were lost due to unrealized reproduction of adult sea turtles that were killed by the DWH oil spill.
- Additional injuries were determined to have occurred, but were not formally quantified, such as injuries to leatherback turtles.

For additional information, see Section 4.8 in the Final Programmatic Damage Assessment and Restoration Plan (PDARP) and Final Programmatic Environmental Impact Statement (PEIS).

Sea turtles in the Gulf of Mexico (GOM) are a shared resource, crossing state, federal, and international boundaries and relying on a system of interconnected beach, nearshore, and offshore habitats. All sea turtles are highly migratory and thus have a wide geographic range. Although sea turtles spend the vast majority of their lives in the water, significant life events occur on land, including nesting, egg incubation, and hatchling emergence and crawl to the water.

The *Deepwater Horizon* (DWH) spill affected nesting (including nesting females, eggs, and hatchlings), small juvenile, large juvenile, and adult sea turtles throughout the GOM (see text box to the left). Sea turtles are long-lived, highly migratory, and occupy multiple habitats over the course of their lives. These life history traits necessitate a portfolio of restoration approaches that can address all species and life stages that were injured by the spill. This portfolio includes ecological benefits achieved through reducing bycatch and other anthropogenic mortality, restoring nesting habitat, and robust monitoring.

Settlement funding allocation for sea turtle restoration (millions $)

	Funds Allocated to Sea Turtles in Early Restoration	Final Settlement Allocation
Regionwide TIG	29.3	60.0
Open ocean TIG	–	55.0
Texas TIG	20.0	7.5
Louisiana TIG	–	10.0
Mississippi TIG	–	5.0
Alabama TIG	–	5.5
Florida TIG	–	20.0
Total funding	**49.3**	**163.0**

Funding allocation is approximate. Numbers are rounded.

Sea turtle funds have been allocated across all seven Trustee Implementation Groups (TIGs), with a particular emphasis on the Open Ocean and Regionwide restoration areas, because of the diversity of species and life stages that were injured and their widespread use of the Gulf of Mexico ecosystem. Trustees may use funds allocated to the restoration areas for restoration outside of the GOM as ecologically appropriate, and these funds may be used for resource- level planning, prioritization, implementation, and monitoring for resource recovery, among others.

In addition, the Trustees initiated 2 sea turtle projects under Early Restoration, the first in Phase II to reduce lighting disturbances to nesting habitat in AL and FL, and the second in Phase IV to reduce bycatch of sea turtles in the shrimp trawl fishery and for enhanced nest detection and protection in TX and Mexico.

Trustees are using a nested framework of programmatic restoration goals, restoration types, and restoration 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: Sea Turtles

The goals of the sea turtle restoration type include:

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

For additional information on sea turtle restoration goals, see Section 5.5.10.1 in the Final PDARP/PEIS.

Strategy to Achieve Goals

This Restoration Type will address the key threats to sea turtles and emphasize activities that are consistent with their recovery plans. Sea turtles face a variety of threats across different life stages and habitats. They spend the vast majority of their lives at sea where they are exposed to anthropogenic activities that threaten their survival.

- The most significant anthropogenic threat to sea turtle populations in the marine environment is bycatch in fishing gear—principally trawls, pelagic and bottom longlines, gillnets, and hook-and-line gear (NMFS & FWS 2008; NMFS et al. 2011).
- While on land, sea turtles also face a variety of threats. In particular, coastal development can alter or destroy sea turtle nesting habitat, which can deter or disrupt nesting and can reduce embryo and hatchling survival. Restoration will address all injured species and life stages by targeting key threats and ensuring consistency with the recovery plans already in place for sea turtles.

The Trustees propose that restoration activities will take place in all five Gulf states and in nearshore and offshore waters to provide benefits for all injured species and life stages. Restoration for sea turtles will focus in the geographic areas with the greatest potential to benefit the targeted species, which could include work outside the Gulf of Mexico.

Restoration Approaches and Techniques

The restoration approaches and potential restoration techniques associated with sea turtle restoration include:

1. Reduce sea turtle bycatch in commercial fisheries through identification and implementation of conservation measures

This restoration approach focuses on reducing the bycatch and mortality of sea turtles in Gulf of Mexico commercial fisheries by identifying, developing, and implementing sea turtle bycatch reduction measures. This approach could identify measures such as:

- Gear modifications (For example: hook size and type)
- Changes in fishing practices (For example: reduced soak times)
- Temporal and spatial fishery management to reduce sea turtle bycatch in GOM commercial fisheries.

2. Reduce sea turtle bycatch in commercial fisheries through enhanced training and outreach to the fishing community

This approach could expand the successful National Oceanic and Atmospheric Administration (NOAA) Gear Monitoring Team (GMT) program, which operates in the Gulf States out of the National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center's Pascagoula Lab. This expansion could allow similar programs to be implemented at the state level.

3. Enhance sea turtle hatchling productivity and restore and conserve nesting beach habitat

This approach could employ the following techniques:

- Reduce artificial lighting visible from nesting beaches
- Enhance protection of nests by addressing anthropogenic threats
- Reduce nesting beach barriers
- Acquire lands for conservation of nesting beach habitat
- Beach user outreach and education.

4. Reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures

This approach would first focus on improving the understanding of bycatch in recreational fisheries in the GOM (For example: characterization of sea turtle bycatch on hook-and-line gear). Once identified, potential bycatch reduction measures could be experimentally implemented to determine their effectiveness.

5. Reduce sea turtle bycatch in commercial fisheries through enhanced state enforcement effort to improve compliance with existing sea turtle conservation requirements

This approach could include two primary techniques:

- Provide training for and outreach to state fishery enforcement personnel
- Increase state fishery enforcement resources (For example: additional personnel and necessary equipment and vessels).

6. Increase sea turtle survival through enhanced mortality investigation and early detection of and response to anthropogenic threats and emergency events

This approach could include:

- Enhanced network response and coordination
- Enhanced preparedness and response capacity for emergency events
- Enhanced investigation of mortality sources
- Enhanced data access and analysis
- Enhanced rehabilitation capability where necessary
- Improved coordination and communication among and between rehabilitation facilities, state coordinators, the U.S. Fish and Wildlife Service, and NOAA.

7. Reduce injury and mortality of sea turtles from vessel strikes

This approach could include:

- Public outreach and education
- Enhanced understanding of the temporal and spatial distribution of vessel strikes
- Enhanced understanding of additional cofactors that may influence the frequency of vessel strikes (For example: water depth, vessel speed, vessel size)
- Development of potential mechanisms to reduce the frequency of vessel strikes (for example: voluntary speed restrictions or vessel exclusion areas in highest-risk locations).

For additional information on sea turtle restoration approaches and techniques, see Chapter 5, Appendix D.4, 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 restoration success at meeting its restoration objectives and determining the need for any corrective actions to maximize benefits for sea turtles through projects related to bycatch reduction and improving sea turtle hatchling production. Performance monitoring will be designed to determine if projects, individually and together, are meeting their objectives with respect to the restoration of sea turtles. Although project-level objectives will vary, common metrics will be used, where possible, to evaluate and compare the performance success of sea turtle restoration projects. Performance monitoring for specific projects may rely on existing and/or enhancement of existing programs like fishery observer programs, and use of electronic monitoring and surveys and data collection during project 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 nesting beach and at-sea monitoring and compilation and analyses of relevant information and data about sea turtles, 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 sea turtle restoration monitoring, see Section 5.5.10.4 in the Final PDARP/PEIS.

PHOTO CREDITS.

Page 1 *(top)*. Loggerhead turtle nesting in Florida. *Blair Witherington.*

Page 1 *(bottom)*. Juvenile Kemp's ridley turtle in Sargassum. *Blair Witherington.*

Page 2 *(top).* A loggerhead turtle is returned to the sea following capture and attachment of a satellite tag. *NOAA.*

Page 2 *(bottom).* NOAA gear specialists demonstrate TED requirements and inspection procedures. *NOAA.*

1. Introduction

Five species of sea turtles inhabit the northern Gulf of Mexico (GOM): Kemp's ridley (*Lepidochelys kempii*), loggerhead (*Caretta caretta*), green turtle (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), and leatherback (*Dermochelys coriacea*) (Figure 1). Kemp's ridleys, loggerheads, green turtles, and hawksbills are in the *Cheloniidae* family (i.e., hard shells); and leatherbacks are in the *Dermochelyidae* family. All of these species were present within the area affected by the *Deepwater Horizon* (DWH) oil spill and response efforts (DWH oil spill), and all except for leatherbacks had quantifiable injuries from the spill. Leatherbacks were also injured, but their injuries could not be quantified.

Figure 1. Five species of sea turtles inhabit the GOM. Clockwise from top left: Kemp's ridley, loggerhead, green turtle, hawksbill, and leatherback. Note: species not shown to scale.

Sources: Dawn Witherington; DWH NRDA Trustees, 2016.

This module provides relevant biological and ecological information to support the design, implementation, and management of restoration projects to address injuries to sea turtles caused by the DWH oil spill. 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 National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share federal jurisdiction for the conservation and recovery of sea turtles. The roles of the two agencies are defined in a joint Memorandum of Understanding (MOU), originally entered into in

1977, and updated in 2015. USFWS has jurisdiction in the terrestrial environment and NMFS has jurisdiction in the marine environment, unless otherwise specified in the MOU. The state agencies coordinate with the federal agencies to fulfill management responsibilities within individual states.

The combination of unique life history traits (e.g., widely dispersed, slow-growing, late maturing) of sea turtles and numerous threats make their populations prone to rapid declines and slow to recover from significant negative impacts (Crouse et al., 1987). For these reasons, the DWH Trustees emphasized that sea turtles require long-term, consistent, effective protection to prevent further population declines and possible extinction (DWH NRDA Trustees, 2016). Kemp's ridleys, hawksbills, and leatherbacks are globally listed as Endangered under the federal Endangered Species Act of 1973 (ESA). Loggerheads in the northern GOM belong to the Northwest Atlantic Ocean distinct population segment (DPS)[1] and are listed as Threatened under the ESA. Green turtles in the northern GOM belong to the North Atlantic Ocean DPS and are listed as Threatened under the ESA.

1.2 Sea Turtle Life Stages and Habitat Areas

Within their expansive ranges, sea turtles occupy different habitats based on life stage and breeding phase. It is critical to understand the distribution of sea turtles in the northern GOM based on life stage and how these species use the habitats in these areas. This information is essential to assess impacts of various threats and to design restoration projects for sea turtles.

The sea turtle life cycle (Table 1; Figure 2) begins at egg laying on nesting beaches, followed by hatchling emergence and entry into the ocean, and continues as small juvenile turtles usually associated with convergence zones in open-ocean areas over a period of at least several years (Bolten, 2003). Turtles in this life stage remain at or near the surface, associated with floating material, such as mats of Sargassum alga habitats (Witherington et al., 2012). After this open-ocean (i.e., oceanic) phase, turtles recruit to continental shelf (i.e., neritic) areas, where they continue growing until reaching maturity one to several decades later (Bolten, 2003). Turtles mostly remain in continental shelf areas for the rest of their lives, with occasional forays to open-ocean habitats. The exception to this description of the at-sea life cycle of sea turtles is the leatherback, a species that is considered the most pelagic of the sea turtles, and the species we know least about the juvenile stage(s). Apart from adult females, which come ashore approximately every two to three years to lay eggs several times in a season, sea turtles remain at sea for their entire lives, often showing site-fidelity to selected foraging grounds (Bolten, 2003; Shaver et al., 2013; Hart et al., 2014; DWH NRDA Trustees, 2016).

1. A DPS is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or distinct population segments of vertebrate species. For more information, go to: http://www.nmfs.noaa.gov/pr/pdfs/fr/fr61-4722.pdf.

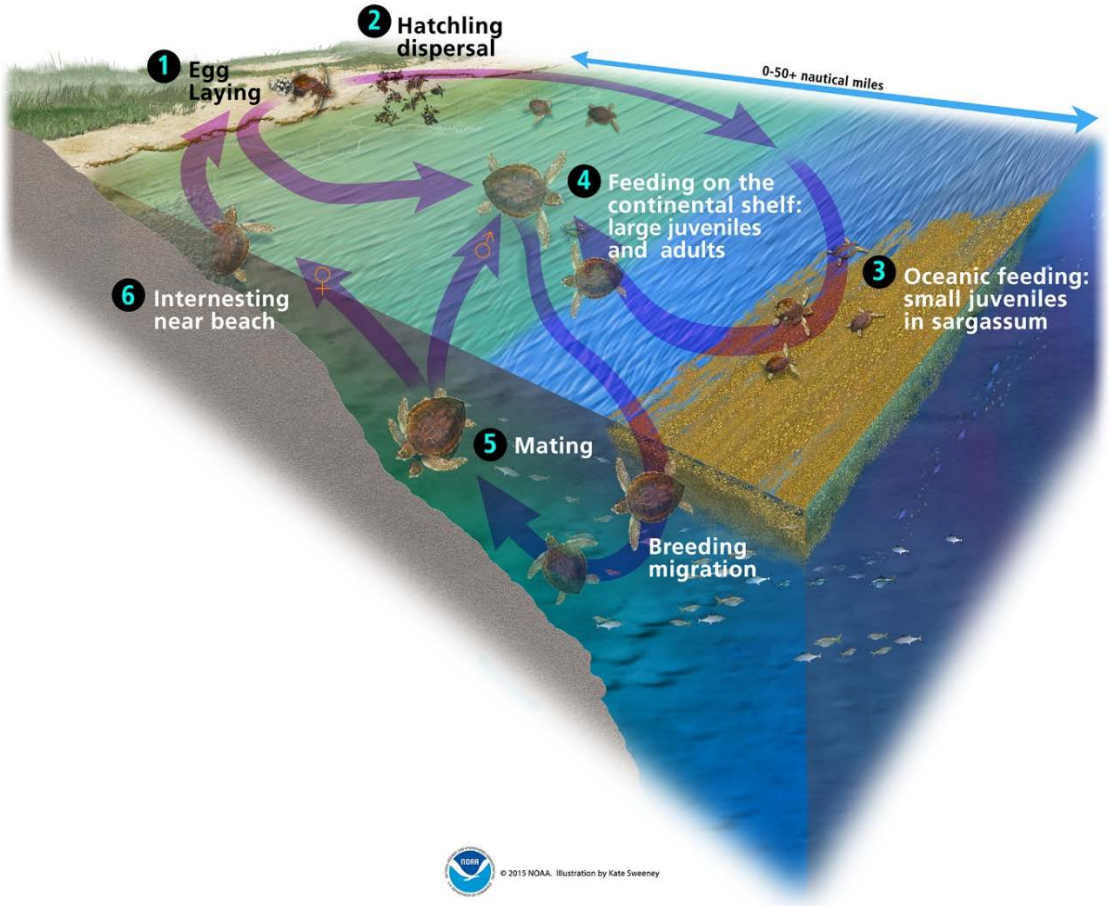
Table 1. Summary of sea turtle life stages and habitats (DWH NRDA Trustees, 2016)

Life stage	Habitat	Description of turtles in this stage
Nesting females, eggs, hatchlings	Northern GOM sandy beaches mainly in Florida, Alabama, Texas, and Mexico	Female turtles nest, embryos develop while buried in sand, hatchlings emerge and enter the ocean.
Small juveniles	Oceanic life stage: open ocean; surface habitats throughout the northern GOM	Spend more than 80% of their time at or near the sea surface, limited diving ability, tend to associate with floating Sargassum, drift and swim to remain in surface currents.
Large juveniles and adults	Neritic life stage: continental shelf, nearshore and inshore habitats, oceanic waters	Use the entire water column, from surface to bottom; active swimmers; dive frequently and typically deeper than 20 m; spend on average 10% of time at the surface; consistently use the same breeding and foraging areas; actively migrate to breed (adults). Some individuals migrate between neritic and deeper oceanic waters and reproductive migrations may also cross oceanic waters.

Diets of sea turtles vary by species and often by life stage. Different sea turtle species show unique dietary specializations: hawksbills primarily feed on sponges; leatherbacks primarily feed on jellyfish and salps; and green turtles are herbivores, primarily feeding on seagrass and macroalgae. Loggerheads and Kemp's ridleys are carnivores, primarily feeding on benthic invertebrates, most commonly crabs and mollusks, but their diets vary regionally depending on available prey species (Bjorndal, 1997). Sea turtles generally spend more than 90% of their time submerged, and regularly perform dives 5 to 20 minutes long at 10- to 50-m depths (Lutcavage and Lutz, 1997), though deeper dives occur depending on species and distribution.

Loggerheads, Kemp's ridleys, and green turtles nest on suitable beaches in the GOM, predominantly in Florida, Alabama, Texas, and Mexico, with occasional or rare nesting in Mississippi and Louisiana. Loggerheads, green turtles, hawksbills, and Kemp's ridleys in the northern GOM have early developmental phases in the oceanic zone, and juvenile and adult stages in the neritic zone. Less is known about the distribution of leatherbacks and the life stages present in the GOM. Despite general similarities in life history patterns, species vary substantially in the timing of movement between the neritic and oceanic stages (see Table 1; Figure 2), and in how many years turtles spend in different life stages (Bolten, 2003). Section 2 provides details about species-specific variability in life history patterns.

Figure 2. Generalized sea turtle life cycle. (1) The life cycle starts with egg laying. (2) Hatchlings then leave nesting beaches and swim away from the coast to reach oceanic areas (i.e., offshore, depths typically > 200 m), (3) where they remain for several years associated with Sargassum and other surface habitats. (4) After growing to larger body sizes, they move onto the continental shelf and closer to shore until reaching adulthood. (5) Adults perform breeding migrations to the areas where they were born, sometimes across oceanic areas, to find mates. (6) Adult male turtles return to foraging areas after mating, while adult females remain near nesting beaches during nesting seasons that can last one to two months for each female.



Source: DWH NRDA Trustees, 2016.

1.3 Threats to Sea Turtles in the Northern GOM

Sea turtles are widely distributed and are perceived to be abundant, but human threats have significantly reduced sea turtle populations worldwide (Bjorndal and Jackson, 2003). Threats can differentially affect specific sea turtle life stages (Bolten et al., 2011). Sections 1.3.1–1.3.4 summarize the principal threats to sea turtles in the northern GOM; Section 2 provides specific details about particular threats to each species.

1.3.1 Fisheries Bycatch

The incidental capture of turtles in fishing gear (i.e., fisheries bycatch) has been a major contributor to past declines and is a major threat to future recovery of all sea turtle species, including populations in the GOM (Bolten et al., 2011; NMFS et al., 2011). Turtles frequently become entangled, ensnared, and hooked in fishing gear, including trawls, gillnets, hook-and-line gear (e.g., pelagic longlines, bottom longlines), pound nets, and pot and trap fisheries. Depending on gear type and fishing operations, these interactions can be fatal (Lewison et al., 2013). More sea turtles are taken as bycatch in shrimp trawls than in all other fishing gears in the GOM combined (Finkbeiner et al., 2011), but sea turtle bycatch in other commercial (e.g., bottom longline, pelagic longline) and recreational fisheries (e.g., pier-based hook-and-line) is also a significant threat.

1.3.2 Human Activity in Coastal Areas (Nearshore and Beaches)

Human-induced alterations and human use of coastal environments can alter or destroy sea turtle nesting habitat, thereby hindering nesting as well as reducing embryo and hatchling survival (Wallace et al., 2011). Coastal development changes the physical attributes of beaches and can decrease the resilience of beaches to natural forces of erosion by destroying or diminishing natural dune and beach formation processes (NMFS and USFWS, 2008). Beach nourishment and coastal armoring are physical alterations that are intended to sustain upland infrastructure against erosion, but these practices decrease the suitability of beach habitats for sea turtle nesting (NMFS and USFWS, 2008). Hopper dredges, which are frequently used to dredge sand for beach nourishment projects or to widen/deepen channels, can entrain and kill sea turtles (NMFS, 1997). In addition, anthropogenic light sources along the coastline can have negative impacts on the nocturnal behaviors of both nesting sea turtles and hatchlings, including disrupted ocean-finding, which can negatively affect reproduction and survival (Witherington and Martin, 2003). Vehicles on beaches can run over nests and turtles, and leave ruts that impede hatchlings from reaching the beach (Mann, 1977; Hosier et al., 1981; Cox et al., 1994; Hughes and Caine, 1994). Human presence and recreational beach equipment on the beach overnight can block or deter nesting female access to the nesting beach and hatchling access to water (Sobel, 2002).

1.3.3 Pollution and Pathogens

Pollution from human activities, including oil spills, may also impact sea turtle populations in terrestrial, nearshore, and oceanic environments (Wallace et al., 2011; DWH NRDA Trustees, 2016). Municipal, industrial, and household sources introduce to sea turtle habitats various pollutants such as pesticides, hydrocarbons, and organochlorides (Keller, 2013). These pollutants may cause adverse health effects to sea turtles (Stewart et al., 2011; Camacho et al., 2012). This category also includes impacts from pervasive pathogens (e.g., fibropapilloma virus) on turtle health (Herbst, 1994) and marine debris that affects sea turtles through ingestion or entanglement, making them more susceptible to infections and death (Nelms et al., 2015).

1.3.4 Climate Change

Climate change can have several potential impacts on turtles and their habitats (Hamann et al., 2013). Sea level rise, and increased storm frequency and intensity, could alter sea turtles' nesting habitats, nest selection, diet, and home ranges. In addition, climate change impacts on sea turtles may be exacerbated by effects of other threats. For example, alterations and degradation of

suitable nesting or foraging habitats due to coastal development and construction, or bycatch mortality, could make sea turtle populations less resilient to negative effects of climate change. In addition, increasing sand temperatures could skew hatchling sex ratios and embryo survival.

2. Species Distributions, Life History, and Habitat Information

The following sections discuss species-specific life history and habitat information for the five species of turtles that occur in the northern GOM. For each species, there is a discussion of population structure, if applicable, based on either the DPS characterization under the ESA, or, if DPSs have not been identified, information about populations that occur in the northern GOM. These sections also include information on nesting beaches, the oceanic life stage, federally designated critical habitats, and, briefly, impacts of the DWH oil spill on each species. For more details on each species, please see key references cited in each of the species-specific sections below.

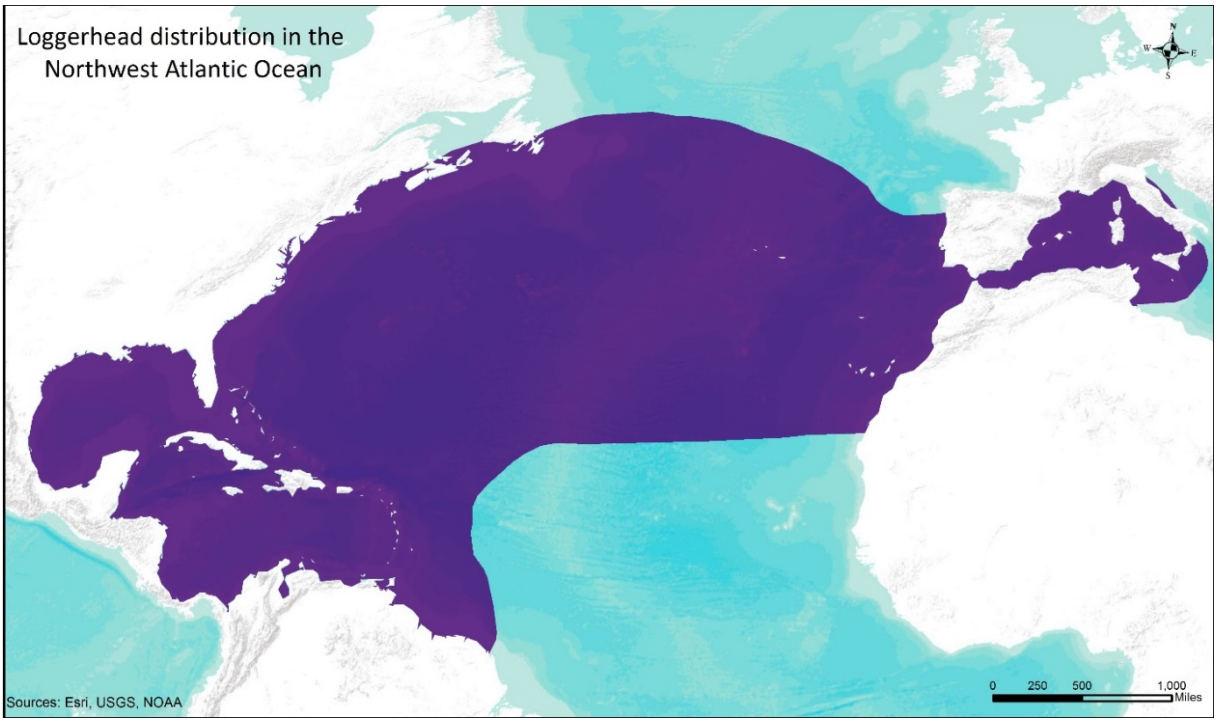
2.1 Loggerhead (*Caretta caretta*)

2.1.1 Description, Distribution, and Populations

Loggerheads were named for their relatively large heads, which support powerful jaws and enable them to feed on hard-shelled prey such as whelks and conch. Although the species is globally distributed within temperate, subtropical, and tropical latitudes (Figure 3), loggerhead populations vary in abundance, trends, and other traits among regions (NMFS and USFWS, 2008). To reflect this regional variation and provide appropriate units for assessment and management, NMFS and the USFWS designated the following DPSs for loggerhead sea turtles under the ESA (76 FR 184, 2011):

- Northwest Atlantic Ocean DPS
- South Atlantic Ocean DPS
- Southeast Indo-Pacific Ocean DPS
- Southwest Indian Ocean DPS
- Northeast Atlantic Ocean DPS
- Mediterranean Sea DPS
- North Indian Ocean DPS
- North Pacific Ocean DPS
- South Pacific Ocean DPS.

Figure 3. Loggerhead distribution in the Northwest Atlantic Ocean, i.e., the Northwest Atlantic Ocean DPS (Final Rule 76 FR 184, 2011).



Source: Wallace et al., 2010.

The Northwest Atlantic Ocean DPS, which occurs largely in the United States (Figure 3), is further divided into five recovery units[2] for assessment and management (NMFS and USFWS, 2008):

- Northern
- Peninsular Florida
- Dry Tortugas
- Northern GOM
- Greater Caribbean.

The northern GOM recovery unit of loggerhead sea turtles is one of the smallest subpopulations of this species (NMFS and USFWS, 2008; Hart et al., 2014).

2. Recovery units are subunits of the listed species that are geographically or otherwise identifiable and essential to recovery of the species. Recovery units are individually necessary to conserve genetic robustness, demographic robustness, important life-history stages, or some other feature necessary for long-term sustainability of the species.

2.1.2 Life Stage Classifications

The loggerhead recovery plan (NMFS and USFWS, 2008) defined life stages for Northwest Atlantic Ocean DPS loggerheads as:

1. Hatchling to post-hatchling, terrestrial to oceanic [approximately 4–6 cm straight carapace length (SCL)]
2. Juvenile, oceanic (approximately 8.5–64.0 cm SCL)
3. Juvenile, oceanic or neritic (approximately 46–87 cm SCL)
4. Adult, neritic or oceanic (approximately ≥ 83–87 cm SCL).

Nesting Beaches

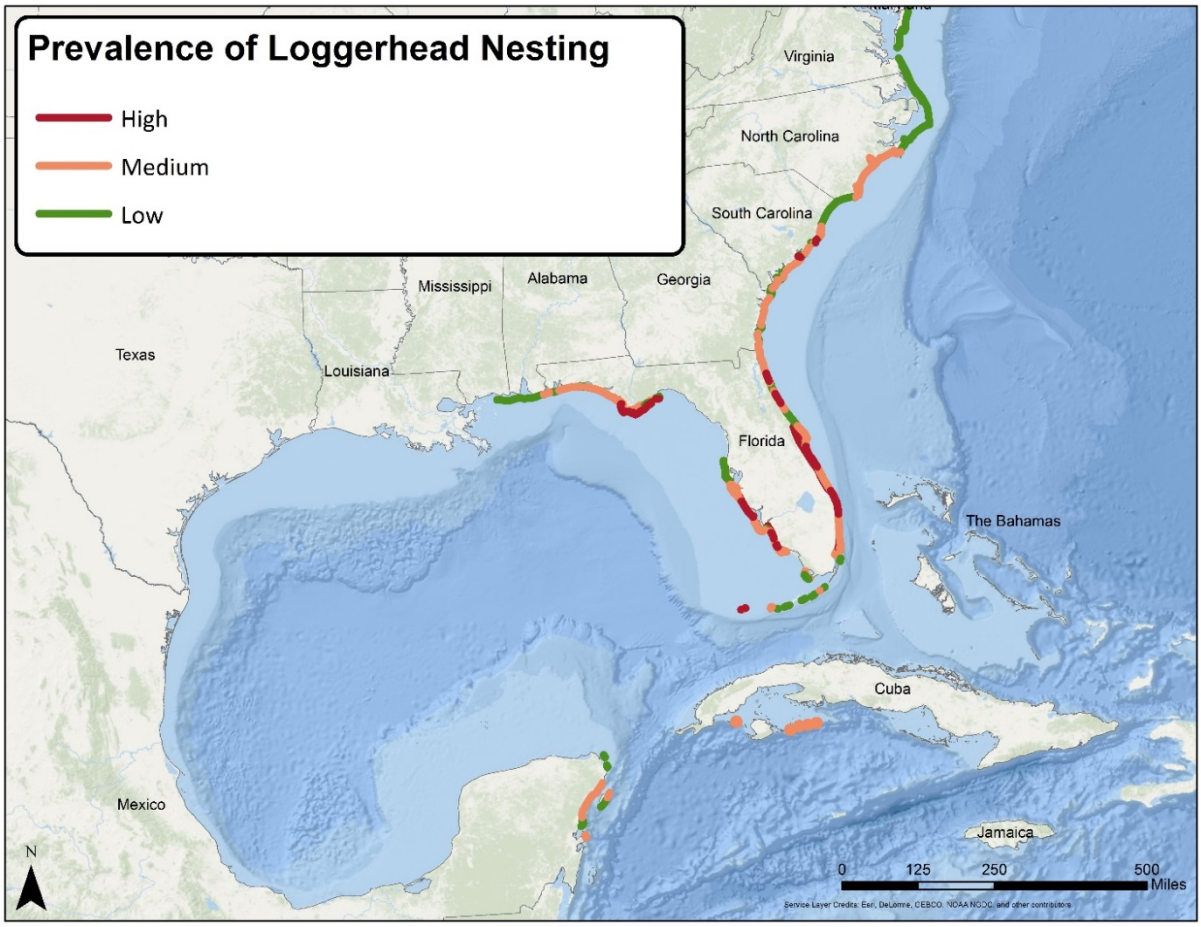
Loggerhead nesting beaches occur throughout the GOM, with the Northern GOM recovery unit nesting primarily along the Florida Panhandle and Alabama, the Peninsular Florida recovery unit nesting in Southwest Florida, the Dry Tortugas recovery unit nesting in Dry Tortugas National Park, and the Greater Caribbean recovery unit nesting primarily along the Yucatan Peninsula in Mexico (NMFS, 2013) (Figure 4). The Peninsular Florida recovery unit and the Northern recovery unit also nest along the East Coast (i.e., Atlantic Ocean) of the United States from Florida to southern Virginia.

Female loggerheads return to the beach where they hatched (natal beach) every two to three years to nest. In the southeastern United States, mating occurs in late March to early June, and females lay eggs between late April and early September. Females lay three to five clutches, and sometimes more, during a single nesting season. Hatchlings emerge between late June and mid-November after approximately two months of incubation.

Marine Stages

The duration of the oceanic juvenile stage for Northwest Atlantic Ocean DPS loggerhead may range from 6 to 24 years (Avens et al., 2013), which is much longer than for Kemp's ridley (Section 2.2) and green turtles (Section 2.3). Following recruitment to neritic habitat zones, juvenile and adult loggerhead turtles from several recovery units, including the Northern GOM recovery unit, forage in continental shelf areas of the GOM (Conant et al., 2009). Some neritic juvenile and adult loggerheads move between neritic and oceanic environments (Snover, 2002; Bolten, 2003; Conant et al., 2009; Hart et al., 2014; Ramirez et al., 2015). The duration of the adult life stage may be as long as 46 years based on size-at-age growth curves of adult turtles; however, this may be an underestimate of the adult life stage duration due to the challenge associated with long-term monitoring and identification of individual turtles over several decades (Avens et al., 2015).

Figure 4. Prevalence of loggerhead nesting in the GOM and adjacent areas. Categories (high, medium, and low) for nesting prevalence were generally aligned with nesting density classifications as per the Florida Statewide Atlas of Sea Turtle Nesting Occurrence and Density (http://myfwc.com/research/wildlife/sea-turtles/nesting/nesting-atlas/), wherein "high" density sites are those that have multi-year average density values in the top 25% of the range of values, "low" density sites are those in the lowest 25% of the range of values, and sites between high and low density (the other 50% of values) are classified as "medium" density. We extended this system to include sites outside of Florida within the United States and in other countries, by including binned nest abundance data (nest densities were unavailable) from the State of the World's Sea Turtles (SWOT; http://seamap.env.duke.edu/swot) and Fuentes et al. (2016). Note: This map is intended to show general, not quantitative, patterns in nesting distribution and abundance within the area occupied by the Northwest Atlantic Ocean DPS loggerhead.



2.1.3 Threats to Loggerheads

The Loggerhead Recovery Team[3] performed a comprehensive threats assessment in the recovery plan that adjusted for relative effects of threats on each life stage to help develop and prioritize recovery actions in the NW Atlantic Loggerhead Recovery Plan (NMFS and USFWS, 2008). The highest priority threats include bycatch in bottom trawl, pelagic longline, demersal longline, and demersal large mesh gillnet fisheries; legal and illegal harvest; vessel strikes; beach armoring; beach erosion; marine debris ingestion; oil pollution; light pollution; and predation by native and exotic species (NMFS and USFWS, 2008). Numerous other threats, ranging from low to medium priority, were also identified in the NW Atlantic Loggerhead Recovery Plan threats assessment.

2.1.4 Critical Habitat

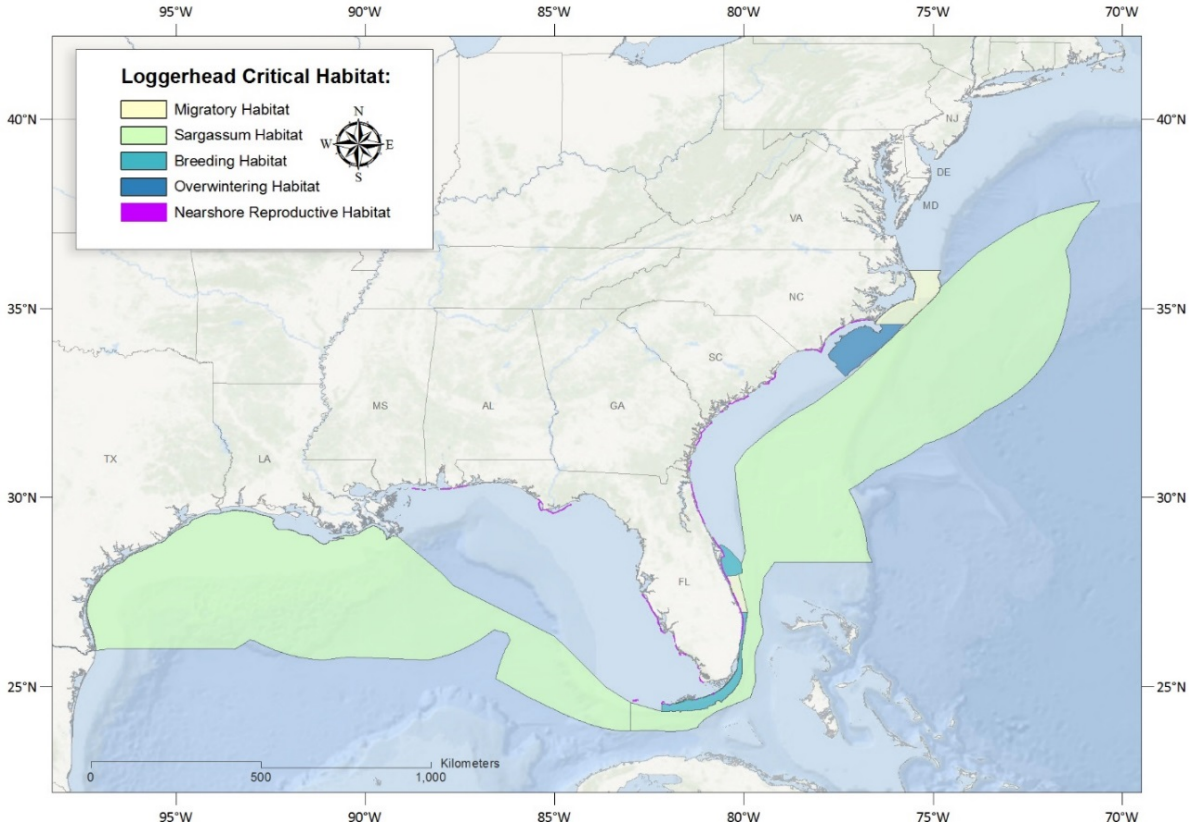
Critical habitat is defined under the ESA as specific geographic areas that contain features essential to the conservation of an endangered or threatened species, and that may require special management and protection. In 2013, NMFS and USFWS designated critical habitat for loggerheads in the United States, including 38 marine sites (in U.S. waters) within the range of the Northwest Atlantic Ocean DPS (Figure 5) and approximately 685 miles of nesting beaches in North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi. These areas include nesting beaches, nearshore reproductive habitats, winter areas, breeding areas, migratory corridors, and Sargassum habitats (79 FR 39755 and 79 FR 39855, 2014).

2.1.5 DWH Impacts

Between 2,070 and 10,400 oceanic juvenile loggerheads, and between 2,200 and 3,600 neritic juvenile and adult loggerheads were killed by the DWH oil spill (DWH NRDA Trustees, 2016). The spill is known to have affected loggerheads from the Peninsular Florida and northern GOM units, but may also have affected turtles from other units as well.

3. Recovery plans are developed by the USFWS and/or the NMFS, sometimes prepared with assistance of recovery teams, contractors, state agencies, and others. The NW Atlantic Loggerhead Recovery Plan was developed by the Loggerhead Recovery Team, which consisted of federal, state, and academic sea turtle experts.

Figure 5. Critical habitat for loggerhead sea turtles in marine areas as designated by NMFS (79 FR 39855, 2014). Loggerhead sea turtles are the only species with designated critical habitat in the GOM.



Source: NMFS, 2013.

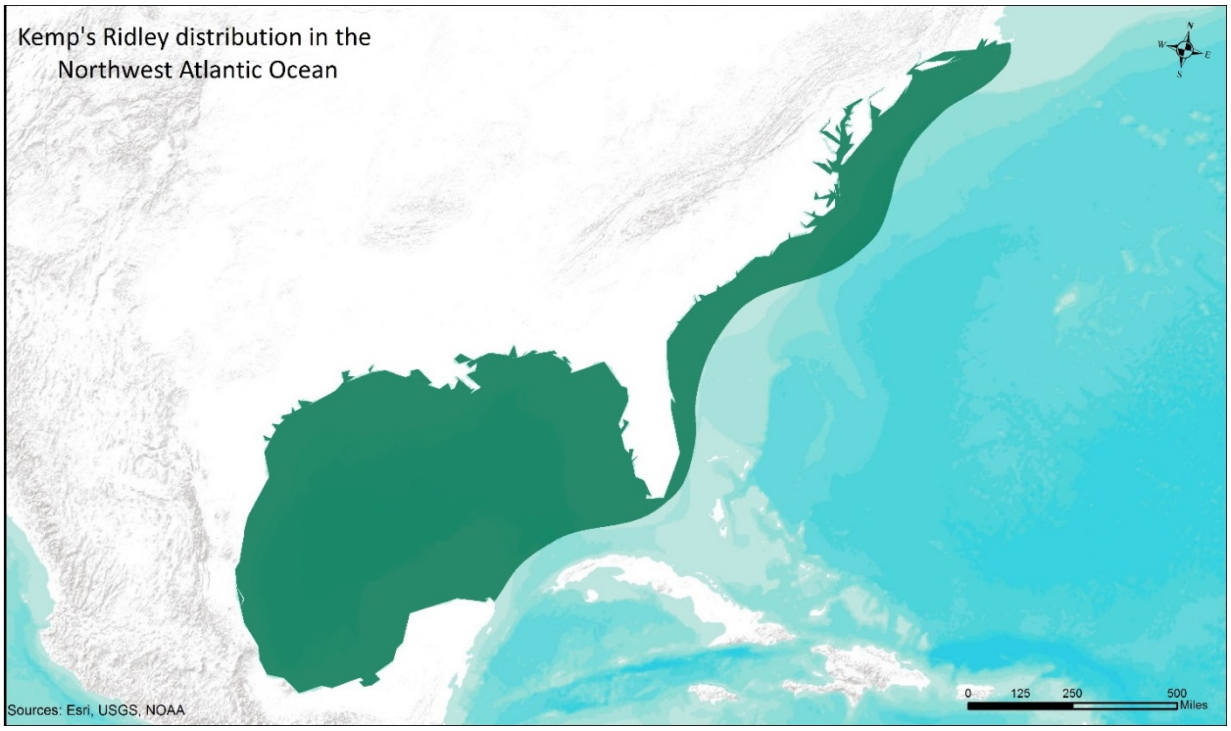
2.2 Kemp's Ridley (*Lepidochelys kempii*)

2.2.1 Description, Distribution, and Populations

At maturity, Kemp's ridleys are the smallest sea turtle in the world. Their top shell (carapace) is often as wide as it is long, and contains five pairs of costal scutes. Kemp's ridleys display one of the most unique synchronized nesting behaviors in the natural world. Large groups of Kemp's ridleys gather offshore before wave upon wave of females come ashore and nest within a concentrated, multi-day period in what is known as an *arribada*, which means "arrival" in Spanish.

There is a single global population of Kemp's ridley sea turtles that nests almost exclusively in the western GOM and otherwise occupies the GOM and Northwest Atlantic Ocean (NMFS et al., 2011; NMFS and USFWS, 2015) (Figure 6).

Figure 6. The Kemp's ridley distribution in the Northwest Atlantic Ocean, including nesting sites concentrated in the western GOM.



Source: Wallace et al., 2010.

2.2.2 Life Stage Classifications

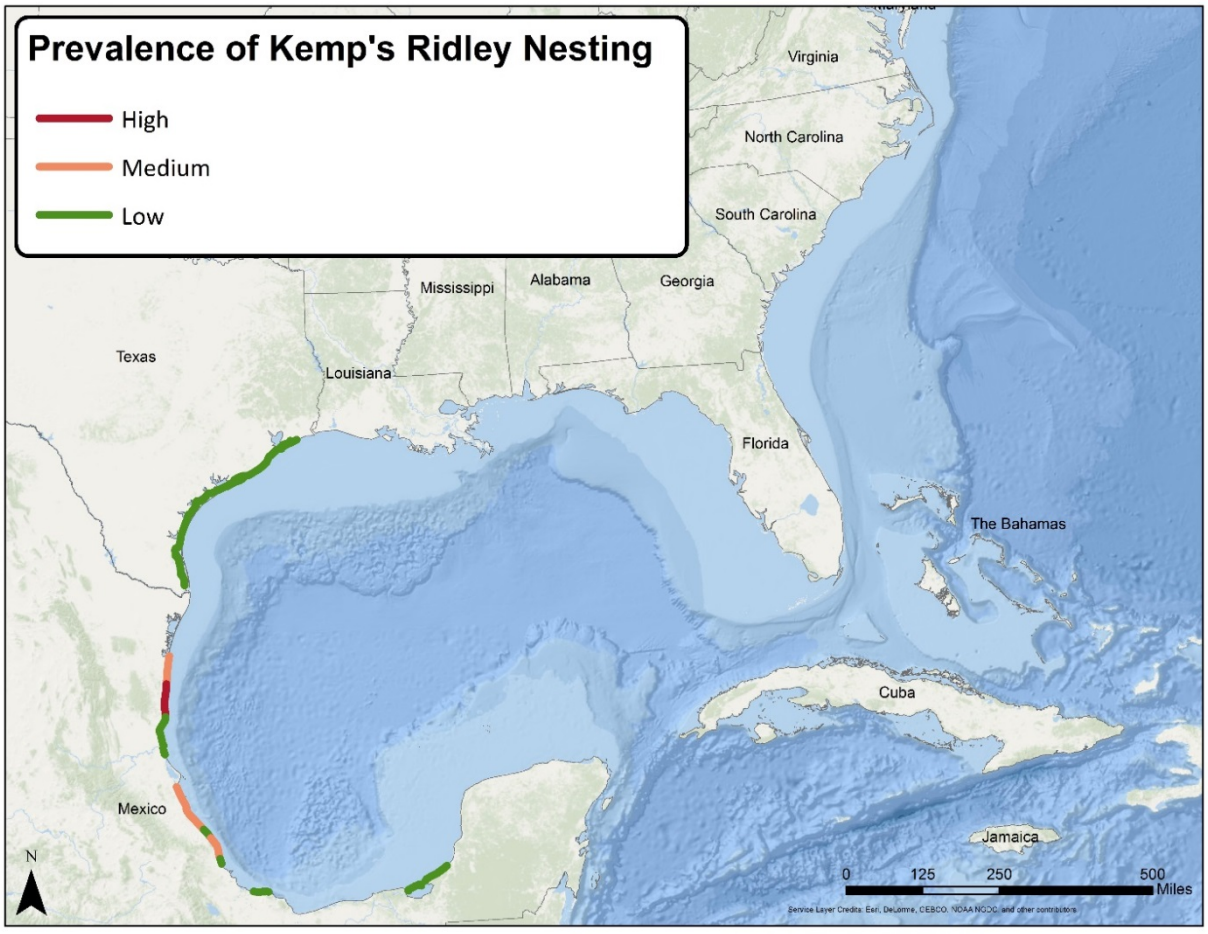
Kemp's ridley life stages can be classified as follows (NMFS et al., 2011; NMFS and USFWS, 2015):

1. Hatchling, terrestrial to oceanic (approximate size ≤ 5 cm SCL)
2. Juvenile, oceanic (approximate size 5–30 cm SCL)
3. Juvenile, oceanic to neritic (approximate size 30–60 cm SCL)
4. Adult, neritic or oceanic (approximate size ≥ 60 cm SCL).

Nesting Beaches

Kemp's ridley sea turtle nesting is concentrated on beaches in the western GOM, specifically in Tamaulipas, Mexico (Figure 7). In the United States, nesting occurs primarily in Texas and rarely in other states in the GOM and southeastern United States (NMFS and USFWS, 2015). Female Kemp's ridleys return to their natal beaches every one – two years to nest. Kemp's ridleys nest from April to July, laying 2 to 3 clutches of approximately 100 eggs, which incubate for 50–60 days.

Figure 7. Prevalence of Kemp's ridley nesting in the GOM and adjacent areas. Categories (high, medium, and low) for nesting prevalence were generally aligned with nesting density classifications as per the Florida Statewide Atlas of Sea Turtle Nesting Occurrence and Density (http://myfwc.com/research/wildlife/sea-turtles/nesting/nesting-atlas/), wherein "high" density sites are those that have multi-year average density values in the top 25% of the range of values, "low" density sites are those in the lowest 25% of the range of values, and sites between high and low density (the other 50% of values) are classified as "medium" density. We extended this system to include sites outside of Florida within the United States and in other countries, by including binned nest abundance data (nest densities were unavailable) from SWOT (http://seamap.env.duke.edu/swot) and Fuentes et al. (2016). Note: This map is intended to show general, not quantitative, patterns in nesting distribution and abundance within the area occupied by Kemp's ridleys in the Northwest Atlantic Ocean.



Marine Stages

After hatchlings emerge from their nests and enter the ocean, post-hatchling and early juvenile dispersion is likely influenced by predominant currents in the western Gulf (NMFS et al., 2011; Putman et al., 2013). Oceanic juvenile Kemp's ridleys spend their first one to four years (the average is two years) in surface habitats (NMFS et al., 2011; NMFS and USFWS, 2015). Recruitment to neritic habitats occurs across a range of sizes – most juveniles are 20–30 cm SCL when they recruit to neritic habitats (NMFS et al., 2011). Kemp's ridleys reach maturity at younger average ages (7–14 years; the average is 12 years) than other sea turtle species (NMFS et al.,

2011; NMFS and USFWS, 2015). Kemp's ridleys nesting in both Mexico and Texas take up residence at foraging areas across the GOM, especially in the neritic waters of the northern GOM (Shaver et al., 2013), and migration occurs in nearshore Gulf waters (Shaver et al., 2016). Inter-nesting areas for Kemp's ridleys nesting in Texas were recently defined as lying in a narrow band of nearshore western Gulf of Mexico waters in the USA and Mexico, with mean water depth of 14 to 19 m within a mean distance to shore of 6 to 11 km (Shaver et al., 2017).

2.2.3 Threats to Kemp's Ridleys

The Kemp's Ridley Recovery Team performed a detailed threats assessment for all life stages, which identified bycatch in shrimp trawls as the most significant threat to population recovery. Other threats include fisheries bycatch in other gear types, such as non-bottom trawls and demersal gillnets, and commercial and recreational hook-and-line fisheries; alterations of nesting habitat (e.g., beach driving, human presence on beaches); and predation (NMFS et al., 2011).

2.2.4 Critical Habitat

There is currently no critical habitat designated for Kemp's ridleys.

2.2.5 DWH Impacts

The DWH oil spill significantly affected all life stages of this species in the GOM, especially oceanic juveniles; approximately 35,500 to 86,500 surface-pelagic juveniles, and 2,100 to 3,100 neritic juveniles and adult Kemp's ridleys were killed by the DWH spill. The DWH Trustees estimated that as many as 20% of all one- to two-year-old Kemp's ridleys that were alive at the time of the DWH spill were killed as a results of the oil spill (DWH NRDA Trustees, 2016).

2.3 Green Turtle (*Chelonia mydas*)

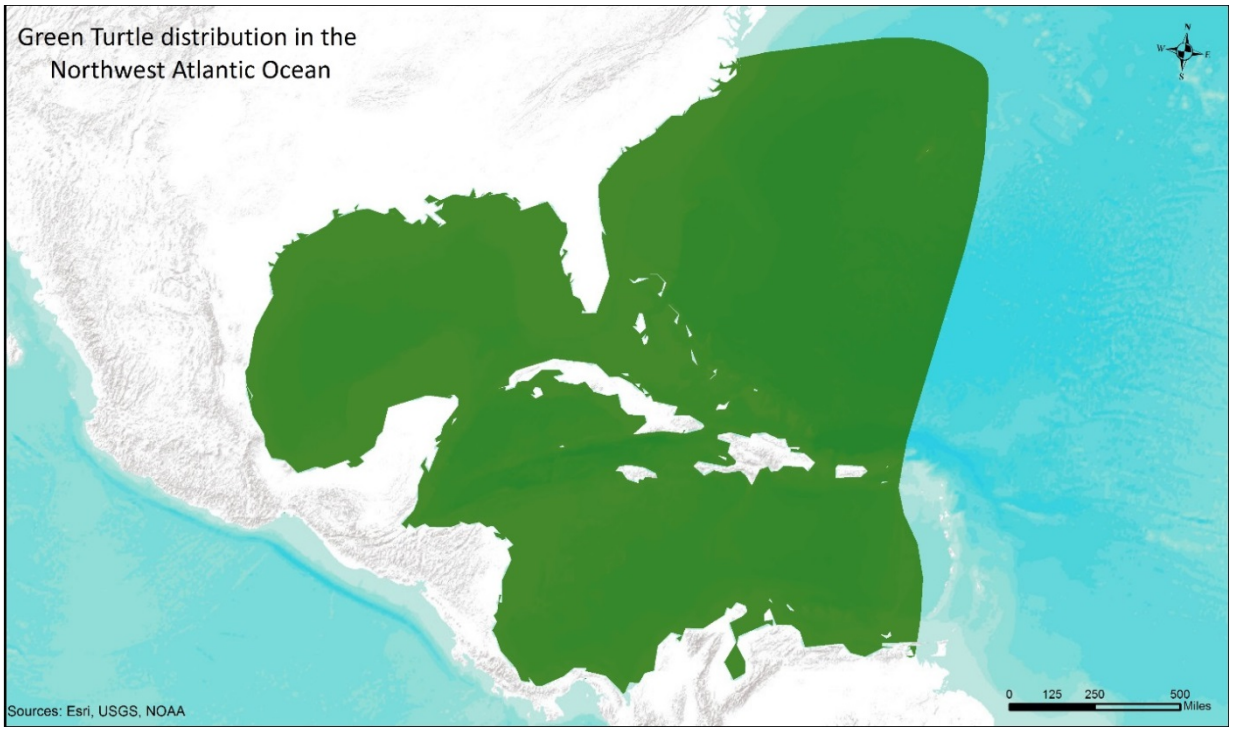
2.3.1 Description, Distribution, and Populations

Green turtles reach the largest adult sizes of the hard-shelled sea turtles species, but they have proportionally small heads relative to their body sizes. Green turtles are primarily herbivorous, feeding primarily on seagrasses and macroalgae. NMFS and USFWS have defined 11 green turtle DPSs under the ESA to reflect the geographic variation in green turtle populations worldwide (Seminoff et al., 2015; 81 FR 20057, 2016):

- Central North Pacific Ocean DPS
- East Indian-West Pacific Ocean DPS
- East Pacific Ocean DPS
- North Atlantic Ocean DPS
- North Indian Ocean DPS
- South Atlantic Ocean DPS
- Southwest Indian Ocean DPS
- Southwest Pacific Ocean DPS
- Central South Pacific Ocean DPS
- Central West Pacific Ocean DPS
- Mediterranean DPS.

Green turtles in the GOM are a part of the Northwest Atlantic Ocean DPS (Figure 8).

Figure 8. Green turtle distribution in the Northwest Atlantic Ocean, i.e., the North Atlantic Ocean DPS (81 FR 20057, 2016).



Source: Wallace et al., 2010.

2.3.2 Life Stage Classifications

Life stages of the North Atlantic green turtle DPS can be classified as follows (Avens and Snover, 2013; Seminoff et al., 2015):

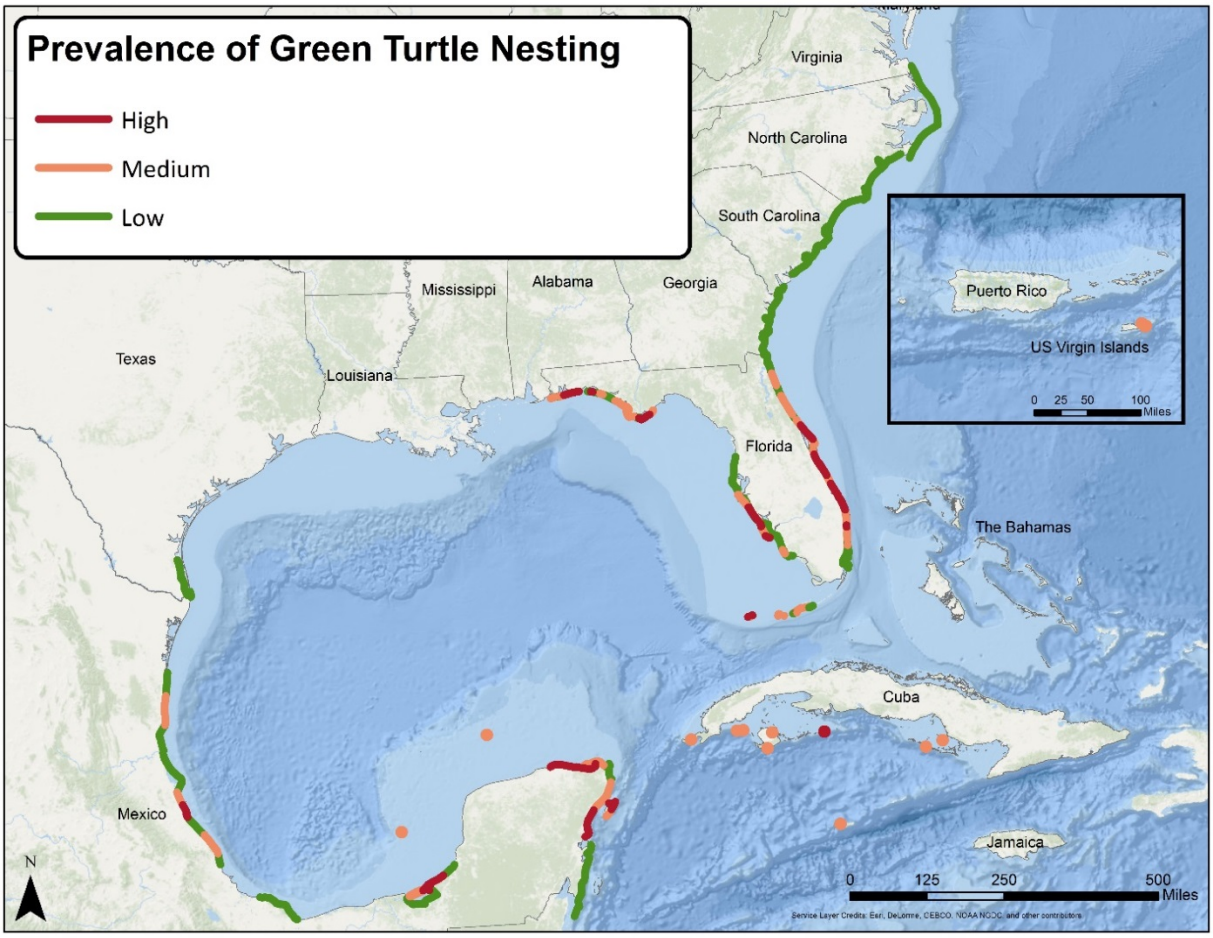
1. Hatchling to post-hatchling, terrestrial to oceanic (approximately 4–6 cm SCL)
2. Juvenile, oceanic (approximately < 30 cm SCL)
3. Juvenile, neritic (approximately 18–78 cm SCL)
4. Adult, neritic or oceanic (approximately ≥ 85–100 cm SCL).

Nesting Beaches

Green turtle nesting beaches occur worldwide. Large rookeries (≥ 500 nesting females) in the North Atlantic DPS exist in Florida, Cuba, the Yucatan Peninsula of Mexico, and Costa Rica (Seminoff et al., 2015). In the GOM, green turtle nesting is concentrated in Southwest Florida and the Yucatan Peninsula of Mexico (Figure 9).

Female green turtles return to their natal beaches every two to three years to nest. While nesting season varies from location to location in the southeastern United States, females generally nest in the summer between June and September; peak nesting occurs in June and July. During the nesting season, females nest at approximately two-week intervals. They lay an average of five clutches per season. Hatchlings emerge after approximately two months of incubation.

Figure 9. Prevalence of green turtle nesting in the GOM and adjacent areas. Categories (high, medium, and low) for nesting prevalence were generally aligned with nesting density classifications as per the Florida Statewide Atlas of Sea Turtle Nesting Occurrence and Density (http://myfwc.com/research/wildlife/sea-turtles/nesting/nesting-atlas/), wherein "high" density sites are those that have multi-year average density values in the top 25% of the range of values, "low" density sites are those in the lowest 25% of the range of values, and sites between high and low density (the other 50% of values) are classified as "medium" density. We extended this system to include sites outside of Florida within the United States and in other countries, by including binned nest abundance data (nest densities were unavailable) from SWOT (http://seamap.env.duke.edu/swot) and Fuentes et al. (2016). Note: This map is intended to show general, not quantitative, patterns in nesting distribution and abundance within the area occupied by the Northwest Atlantic green turtle DPS.



Marine Stages

Similar to loggerheads and Kemp's ridleys, post-hatchling green turtles begin an oceanic stage in areas of current convergence and downwelling where material accumulates, most often Sargassum (Witherington et al., 2012; Seminoff et al., 2015). The duration of the surface-pelagic juvenile stage varies widely, ranging from one to seven years in the Atlantic Ocean, which is much shorter than this stage in loggerhead turtles (Goshe et al., 2010). Estimates of the age to sexual maturity for green turtles range from 26 to 40 years, with a reproductive longevity of up to 38 years (Seminoff, 2004; Humburg and Balazs, 2014). In the GOM, juvenile green turtles are commonly

found in inshore bays/sounds and adults/subadults have been regularly reported from the southwest coast of Florida and across the Florida Keys. Foraging areas of adult female green turtles have been primarily identified in the Florida Keys, including areas within and adjacent to the Florida Keys National Marine Sanctuary (Schroeder et al., 2008; Hart et al., 2013).

2.3.3 Threats to Green Turtles

The Green Turtle Status Review Team (Seminoff et al., 2015) identified several important threats for the North Atlantic green turtle DPS in terrestrial and marine environments. In terrestrial areas, threats include coastal development, beachfront lighting, beach erosion caused by sand mining, non-native vegetation, predation by native and exotic animals, and sea level rise. In marine areas, threats include fisheries bycatch in trawls, gillnets, and dredges; pollution; vessel strikes; and fibropapillomatosis.

2.3.4 Critical Habitat

Critical habitat for green sea turtles was designated in 1998 for marine areas around Culebra Island, Puerto Rico (63 FR 46693, 1998).

2.3.5 DWH Impacts

Approximately 15,300 to 55,100 surface-pelagic juvenile green turtles were killed by the DWH oil spill (DWH NRDA Trustees, 2016). Most of these animals likely originated from nesting populations in Mexico, Cuba, Costa Rica, and possibly the United States (Seminoff et al., 2015) (Figure 9).

2.4 Hawksbill (*Eretmochelys imbricata*)

2.4.1 Description, Distribution, and Populations

Hawksbills are medium-sized compared to other hard-shelled turtle species. The hawksbill turtle's head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. The shape of the mouth allows the hawksbill turtle to reach into holes and crevices of coral reefs to capture sponges, their primary food source as adults, and other invertebrates.

Hawksbills are distributed globally, but are generally constrained to tropical latitudes, including in the Northwest Atlantic Ocean (Figure 10). The ESA five-year review of hawksbill sea turtles suggested that the DPS policy may apply to this species because available information on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies) appears to indicate the possible separation of populations by ocean basins (NMFS and USFWS, 2013a). NMFS and USFWS developed a recovery plan for hawksbills in the U.S. Caribbean, the Atlantic Ocean, and the GOM in 1993 (NMFS and USFWS, 1993).

Figure 10. Hawksbill distribution in the Northwest Atlantic Ocean.

Source: Wallace et al., 2010.

2.4.2 Life Stage Classifications

Life stage classifications have not been as well-defined for hawksbills as for other species, but generally follow a similar pattern to that of green turtles (Avens and Snover, 2013):

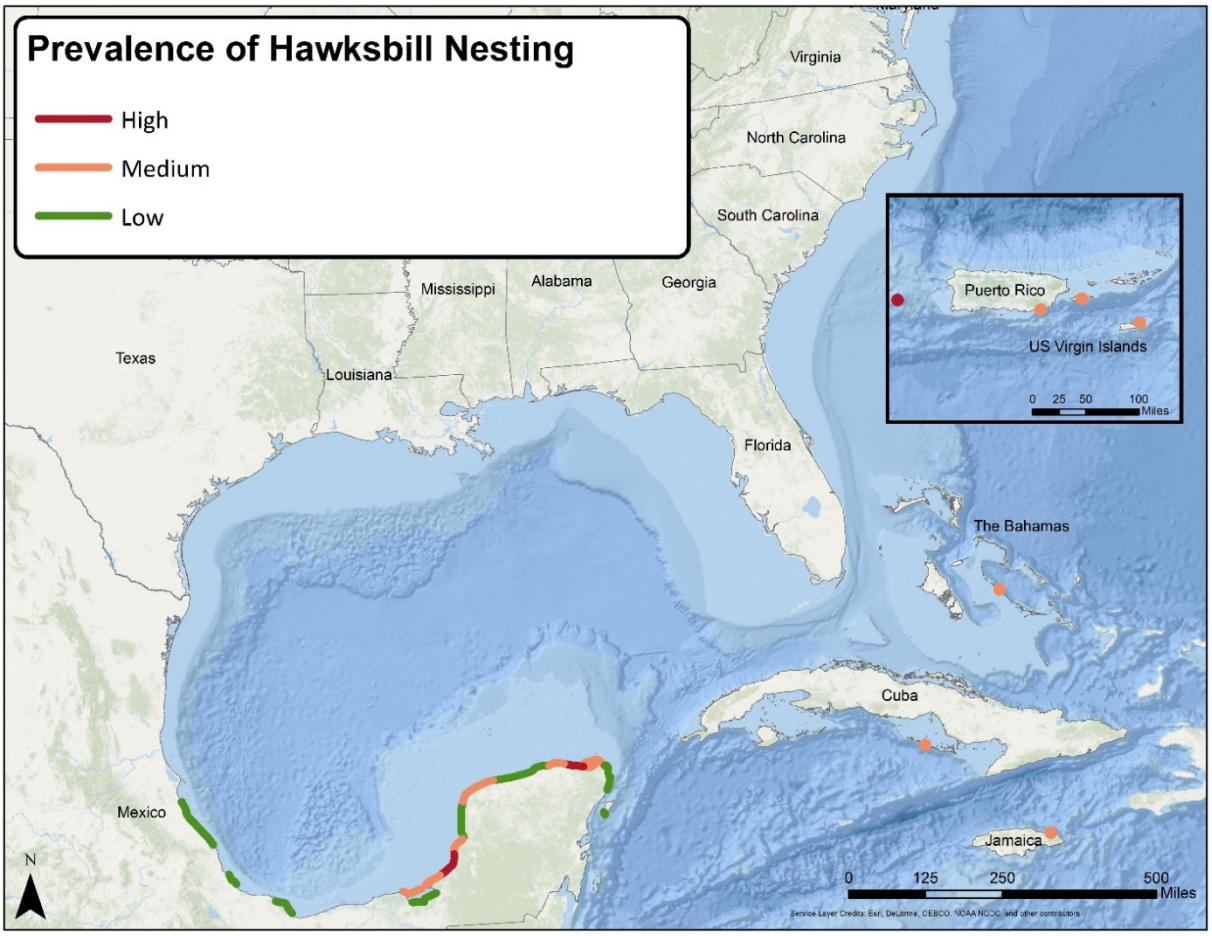
1. Hatchling to post-hatchling, terrestrial to oceanic (approximately 4 cm SCL)
2. Juvenile, oceanic (approximately < 25 cm SCL)
3. Juvenile, oceanic or neritic (approximately 25–70 cm SCL)
4. Adult, neritic or oceanic (approximately ≥ 80–90 cm SCL).

Nesting Beaches

In the GOM and insular Caribbean, significant concentrations of hawksbill sea turtle nesting (> 100 females/year) occur in the Yucatan Peninsula of Mexico, Cuba, the Bahamas, the U.S. Virgin Islands, Puerto Rico, the French West Indies, Barbados, and Trinidad and Tobago (NMFS and USFWS, 2013a) (Figure 11).

Female hawksbills return to their natal beaches or nearby coastal areas every two to three years to nest. They commonly nest on pocket beaches with little sand, and build relatively shallow nests just beneath the surface of the sand high up on the beach or in the beach/dune vegetation. The nesting season varies with locality, but in most locations nesting occurs between April and November. A female hawksbill generally lays three to five clutches per season, which contain an average of 130 eggs. Hatchlings emerge after approximately two months of incubation.

Figure 11. Prevalence of hawksbill nesting in the GOM and adjacent areas. Categories (high, medium, and low) for nesting prevalence were generally aligned with nesting density classifications as per the Florida Statewide Atlas of Sea Turtle Nesting Occurrence and Density (http://myfwc.com/research/wildlife/sea-turtles/nesting/nesting-atlas/), wherein "high" density sites are those that have multi-year average density values in the top 25% of the range of values, "low" density sites are those in the lowest 25% of the range of values, and sites between high and low density (the other 50% of values) are classified as "medium" density. We extended this system to include sites outside of Florida within the United States and in other countries, by including binned nest abundance data (nest densities were unavailable) from SWOT (http://seamap.env.duke.edu/swot) and Fuentes et al. (2016). Note: This map is intended to show general, not quantitative, patterns in nesting distribution and abundance within the area occupied by hawksbills in the Northwest Atlantic Ocean.



Marine Stages

Hawksbill turtles have an oceanic juvenile phase that is similar to that of green turtles. Although the oceanic phase of this species is not well-understood, hatchlings are believed to remain in the oceanic environment for one to three years until they reach a carapace length of approximately 20–30 cm (Snover et al., 2013). Like other hard-shelled turtles, hawksbills then recruit to neritic areas, where they remain until reaching adulthood. Estimates for the age to reach maturity for this species range from 20 to 40 years depending on the population (NMFS and USFWS, 2013a).

Individual turtles have been recorded actively nesting for 14 to 24 years in the Caribbean (NMFS and USFWS, 2013a).

2.4.3 Threats to Hawksbills

The killing of hawksbills for the scutes of their carapace, the source of "tortoiseshell," has historically been the most significant threat to the species in the Northwest Atlantic Ocean and worldwide (NMFS and USFWS, 2013a). Other significant threats to hawksbills include alterations of nesting habitats (e.g., coastal construction, beach armoring and nourishment, sand extraction, beachfront lighting) and marine habitats (e.g., mangrove removal, contamination, degradation of benthic habitats); climate change effects on sea level rise and health of coral reefs, upon which many hawksbill populations are dependent; taking of eggs for commercial and subsistence use; and fisheries bycatch.

2.4.4 Critical Habitat

USFWS designated the terrestrial areas on Isla Mona, Culebra Island, Cayo Norte, and Culebrita Island as critical habitat for hawksbills in 1982 (47 FR 27295, 1982). NMFS designated marine areas around Mona and Monito islands in Puerto Rico in 1998 (63 FR 46693, 1998).

2.4.5 DWH Impacts

Approximately 595 to 2,990 surface-pelagic juvenile hawksbills were killed by the DWH oil spill (DWH NRDA Trustees, 2016). These animals likely originated from nesting beaches outside of the northern GOM (e.g., Mexico, Cuba) (Figure 11).

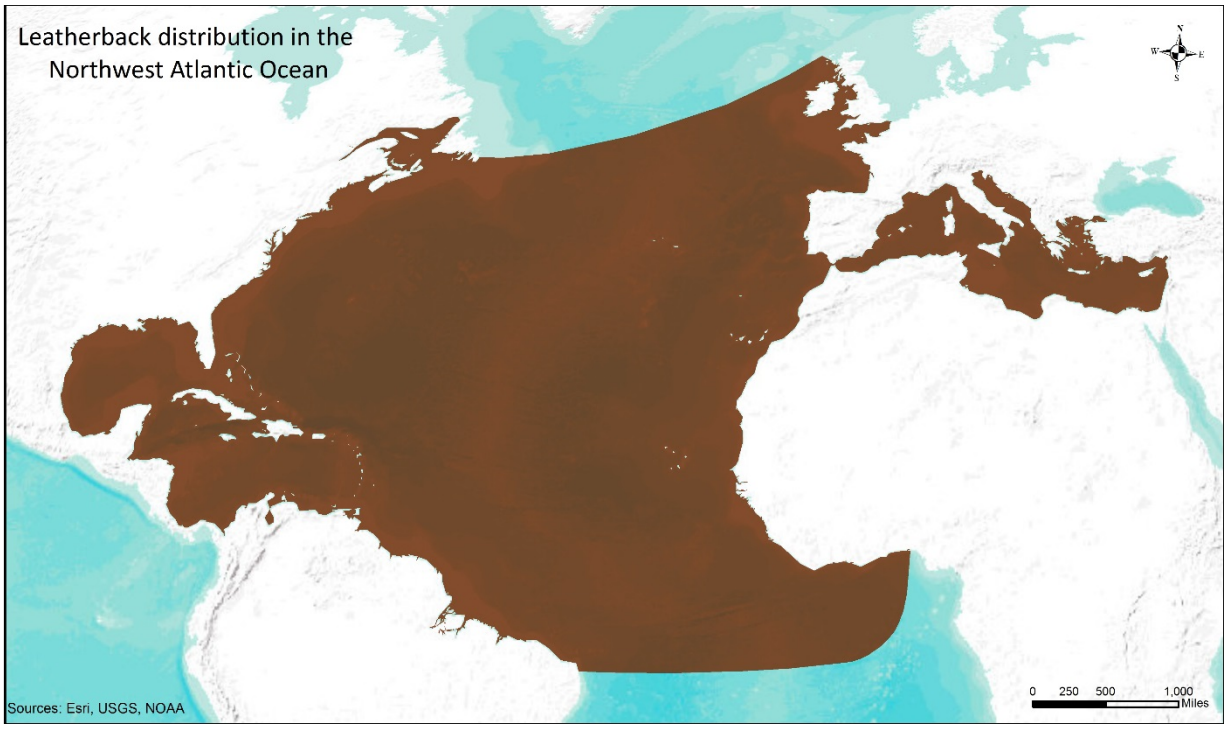
2.5 Leatherback (*Dermochelys coriacea*)

2.5.1 Description, Distribution, and Populations

The leatherback is the largest turtle – and one of the largest living reptiles – in the world. Its carapace has seven longitudinal ridges and tapers to a blunt point, which help give the carapace a more hydrodynamic structure. Leatherbacks' mouths have pointed tooth-like cusps and sharp-edged jaws that are adapted for a diet of soft-bodied prey, such as jellyfish and salps. In addition, like other sea turtle species, their mouths and throats also have backward-pointing spines that help retain ingested prey while excess water is squeezed out through the animal's mouth while chewing and swallowing.

Leatherbacks are among the most widely distributed vertebrates in the world, ranging from foraging areas in sub-polar latitudes to breeding areas in the tropics, including the Northwest Atlantic Ocean (Figure 12). Leatherback sea turtles are distributed throughout the world's oceans, with adults of this species occasionally undertaking migrations of up 11,000 km between foraging areas and nesting beaches (NMFS and USFWS, 2013b). The ESA five-year review of leatherbacks suggested that the DPS policy may apply to this species because available information on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies) appears to indicate the possible separation of populations by ocean basins (NMFS and USFWS, 2013b). Leatherbacks occur throughout the Wider Caribbean and the northern GOM; NMFS and USFWS developed a recovery plan for leatherbacks in the U.S. Caribbean, Atlantic, and GOM in 1992 (NMFS and USFWS, 1992).

Figure 12. Leatherback distribution in the Northwest Atlantic Ocean



Source: Wallace et al., 2010.

2.5.2 Life Stage Classifications

Unlike other sea turtle species occurring in the GOM, there are no apparent differences in ecosystems or habitat types used by leatherbacks based on marine life stages: all leatherback life stages after hatching can occur in both oceanic and continental shelf habitats (Bolten, 2003).

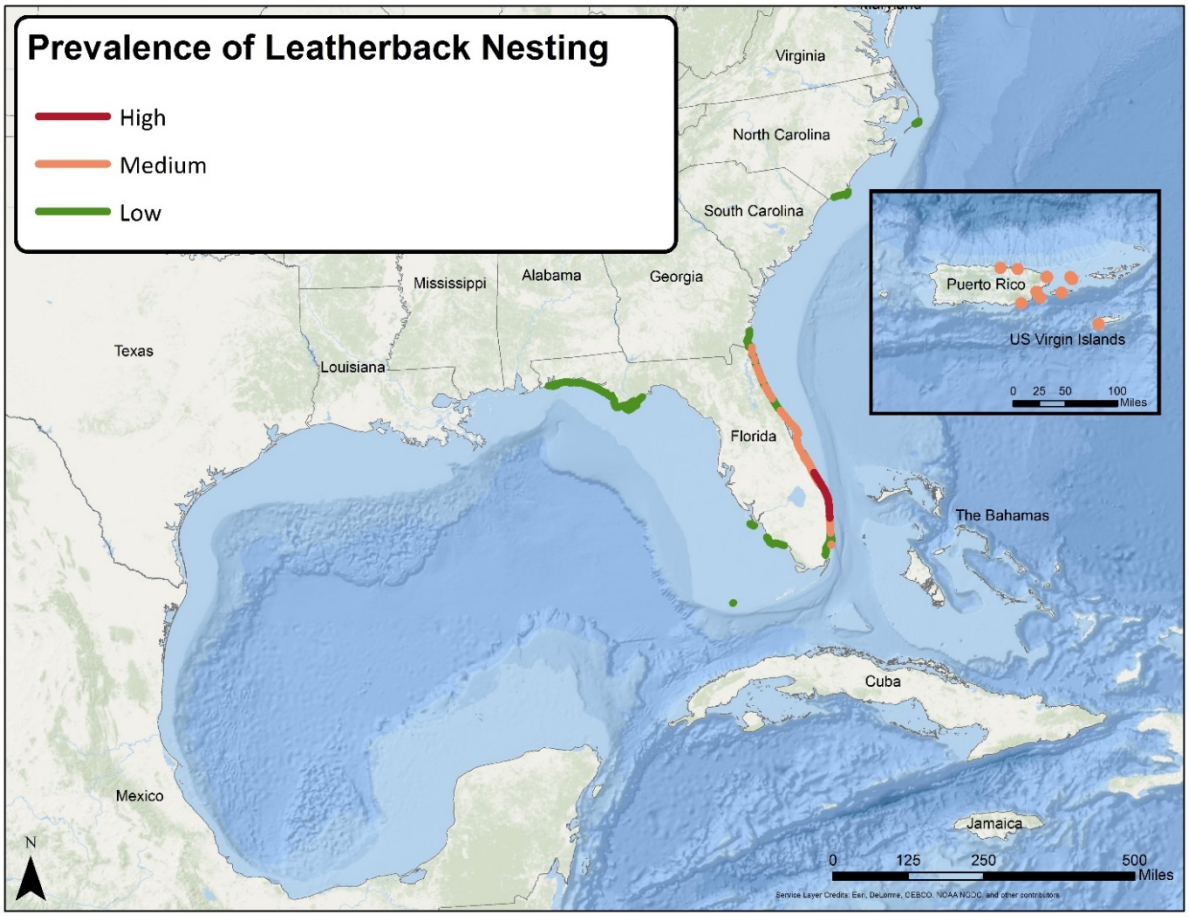
Nesting Beaches

In the Northwest Atlantic, leatherback turtles have important nesting beaches along the east coast of Florida, St. Croix (U.S. Virgin Islands), Puerto Rico, Costa Rica, and Panama; and additional sites in South America (NMFS and USFWS, 2013b) (Figure 13). Female leatherbacks return to their natal beaches or nearby coastal areas every two to three years to nest. Females nest several times during a nesting season, typically at 8–12 day intervals, and lay clutches of approximately 100 eggs. Hatchlings emerge after about two months of incubation.

Marine Stages

Leatherbacks migrate through and feed in the GOM. Adult leatherbacks typically occupy the top ~ 800 ft (~ 250 m) of the water column (James et al., 2005), but are capable of diving extraordinarily deep [down to 4,200 ft (1,280 m)] and for very long periods (up to 85 mins; Houghton et al., 2008). Estimates of age to maturity for leatherbacks range from 13 to 29 years, depending on the method used to generate the estimates (Avens et al., 2009; Jones et al., 2011; NMFS and USFWS, 2013b).

Figure 13. Prevalence of leatherback nesting in the Northwest Atlantic Ocean. Categories (high, medium, and low) for nesting prevalence were generally aligned with nesting density classifications as per the Florida Statewide Atlas of Sea Turtle Nesting Occurrence and Density (http://myfwc.com/research/wildlife/sea-turtles/nesting/nesting-atlas/), wherein "high" density sites are those that have multi-year average density values in the top 25% of the range of values, "low" density sites are those in the lowest 25% of the range of values, and sites between high and low density (the other 50% of values) are classified as "medium" density. We extended this system to include sites outside of Florida within the United States and in other countries, by including binned nest abundance data (nest densities were unavailable) from SWOT (http://seamap.env.duke.edu/swot) and Fuentes et al., 2016. Note: This map is intended to show general, not quantitative, patterns in nesting distribution and abundance within the area occupied by leatherbacks in the Northwest Atlantic Ocean.



2.5.3 Threats to Leatherbacks

Threats to leatherbacks in the Northwest Atlantic include fisheries bycatch in commercial pelagic longlines, commercial trap/pot fisheries, and small-scale coastal net and trap/pot fisheries; harvest of eggs and nesting females; alterations to nesting habitat (e.g., construction, beach armoring and nourishment, sand extraction); and ingestion of marine debris, specifically plastics (NMFS and USFWS, 2013b).

2.5.4 Critical Habitat

Critical marine habitat for leatherback turtles was designated in the U.S. Virgin Islands (Sandy Point, St. Croix) in 1979 (44 FR 17710, 1979), and along the U.S. West Coast in 2012 (77 FR 4170, 2012).

2.5.5 DWH Impacts

The northern GOM is a foraging area for leatherbacks that primarily belong to breeding rookeries in the wider Caribbean (e.g., Costa Rica, Panama, Colombia) (TEWG, 2007; Stewart et al., 2016), and leatherback turtles were sighted within the DWH oil spill footprint during the spill period. Therefore, leatherbacks were exposed to oil in the northern GOM (DWH NRDA Trustees, 2016). However, leatherback injuries caused by the DWH spill were not quantified for multiple reasons. For example, logistical constraints due to the leatherbacks' massive size and competing resource needs prevented allocation of dedicated search efforts for this species. In addition, offshore rescues and aerial surveys were focused on other species, and thus could not effectively document leatherback presence and exposure in the spill area.

References

44 FR 17710. 1979. Determination of Critical Habitat for the Leatherback Sea Turtle. 44 Fed. Reg. 58. March 23, 1979. *Federal Register: The Daily Journal of the United States*.

47 FR 27295. 1982. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Hawksbill Sea Turtle in Puerto Rico. 47 Fed. Reg. 122. June 24, 1982. *Federal Register: The Daily Journal of the United States*.

63 FR 46693. 1998. Designated Critical Habitat; Green and Hawksbill Turtles. 63 Fed. Reg. 170. September 2, 1998. *Federal Register: The Daily Journal of the United States*.

76 FR 184. 2011. Endangered and Threatened Species; Determination of Nine Distinct Population Segments of Loggerhead Sea Turtles as Endangered or Threatened; Final Rule. 76 Fed. Reg. 184. September 22, 2011. *Federal Register: The Daily Journal of the United States*.

77 FR 4170. 2012. Listing Endangered and Threatened Wildlife and Designating Critical Habitat; 12-Month Determination on How to Proceed with a Petition to Revise Designated Critical Habitat for the Endangered Leatherback Sea Turtle. 77 Fed. Reg. 107. June 4, 2012. *Federal Register: The Daily Journal of the United States*.

79 FR 39755. 2014. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northwest Atlantic Ocean Distinct Population Segment of the Loggerhead Sea Turtle. 79 Fed. Reg. 132. July 10, 2014. *Federal Register: The Daily Journal of the United States*.

79 FR 39855. 2014. Endangered and Threatened Species; Critical Habitat for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment (DPS) and Determination Regarding Critical Habitat for the North Pacific Ocean Loggerhead DPS; Final Rule. 79 Fed. Reg. 132. July 10, 2014. *Federal Register: The Daily Journal of the United States*.

81 FR 20057. 2016. Endangered and Threatened Wildlife and Plants; Final Rule to List Eleven Distinct Population Segments of the Green Sea Turtle (*Chelonia mydas*) as Endangered or

Threatened and Revision of Current Listings under the Endangered Species Act; Final Rule. 81 Fed. Reg. 66. April 6, 2016. *Federal Register: The Daily Journal of the United States*.

Avens, L. and M.L. Snover. 2013. Age and age estimation in sea turtles. In *The Biology of Sea Turtles, Vol. III*, J. Wyneken, K.J. Lohmann, and J.A. Musick (eds.). CRC Press. Boca Raton, FL. pp. 97–133.

Avens, L., J.C. Taylor, L.R. Goshe, T.T. Jones, and M. Hastings. 2009. Use of skeletochronological analysis to estimate age of leatherback sea turtles *Dermochelys coriacea* in the western North Atlantic. *Endangered Species Research* 8:165–177.

Avens, L., L.R. Goshe, L. Coggins, M.L. Snover, M. Pajuelo, K.A. Bjorndal, and A.B. Bolten. 2015. Age and size at maturation and adult stage duration for loggerhead sea turtles in the western North Atlantic. *Mar. Biol.* 162:1749–1767.

Avens, L., L.R. Goshe, M. Pajuelo, K.A. Bjorndal, B.D. McDonald, G.E. Lemons, A.B. Bolten, and J.A. Seminoff. 2013. Complementary skeletochronology and stable isotope analyses offer new insight into juvenile loggerhead sea turtle oceanic stage duration and growth dynamics. *MEPS* 491:235–251.

Bjorndal, K.A. 1997. Foraging ecology and nutrition of sea turtles. In *The Biology of Sea Turtles, Vol. I*, P.L. Lutz and J.A. Musick (eds.). CRC Press, Boca Raton, FL. pp. 199–233.

Bjorndal, K.A. and J.B.C. Jackson. 2003. Roles of sea turtles in marine ecosystems: Reconstructing the past. In *The Biology of Sea Turtles, Vol. II,* P.L. Lutz, J.A. Musick, and J. Wyneken (eds.). CRC Press, Boca Raton, FL. pp. 259–274.

Bolten, A.B. 2003. Variation in sea turtle life history patterns: Neritic vs. oceanic life history stages. In *The Biology of Sea Turtles, Vol. II*, P.L. Lutz, J.A. Musick, and J. Wyneken (eds.). CRC Press, Boca Raton, FL. pp. 243–257.

Bolten, A.B., L.B. Crowder, M.G. Dodd, S.L. MacPherson, J.A. Musick, B.A. Schroeder, B.E. Witherington, K.J. Long, and M.L. Snover. 2011. Quantifying multiple threats to endangered species: An example from loggerhead sea turtles. *Frontiers in Ecology and Evolution* 9:295–301.

Camacho, M., L.D. Boada, J. Orós, P. Calabuig, M. Zumbado, and O.P. Luzardo. 2012. Comparative study of polycyclic aromatic hydrocarbons (PAHs) in plasma of eastern Atlantic juvenile and adult nesting sea turtles (*Caretta caretta*). *Marine Pollution Bulletin* 64:1974–1980.

Conant, T.A., P.H. Dutton, T. Eguchi, S.P. Epperly, C.C. Fahy, M.H. Godfrey, S.L. MacPherson, E.E. Possardt, B.A. Schroeder, J.A. Seminoff, M.L. Snover, C.M. Upite, and B.E. Witherington. 2009. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. In *Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service*. August.

Cox, J.H., H.F. Percival, and S.V. Colwell. 1994. Impact of vehicular traffic on beach habitat and wildlife at Cape San Blas, Florida. Cooperative Fish and Wildlife Research Unit Technical Report Number 50.

Crouse, D.T., L.B. Crowder, and H. Caswell. 1987. A stage-based population model for loggerhead sea turtles and implications for conservation. *Ecology* 68:1412–1423. doi: 10.2307/1939225.

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. Accessed 5/10/2017.

Finkbeiner, E.M., B.P. Wallace, R.L. Lewison, J.E. Moore, L.B. Crowder, and A.J. Read. 2011. Cumulative impacts of sea turtle bycatch in U.S. fisheries from 1990–2007. *Biological Conservation* 144:2719–2727.

Fuentes, M.M.P.B., C. Gredzens, B.L. Batemen, R. Boettcher, S.A. Ceriani, M.H. Godfrey, D. Helmers, D.K. Ingram, R.L. Kamkrowski, M. Pate, R.L. Pressey, and V.C. Radeloff. 2016. Conservation hotspots for marine turtle nesting in the United States based on coastal development. *Ecological Applications* 0(0):1–12.

Goshe, L.R., L. Avens, F.S. Scharf, and A.L. Southwood. 2010. Estimation of age at maturation and growth of Atlantic green turtles (*Chelonia mydas*) using skeletochronology. *Mar. Biol.* 157:1725–1740.

Hamann, M., M.M.P.B. Fuentes, N.C. Ban, and V.J.L. Mocellin. 2013. Climate change and marine turtles. In *The Biology of Sea Turtles, Vol III*, J. Wyneken, K.J. Lohmann, and J.A. Musick (eds.). CRC Press, Boca Raton, FL. pp. 353–378.

Hart, K.M., M.M. Lamont, A.R. Sartain, and I. Fujisaki. 2014. Migration, foraging, and residency patterns for northern Gulf loggerheads: Implications of local threats and international movements. *PLoS One* 9(7). doi: 10.1371/journal.pone.0103453.

Hart, K.M., M.M. Lamont, A.R. Sartain, I. Fujisaki, and B.S. Stephens. 2013. Movements and habitat-use of loggerhead sea turtles in the Northern Gulf of Mexico during the reproductive period. *PLoS ONE* 8(7):e66921. doi: 10.1371/journal.pone.0066921.

Herbst, L.H. 1994. Fibropapillomatosis of marine turtles. *Annual Review of Fish Diseases* 4:389–425.

Hosier, P.E., M. Kochhar, and V. Thayer. 1981. Off-road vehicle and pedestrian track effects on the sea-approach of hatchling loggerhead turtles. *Environmental Conservation* 8:158–161.

Houghton, J.D.R., T.K. Doyle, J. Davenport, R.P. Wilson, and G.C. Hays. 2008. The role of infrequent and extraordinary deep dives in leatherback turtles (*Dermochelys coriacea*). *Journal of Experimental Biology* 211:2566–2575. doi: 10.1242/jeb.020065.

Hughes, A.L. and E.A. Caine. 1994. The effect of beach features on hatchling loggerhead sea turtles. In *Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation*, March 1–5, Hilton Head, SC. p. 237. National Oceanic and Atmospheric Administration, Technical Memorandum NMFS-SEFSC-351.

Humburg, I.N. and G.H. Balazs. 2014. Forty Years of Research: Recovery Records of Green Turtles Observed or Originally Tagged at French Frigate Shoals in the Northwestern Hawaiian

Islands, 1973–2013. U.S. Department of Commerce, NOAA Technical Memo, NOAA-TM-NMFS-PIFSC-40.

James, M.C., R.A. Myers, and C.A. Ottensmeyer. 2005. Behaviour of leatherback sea turtles, *Dermochelys coriacea*, during the migratory cycle. *Proceedings of the Royal Society* (B) 272:1547–1555.

Jones, T.T., M.D. Hastings, B.L. Bostrom, D. Pauly, and D.R. Jones. 2011. Growth of captive leatherback turtles, *Dermochelys coriacea*, with inferences on growth in the wild: Implications for population decline and recovery. *Journal of Experimental Marine Biology and Ecology* 399:84–92.

Keller, J.M. 2013. Exposure to and effects of persistent organic pollutants. In *The Biology of Sea Turtles, Volume III*, J. Wyneken, K.J. Lohmann, and J.A. Musick (eds.). CRC Press, Boca Raton, FL. pp. 285–328.

Lewison, R., B. Wallace, J. Alfaro-Shigueto, J.C. Mangel, S.M. Maxwell, and E.L. Hazen. 2013. Fisheries bycatch of marine turtles: Lessons learned from decades of research and conservation. In *The Biology of Sea Turtles, Vol. III*, J.A. Musick, J. Wyneken, and K.J. Lohmann (eds.). CRC Press, Boca Raton, FL. pp. 329–351.

Lutcavage, M.L. and P.L. Lutz. 1997. Diving physiology. In *The Biology of Sea Turtles, Vol. I*, P.L. Lutz and J.A. Musick (eds.). CRC Press, Boca Raton, FL. pp. 277–296.

Mann, T.M. 1977. Impact of Developed Coastline on Nesting and Hatchling Sea Turtles in Southeastern Florida. Unpublished Master of Science thesis. Florida Atlantic University, Boca Raton, FL.

Nelms, S.E., E.M. Duncan, A.C. Broderick, T.S. Galloway, M.H. Godfrey, M. Hamann, P.K. Lindeque, and B.J. Godley. 2015. Plastic and marine turtles: A review and call for research. *ICES Journal of Marine Science* 73(2):165–181. doi: 10.1093/icesjms/fsv165.

NMFS. 1997. Endangered Species Act Section 7 Consultation – Biological Opinion on Navy Activities Off the Southeastern United States along the Atlantic Coast. National Marine Fisheries Service.

NMFS. 2013. Biological Report on the Designation of Marine Critical Habitat for the Loggerhead Sea Turtle, *Caretta caretta.* National Marine Fisheries Service, Silver Spring, MD.

NMFS and USFWS. 1992. Recovery Plan for Leatherback Turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. National Marine Fisheries Service and U.S. Fish and Wildlife Service. Washington, DC.

NMFS and USFWS. 1993. Recovery Plan for the Hawksbill Turtle *Eretmochelys imbricata* in the U.S. Caribbean, Atlantic, and Gulf of Mexico. National Marine Fisheries Service, St. Petersburg, FL, and U.S. Fish and Wildlife Service, Atlanta, GA.

NMFS and USFWS. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtles (*Caretta caretta*), 2nd revision. National Marine Fisheries Service, Silver Spring, MD, and U.S. Fish and Wildlife Service, Atlanta, GA.

NMFS and USFWS. 2013a. Hawksbill Sea Turtles (*Eretmochelys embricata*) 5-Year Review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, MD, and U.S. Fish and Wildlife Service, Jacksonville, FL.

NMFS and USFWS. 2013b. Leatherback Sea Turtle (*Dermochelys coriacea*) 5-Year Review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, MD, and U.S. Fish and Wildlife Service, Jacksonville, FL.

NMFS and USFWS. 2015. Kemp's Ridley Sea Turtle (*Lepidochelys kempii*); 5-Year Review Summary and Evaluation. National Marine Fisheries Service Office of Protected Resources, Silver Spring, MD, and U.S. Fish and Wildlife Service, Southwest Region.

NMFS, USFWS, and SEMARNAT. 2011. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. National Marine Fisheries Service, U.S. Fish and Wildlife Service, and Secretariat of Environment and Natural Resources. Silver Spring, MD.

Putman, N., K.L. Mansfield, R. He, D.J. Shaver, and P. Verley. 2013. Predicting the distribution of oceanic-stage Kemp's ridley sea turtles. *Biology Letters* 9(5):October. doi: 10.1098/rsbl.2013.0345. Available: http://dx.doi.org/10.1098/rsbl.2013.0345. Accessed 5/10/2017.

Ramirez, M.D., L. Avens, J.A. Seminoff, L.R. Goshe, and S.H. Heppell. 2015. Patterns of loggerhead turtle ontogenetic shifts revealed through isotopic analysis of annual skeletal growth increments. *Ecosphere* 6:1–17.

Schroeder, B.A., L. Ehrhart, D. Bagley, M. Coyne, A. Foley, G. Balazs, and B. Witherington. 2008. Migratory routes and resident areas of adult female and male Florida green turtles. In *Proceedings of the 27th Annual Symposium on Sea Turtle Biology and Conservation*, A.F. Rees, M. Frick, A. Panagopoulou, and K. Williams (eds.). NOAA Technical Memorandum NMFS-SEFSC-569. pp. 59–60.

Seminoff, J.A. 2004. *Chelonia mydas*. The IUCN Red List of Threatened Species 2004: e.T4615A11037468. Southwest Fisheries Science Center. Available: http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T4615A11037468.en. Accessed 5/10/2017.

Seminoff, J.A., C.D. Allen, G.H. Balazs, P.H. Dutton, T. Eguchi, H.L. Haas, S.A. Hargrove, M.P. Jensen, D.L. Klemm, A.M. Lauritsen, S.L. MacPherson, P. Opay, E.E. Possardt, S.L. Pultz, E.E. Seney, K.S. Van Houtan, and R.S. Waples. 2015. Status Review of the Green Turtle (*Chelonia mydas*) under the U.S. Endangered Species Act. NOAA Technical Memorandum, NOAANMFS-SWFSC-539.

Shaver, D.J., K.M. Hart, I. Fujisaki, C. Rubio, A.R. Sartain, J. Peña, P.M. Burchfield, D.G. Gamez, and J. Ortiz. 2013. Foraging area fidelity for Kemp's ridleys in the Gulf of Mexico. *Ecology and Evolution* 3(7):2002–2012. doi: 10.1002/ece3.594.

Shaver, D.J., K.M. Hart, I. Fujisaki, C. Rubio, A.R. Sartain-Iverson, J. Peňa, D. Gomez Gamez, R. Miron, P.M. Burchfield, H.J. Martinez, and J. Ortiz. 2016. Migratory corridors of adult female Kemp's ridley turtles in the Gulf of Mexico. *Biological Conservation* 194:158–167.

Shaver, D.J., K.M. Hart, I. Fujisaki, D. Bucklin, A.R. Iverson, C. Rubio, T. Backof, P.M. Burchfield, R. de Jesus Gonzalez Diaz Miron, P.H. Dutton, A. Frey, J. Peña, D. Gomez Gamez, H.J. Martinez, and J. Ortiz. 2017. Inter-nesting movements and habitat-use of adult female Kemp's

ridley turtles in the Gulf of Mexico. *PLoS ONE* 12(3). Available: http://dx.doi.org/10.1371/journal.pone.0174248. Accessed 5/10/2017.

Snover, M.L. 2002. Growth and Ontogeny of Sea Turtles Using skeletochronology: Methods, Validation and Application to Conservation. Unpublished Ph.D. dissertation at Duke University, Durham, NC.

Snover, M.L., G.H. Balazs, S.K.K. Murakawa, S.K. Hargrove, M.R. Rice, and W.A. Seitz. 2013. Age and growth rates of Hawaiian hawksbill sea turtles (*Eretmochelys imbricata*) using skeletochronology. *Marine Biology* 160:37–46.

Sobel, D. 2002. A photographic documentation of aborted nesting attempts due to lounge chairs. In *Proceedings of the Twentieth Annual Symposium on Sea Turtle Biology and Conservation*, A. Mosier, A. Foley, and B. Brost (compilers). NOAA Technical Memorandum NMFS-SEFSC-477. p. 311.

Stewart, K.R., J.M. Keller, R. Templeton, J.R. Kucklick, and C. Johnson. 2011. Monitoring persistent organic pollutants in leatherback turtles (*Dermochelys coriacea*) confirms maternal transfer. *Marine Pollution Bulletin* 62:1396–1409. doi: 10.1016/j.marpolbul.2011.04.042.

Stewart, K.R., E.L. LaCasella, S.E. Roden, M.P. Jensen, L.W. Stokes, S.P. Epperly, and P.H. Dutton. 2016. Nesting population origins of leatherback turtles caught as bycatch in the U.S. pelagic longline fishery. *Ecosphere* 7(3):e01272.

TEWG. 2007. An Assessment of the Leatherback Turtle Population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-555. Turtle Expert Working Group.

Wallace, B.P., A.D. DiMatteo, A.B. Bolten, M.Y. Chaloupka, B.J. Hutchinson, F.A. Abreu-Grobois, J.A. Mortimer, J.A. Seminoff, D. Amorocho, K.A. Bjorndal, J. Bourjea, B.W. Bowen, R. Briseño Dueñas, P. Casale, B.C. Choudhury, A. Costa, P.H. Dutton, A. Fallabrino, E.M. Finkbeiner, A. Girard, M. Girondot, M. Hamann, B.J. Hurley, M. López-Mendilaharsu, M.A. Marcovaldi, J.A. Musick, R. Nel, N.J. Pilcher, S. Troëng, B. Witherington, and R.B. Mast. 2011. Global conservation priorities for marine turtles. *PLoS One* 6(9). doi: 10.1371/journal.pone.0024510.

Wallace, B.P., A.D. DiMatteo, B.J. Hurley, E.M. Finkbeiner, A.B. Bolten, M.Y. Chaloupka, B.J. Hutchinson, F.A. Abreu-Grobois, D. Amorocho, K.A. Bjorndal, J. Bourjea, B.W. Bowen, R. Briseño Dueñas, P. Casale, B.C. Choudhary, A. Costa, P.H. Dutton, A. Fallabrino, A. Girard, M. Girondot, M.H. Godfrey, M. Hamann, M. López-Mendilaharsu, M.A. Marcovaldi, J.A. Mortimer, J.A. Musick, R. Nel, N.J. Pilcher, J.A. Seminoff, S. Troëng, B. Witherington, and R.B. Mast. 2010. Regional Management Units for Marine Turtles: A Novel Framework for Prioritizing Conservation and Research across Multiple Scales. *PLoS ONE* 5(12):1–11. doi: 10.1371/journal.pone.0015465&type = printable.

Witherington, B., S. Hirama, and R. Hardy. 2012. Young sea turtles of the pelagic Sargassum-dominated drift community: Habitat use, population density, and threats. *Marine Ecology Progress Series* 463:1–22.

Witherington, B.E. and R.E. Martin. 2003. Understanding, Assessing, and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches. Prepared for Florida Department of Environmental Protection. FMRI Technical Report TR-2, 3rd edition.

Module 3
Overview of Related Activities – Sea Turtles

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 funding mechanisms related to the conservation, management, and/or restoration of sea turtles within the northern Gulf of Mexico (GOM). It does not contain a comprehensive list of all individual sea turtle 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 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 (DWH NRDA Trustees, 2016, pp. 5-379, and 7-16 to 7-17).

The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share federal jurisdiction for the conservation and recovery of sea turtles. The roles of the two agencies are defined in a joint Memorandum of Understanding (MOU), originally entered into in 1977, and updated in 2015. USFWS has jurisdiction in the terrestrial environment and NMFS has jurisdiction in the marine environment, unless otherwise specified in the MOU. Sea turtle stranding response and rehabilitation responsibilities are shared between the two agencies. NMFS serves as the lead for the Sea Turtle Stranding and Salvage Network (STSSN); and USFWS serves as the lead for sea turtle rehabilitation and nest monitoring activities, and facility oversight. The state agencies coordinate with the federal agencies to fulfill management responsibilities within individual states.

2. Existing Federal and State Sea Turtle Recovery and Conservation Programs

This section describes existing federal and state recovery and conservation programs for sea turtles under headings that reflect relevant habitats and threats to sea turtles.

2.1 Federal Recovery Plans

Federal Recovery Plans for sea turtles are developed jointly by NMFS and USFWS in accordance with the jurisdictional MOU between the agencies.

Recovery Plans include (1) a description of site-specific management actions necessary to conserve the species or populations; (2) objective, measurable recovery criteria which, when met, will allow the species or populations to be removed from the endangered or threatened species list; and (3) estimates of the time and funding required to achieve the plan's recovery goals. Recovery Criteria are generally framed in terms of demographic criteria (e.g., population

benchmarks) and listing factor criteria. The listing factor criteria follow the five listing factors in Section 4 of the Endangered Species Act (ESA): (1) present or threatened destruction, modification, or curtailment of a species habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; and (5) other natural or manmade factors affecting its continued existence. The description of site-specific management actions necessary to conserve the species is contained in the Implementation Schedule of the Recovery Plan. The Implementation Schedule assigns priorities to the recovery actions; estimates the time necessary to complete the recovery actions; identifies parties with authority, responsibility, or expressed interest in implementation of the recovery actions; and estimates the cost of the recovery actions and recovery program.

Below are links to the specific recovery plan for each of the five species of sea turtles found in the GOM:

- Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*): Second Revision, 2011
- Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*): Second Revision, 2008
- Recovery Plan for the Hawksbill Turtle (*Eretmochelys imbricate*) in the U.S. Caribbean, Atlantic, and Gulf of Mexico: 1993
- Recovery Plan for Leatherback Turtles (*Dermochelys coriacea*) in the U.S. Caribbean, Atlantic, and Gulf of Mexico: 1992
- Recovery Plan for U.S. Population of Atlantic Green Turtle (*Chelonia mydas*): 1991.

2.2 Relevant Conservation Programs

2.2.1 Nesting Beaches

Conservation programs on nesting beaches that aim to reduce anthropogenic threats typically focus on protecting and improving nesting beach habitat through direct conservation actions as well as outreach to coastal communities and beach users. Nesting beach conservation programs that promote the recovery of sea turtles are found within and outside the GOM, including in other countries (e.g., Mexico). In addition, research and monitoring programs provide support for conservation activities and information to track progress and guide adaptive management.

Protect and Improve Nesting Beach Habitat in the GOM

Some examples of programs around the GOM that protect, conserve, and gather data on nesting sea turtles; and their eggs, hatchlings, and nesting beach habitat include:

- **USFWS**: USFWS has the lead responsibility for conserving and recovering sea turtles on nesting beaches in the United States, including those in the GOM. Federal responsibilities and programs include development and implementation of recovery plans; land acquisition; cooperative programs with states; coordination with nongovernmental organizations (NGOs) to conduct sea turtle nesting monitoring; conduct of nesting surveys of National Wildlife Refuges, and consultation with other federal agencies on projects they fund, permit, or conduct; international cooperation; minimization measures to avoid and reduce take; permitting of activities for research or education involving take; and development of habitat conservation plans. In addition, USFWS designated, under ESA, approximately 685 miles of nesting beach

habitat as critical habitat for the threatened Northwest Atlantic Ocean distinct population segments (DPSs) of loggerhead sea turtles (Final Rule: 79 FR 38755).

- **Florida Fish and Wildlife Conservation Commission (FWC)**: FWC is the overall coordinator for sea turtle nesting beach surveys and nest productivity assessments in Florida. These surveys provide information on the extent and magnitude of nesting, and on the spatial and temporal trends in nest numbers and hatchling production. Using data collected from these efforts, FWC evaluates the effects of human activity (e.g., lighting, coastal construction, beach nourishment, recreation) on nesting sea turtles and their eggs and hatchlings, and identifies important areas for enhanced protection or land acquisition.
- **Various NGOs**: There are numerous NGOs that monitor sea turtle nesting and conduct and/or promote environmental education and scientific research. The NGOs work within existing state and federal nest monitoring programs.
- **Local governments**: Multiple counties and municipalities in Florida and two municipalities in Alabama have sea turtle protection measures such as lighting and/or beach furniture ordinances.
- **National Park Service (NPS)**: NPS conducts nesting surveys on national park lands in Florida and Texas. For example, NPS's Division of Sea Turtle Science and Recovery at the Padre Island National Seashore focuses on conservation and long-term monitoring of sea turtles, especially Kemp's ridleys.

2.2.2 Marine Environment

Conservation programs that address threats in the marine environment promote recovery of sea turtles found in the GOM and operate within and outside the United States, due to the highly migratory nature of sea turtles. Existing programs focus on reducing sea turtle bycatch in fisheries and reducing other anthropogenic threats to sea turtles in the marine environment (e.g., mortality in dredges, incidental capture in power plants). A region-wide program to monitor sea turtle strandings and investigate mortality causes also operates in the GOM and elsewhere in the United States. Examples of some of these recovery activities are briefly described below.

Reduce Sea Turtle Bycatch in Fisheries

The bycatch of sea turtles in fishing gear is a major contributor to past declines and a major threat to future recovery of all sea turtle species, including populations in the GOM (NMFS and USFWS, 2008; NMFS et al., 2011). The primary commercial gear types include trawl, gillnet, pelagic and demersal longline, pound net, and pot/trap gear. Additionally, recreational hook and line fishing from piers and other land-based fixed structures also negatively impact sea turtles. Programs to understand and reduce sea turtle bycatch are critical to ensure the recovery and persistence of populations.

The National Oceanic and Atmospheric Administration (NOAA)/NMFS, through the Office of Protected Resources, the Southeast Regional Office, and the Southeast Fisheries Science Center (SEFSC), works with the fishing industry to develop or modify fishing gear and practices to minimize sea turtle bycatch. Some examples of programs and management actions focused on sea turtle bycatch reduction include:

- **NMFS's National Bycatch Strategy**: The National Bycatch Reduction Strategy's objectives and actions build on past successes and guide NOAA's efforts to reduce bycatch and bycatch mortality.

- **NMFS Regulations to Protect Sea Turtles:** NMFS issues regulations to reduce bycatch and/or reduce the mortality resulting from bycatch [e.g., requirements for the use of Turtle Excluder Devices (TEDs) in the shrimp trawl fishery, requirements for the use of certain hook and bait types in the U.S. longline fishery]. A full list of NMFS regulations (since 2002) to protect sea turtles can be found here: http://www.nmfs.noaa.gov/pr/species/turtles/regulations.htm.
- **NMFS Gear Monitoring Program**: As part of the NMFS SEFSC Harvesting Systems Unit, a team of fishery biologists and gear specialists perform research into the critical problem of fisheries resource management as it relates to commercial and recreational fishing gear. They provide outreach and education to the fishing community on the use and installation of required gear modifications.
- **NMFS Fisheries Observer Programs**: NMFS uses fishery observers to collect data from U.S. commercial fishing and processing vessels. These professionally trained observers gather data to support science, conservation, and management activities. The data they collect are used to monitor federal fisheries, document protected species bycatch, assess fish populations, inform management, and monitor compliance with fishing and safety regulations.

Reduce Effects of Other Anthropogenic Impacts

In addition to fisheries bycatch, numerous other anthropogenic activities affect sea turtles in the terrestrial and marine environments, including oil and gas exploration and production, beach nourishment, dredging, in-water and coastal construction, military activities, vessel strikes, and marine debris.

The NMFS Southeast Regional Office and the USFWS conduct ESA Section 7 consultations on activities that are permitted, funded, or carried out by federal agencies. If an action will result in the "take" of an endangered or threatened species, a Biological Opinion is issued by NMFS and/or USFWS. Here are some examples of federal actions (and Action Agencies) that require ESA Section 7 consultations, and their corresponding Biological Opinions:

- **U.S. Army Corps of Engineers (USACE)**: The USACE works to build and maintain infrastructure; and provides military facilities where U.S. service members train, work, and live. Many of USACE's operations involve the dredging of sediment and sand material in coastal areas, which requires that USACE work with NMFS to develop and implement tools and practices to minimize impacts on sea turtles such as:
  - NMFS Biological Opinion for USACE Reauthorization of 48 Nationwide Permits for Discharges of Dredge and Fill Material of Other Structures or Work in Waters of the United States
  - NMFS Gulf of Mexico Regional Biological Opinion to the U.S. Army Corps of Engineers on Hopper Dredging of Navigation Channels and Borrow Areas in the U.S. Gulf of Mexico
  - U.S. Fish and Wildlife Service Statewide Biological Opinion for Sand Placement Projects along the Florida Coastline.
- **NMFS Platform Removal Observer Program**: This Program deploys NMFS-approved observers to monitor the explosive removal of oil and gas structures in the GOM for potential effects on protected species such as sea turtles.
- **NOAA Marine Debris Program**: This Program leads national and international efforts to research, prevent, and reduce the impacts of marine debris. The program has several current

projects in the GOM, including the removal of derelict vessels and fishing gear, and the examination of microplastic occurrence in Sargassum-associated juvenile fishes.

- **NMFS fisheries and dredging Biological Opinions and consultations for activities around the GOM**: http://sero.nmfs.noaa.gov/protected_resources/section_7/freq_biop/.
- **U.S. Department of Defense:** Each military installation that includes land and water suitable for the conservation and management of natural resources must complete an integrated natural resource management plan (INRMP). An INRMP integrates implementation of the military mission of the installation with stewardship of the natural resources found on the base.
- **Bureau of Ocean Energy Management (BOEM):** BOEM consults with NMFS and the USFWS on geological and geospatial activities, leasing, exploration, and development and production activities to ensure that BOEM-authorized actions are not likely to jeopardize the continued existence of any endangered or threatened species, or to result in the destruction or adverse modification of designated critical habitat.

Coordinate a Stranding Network and Investigate Mortality

The STSSN includes federal, state, academic, and private partners to collect data from stranded sea turtles along the U.S. GOM and Atlantic coasts. In addition, the STSSN responds to unusual stranding events (e.g., cold stunnings, red tide events), collects biological samples, and facilitates the transfer of sick/injured sea turtles to permitted sea turtle rehabilitation centers. STSSN data are used to inform mortality investigations and identify mortality sources.

NMFS coordinates the STSSN through the National STSSN Coordinator who is housed at the NMFS SEFSC, Miami Laboratory. Each state is served by a State Coordinator who manages the day-to-day operations of the STSSN in their respective state. The states contribute the data they collect to the national database housed at the SEFSC. A list of state coordinators and additional information on the STSSN can be found here: https://www.sefsc.noaa.gov/species/turtles/strandings.htm.

2.2.3 International Conservation Programs

In addition to domestic conservation efforts, there are also international conservation programs that address threats on nesting beaches and in marine environments to promote protection and recovery of sea turtle species in the GOM. Some examples of international conservation programs that benefit sea turtles in the GOM include:

- **Kemp's Ridley Binational Project**: Since the 1970s, a number of organizations including the Gladys Porter Zoo, the General Directorate for Wildlife of the Secretariat of Environment and Natural Resources (SEMARNAT) of Mexico, USFWS, NMFS, the Texas Parks and Wildlife Department, NPS, and private groups have cooperated to protect sea turtle nests and hatchlings on Rancho Nuevo and the surrounding Mexican beaches where the majority of Kemp's ridley sea turtles nest.
- **The Wider Caribbean Sea Turtle Conservation Network (WIDECAST)**: WIDECAST is an expert network of biologists, managers, community leaders, and educators in more than 40 nations and territories in the Wider Caribbean Region and the GOM that works toward the recovery and sustainable management of depleted sea turtle populations. WIDECAST works closely to implement Sea Turtle Recovery Action Plans in the Caribbean.
- **Inter-American Convention (IAC) for the Protection and Conservation of Sea Turtles**: The IAC is the only legally binding treaty in the world to protect and conserve sea turtles and

their habitats. The IAC Convention Area is the Americas and maritime areas of the Atlantic, Caribbean, and Pacific to which the Parties have sovereignty. At present, there are 15 Parties whose obligations under the treaty include reducing sea turtle bycatch to the extent possible, eliminating the capture or retention of sea turtles, and protecting and conserving sea turtle habitat. In addition to the obligations outlined in the treaty, the Conference of Parties has also adopted additional measures to improve Pacific leatherback, Caribbean hawksbill, and South Atlantic and North Pacific loggerhead conservation, in addition to considering climate change impacts on sea turtles.

- **Various NGOs in other countries**: Many countries where sea turtle nesting occurs have numerous NGOs that monitor sea turtle nesting and conduct and/or promote environmental education and scientific research.
- **International Commission for the Conservation of Atlantic Tunas (ICCAT)**: ICCAT is an inter-governmental fishery organization that is responsible for the conservation of tuna and tuna-like species in the Atlantic Ocean and its adjacent seas, including international waters of the GOM and the Wider Caribbean Region. ICCAT recommendation 10-09 requires Contracting Parties, Cooperating Non-Contracting Parties, and Entity or Fishing Entity to submit their data on sea turtle interactions in all their fleets each year. This recommendation also asked the ICCAT Standing Committee on Research and Statistics to prepare an assessment of the impact of the ICCAT fisheries on sea turtle populations.
- **Specially Protected Areas and Wildlife (SPAW) Protocol** of the Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region (Cartagena Convention) has four program areas. SPAW and WIDECAST work together to aid member countries in managing protected areas, conserving threatened and endangered species, conserving and managing marine and coastal ecosystems, and developing and implementing Sea Turtle Recovery Action Plans. Activities include criteria for index site monitoring at sea turtle foraging grounds and training.
- **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)**: CITES puts controls in place for the trade of endangered species, such as sea turtles. The 183 Parties have agreed that all sea turtles are listed in Appendix I, which prohibits trade for commercial purposes and only allows trade in exceptional circumstances. CITES has been very important in significantly reducing the trade in green and hawksbill sea turtles in the Americas. While some illegal trade still occurs, international commercial trade is prohibited.
- **National Commission of Natural Protected Areas (CONANP) and the SEMARNAT in Mexico**: CONANP, an agency within SEMARNAT, manages the national sea turtle program in Mexico, including sea turtle nesting beach monitoring and conservation work in the GOM and Caribbean.

2.2.4 Research and Monitoring Programs

Research and monitoring programs provide support for conservation activities in the form of on-the-ground resources and information to track progress and guide adaptive management. Research and monitoring activities focused on sea turtle nesting beaches that support habitat protection and restoration efforts can include nesting beach surveys and assessments of hatchling production; while programs that focus on marine life stages can include activities such as at-sea monitoring of sea turtle abundance, identification of important migratory and foraging areas, health assessments, and population genetic analyses. Example programs are listed below.

NOAA's SEFSC: SEFSC's sea turtle population ecology and monitoring program supports sea turtle conservation and recovery by conducting population assessments; researching stock structure (age and genetics); assessing mortality and strandings; conducting aerial and vessel surveys; developing and transferring bycatch reduction measures; and conducting in-water studies to study population trends, movement patterns and distribution, health assessments, and habitat use.

U.S. Geological Survey (USGS): USGS's Wetland and Aquatic Research Center maintains study sites in the GOM, the Florida Keys, and the Caribbean (e.g., U.S. Virgin Islands), with focused research programs on both in-water and nesting turtles. USGS researchers maintain and oversee long-term mark-recapture datasets, and conduct extensive satellite-tracking projects to determine important migratory and foraging habitats for multiple sea turtle species. In addition, they use multiple methods to address issues surrounding population connectivity, habitat use, health and demography; as well as conduct nesting beach monitoring and maintain study sites in the GOM, the Florida Keys, and the Caribbean (e.g., U.S. Virgin Islands), with focused research programs on both in-water and nesting turtles.

FWC: FWC's Fish and Wildlife Research Institute coordinates monitoring of sea turtle nesting activity around the State of Florida through two long-term programs: the Statewide Nesting Beach Survey (SNBS) and the Index Nesting Beach Survey. Data are used to produce a statewide atlas of sea turtle nesting occurrence and density. FWC also coordinates the collection of data on hatchling production (Nest Productivity Assessment) and coordinates the Florida STSSN. Additionally, FWC conducts research on the distribution, abundance, life histories, ecology, migrations, and threats to marine turtles in Florida and contiguous western Atlantic and Caribbean waters.

2.2.5 Communication and Access to Information

This section presents some examples of existing resources for communication and access to information about sea turtle biology and conservation, including email listserves, the annual international symposium, scientific journals, websites, and other publications.

- **CTURTLE**: An email information network for sea turtle biology and conservation, maintained by the Archie Carr Center for Sea Turtle Research (https://accstr.ufl.edu/resources/cturtle/).
- **International Sea Turtle Society (ISTS) and International Sea Turtle Symposium**: The ISTS convenes a uniquely important annual symposium that brings people together from around the world who are dedicated to the research and conservation of sea turtles (http://internationalseaturtlesociety.org/). Symposium proceedings are available at: http://internationalseaturtlesociety.org/proceedings-2/.
- **Chelonian Conservation and Biology (CCB)**: The CCB international journal of turtle and tortoise research is the only international scientific peer-reviewed journal of cosmopolitan and broad-based coverage of all aspects of conservation and biology of all chelonians, including freshwater turtles, marine turtles, and tortoises (http://www.chelonianjournals.org/).
- **Seaturtle.org**: This website is intended to support research and conservation efforts in the sea turtle community by providing access to the *Marine Turtle Newsletter* (MTN) and other resources, including centralized database management systems to help organizations working to conserve sea turtles manage, organize, and share their data (http://www.seaturtle.org/).

- **Sea Turtle Online Bibliography**: Contains over 21,000 references on all aspects of sea turtle biology and conservation (http://accstr.ufl.edu/resources/online-bibliography/).
- **MTN**: the MTN aims to (1) provide a forum for the exchange of information about all aspects of marine turtle biology and conservation, and (2) alert interested people to particular threats to marine turtles, as they arise (http://www.seaturtle.org/mtn/).
- **FWC's Statewide Atlas of Sea Turtle Nesting Occurrence and Density**: FWC's Fish and Wildlife Research Institute coordinates the SNBS program to document the total distribution, seasonality, and abundance of nesting by sea turtles in Florida (http://myfwc.com/research/wildlife/sea-turtles/nesting/nesting-atlas/).
- **The State of the World's Sea Turtles (SWOT)**: SWOT is a global network of specialists working to accelerate the conservation of sea turtles and their habitats by sharing data and improving data collection, and by communicating and promoting conservation action. SWOT maintains the largest catalog of sea turtle biogeography data in the world, and publishes an annual magazine that highlights success stories, innovations, and new findings of partners worldwide (SWOT: http://seaturtlestatus.org; SWOT database: http://seamap.env.duke.edu/swot).
- **USGS GOM Website:** The USGS GOM website brings together data for assessing and monitoring GOM estuaries. It includes sea turtle-relevant projects, publications, resources, partners, and programs. (https://gom.usgs.gov/web/).

3. 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 its 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.

As of January 2016, approximately $866 million and 68 projects have been identified across several restoration types (including sea turtles) for early restoration in five phases. Sea turtle restoration projects were included within Phase II and Phase IV. These projects are summarized below.

3.1 Improving Habitat Injured by Spill Response: Restoring the Night Sky, Phase II, $4.3 Million

This project reduces light disturbance to nesting habitat for loggerhead sea turtles and consists of multiple components:

- Site-specific surveys of existing light sources for each targeted beach
- Coordination with site managers to develop plans to eliminate, retrofit, or replace existing light fixtures on the property; or to otherwise decrease the amount of light reaching the nesting beach
- The retrofit of streetlights and parking lot lights to decrease the amount of artificial light reaching the nesting beach
- Increased efforts by local governments to ensure compliance with local lighting ordinances
- A public awareness campaign, including educational materials and revision of the FWC Lighting Technical Manual, to include best available technology.

3.2 Sea Turtle Early Restoration, Phase IV, $45 Million

This project consists of four complementary components:

- The Kemp's Ridley Sea Turtle Nest Detection and Enhancement project component will provide additional staff, infrastructure, training, education activities, equipment, supplies, and vehicles over a 10-year period in Texas and Mexico for Kemp's ridley sea turtle nest detection and protection.
- The Enhancement of the STSSN and Development of an Emergency Response Program project component will enhance the existing STSSN beyond current capacities for 10 years across the GOM, and develop a formal Emergency Response Program within the GOM.
- The GOM Shrimp Trawl Bycatch Reduction component will enhance two existing NOAA programs to reduce bycatch of sea turtles in shrimp trawls in the GOM: the Gear Management Team (GMT) program and the Southeast Shrimp Trawl Fisheries Observer program.
- The Texas Enhanced Fisheries Bycatch Enforcement component will enhance the Texas Parks and Wildlife Department enforcement activities for fisheries that incidentally catch sea turtles while they operate primarily in Texas State waters within the GOM, over a 10-year period.

4. Funding Opportunities Related to the DWH Oil Spill

This section is intended to provide a high-level overview of grant program funding restoration actions across the GOM. It is not intended to capture the work of every researcher working on sea turtles in the GOM, but rather provide context to the work that the DWH Trustees will be funding. For more in-depth details on project and research funded through these programs, please visit the links below, which includes the *Deepwater Horizon* Project Tracker maintained by the Gulf of Mexico Alliance (GOMA).

4.1 GOM Alliance

GOMA was established in 2004 by the Gulf State Governors in response to the President's Ocean Action Plan. It was a state-led network of partners working together on projects related to priority issues identified by the Governors in early discussions. Strongly supported by the White House's Council on Environmental Quality, 13 federal agencies led by the U.S. Environmental Protection Agency and NOAA were identified to work with and support this effort. Today, GOMA is actively addressing the region's Priority Issues as well as managing a large-scale oil spill research program, the Gulf of Mexico Research Initiative (GOMRI).

GOMA has developed the *Deepwater Horizon* Project Tracker as a tool to track restoration, research, and recovery projects resulting from the DWH oil spill.

4.1.1 GOM Research Initiative

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

4.2 RESTORE Act

4.2.1 RESTORE Council

The RESTORE Council is an independent entity in the federal government that is charged with helping to restore the ecosystem and economy of the Gulf Coast region by developing and overseeing implementation of a comprehensive restoration plan. The RESTORE 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 from other parties. None of the projects listed on the FPL to date have directly focused on the restoration of sea turtles impacted by the DWH oil spill.

4.2.2 NOAA RESTORE Act Science Program

The mission of the NOAA RESTORE Act Science Program is to carry out research, observation, and monitoring to support, to the maximum extent practicable, the long-term sustainability of the ecosystem, fish stocks, and fish habitat; and the recreational, commercial, and charter-fishing industry in the GOM.

4.2.3 RESTORE Act Centers of Excellence Research Grant Programs

The RESTORE Act specifies which entities for each state are responsible for administering the funds provided by the Department of Treasury under the Centers of Excellence Research Grants Program. The administering entities for each state are:

- 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 Center of Excellence for Texas.

Funds may be used for science, technology, and monitoring in one or more of the following disciplines:

- Coastal and deltaic sustainability, restoration, and protection, including solutions and technology that allow citizens to live in a safe and sustainable manner in a coastal delta in the Gulf Coast region
- Coastal fisheries and wildlife ecosystem research and monitoring in the Gulf Coast region
- Offshore energy development, including research and technology to improve the sustainable and safe development of energy resources in the GOM
- Sustainable and resilient growth, and economic and commercial development in the Gulf Coast region
- Comprehensive observation, monitoring, and mapping of the GOM.

4.3 The National Academy of Sciences 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 U.S. outer continental shelf areas by seeking to improve understanding of the region's interconnecting human, environmental, and energy

systems; and fostering application of these insights to benefit GOM communities, ecosystems, and the Nation.

The National Academy of Sciences also published two reports that are relevant to northern GOM sea turtles:

- Assessment of Sea Turtles Status and Trends: Integrating Demography and Abundance
- Effective Monitoring to Evaluate Ecological Restoration in the Gulf of Mexico.

4.4 National Fish and Wildlife Foundation

4.4.1 National Fish and Wildlife Foundation Gulf Environmental Benefit Fund

Between 2013 and 2018, the Gulf Environmental Benefit Fund (GEBF) will receive $2.544 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 ($1.272 billion) and natural resource projects in Alabama ($356 million), Florida ($356 million), Mississippi ($356 million), and Texas ($203 million). To date, the National Fish and Wildlife Foundation (NFWF) has worked closely with key state and federal resource agencies to award over $870 million of GEBF funds for projects designed to protect, restore, and enhance natural and living resources across the Gulf Coast.

4.4.2 NFWF Gulf Response Grants

From 2010 to 2012, NFWF invested $22.9 million in conservation actions in the 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 other species.

4.4.3 NFWF Gulf Coast Conservation Grants Program

NFWF's Gulf Coast Conservation Grants Program (GCCGP) supports conservation projects that enhance coastal habitats of the 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 NFWF's GEBF or other funding opportunities associated with the DWH oil spill (e.g., RESTORE Act, NRDA, GOMRI).

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. Accessed 5/10/2017.

NMFS and USFWS. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtles (*Caretta caretta*), 2nd Revision. National Marine Fisheries Service and U.S. Fish and Wildlife Service. National Marine Fisheries Service, Silver Spring, MD.

NMFS, USFWS, and SEMARNAT. 2011. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. National Marine Fisheries Service, U.S. Fish and Wildlife Service, and Secretariat of Environment and Natural Resources. National Marine Fisheries Service, Silver Spring, MD.

Module 4
Considerations for Restoration – Sea Turtles

1. Introduction

The purpose of Module 4 is to discuss how proposed restoration approaches and techniques would address key threats to sea turtles in the northern Gulf of Mexico (GOM). Restoration for all life stages of sea turtles will be focused in the geographic areas with the greatest potential to benefit sea turtle species and life stages injured during the *Deepwater Horizon* (DWH) oil spill, which could include work inside and outside the GOM[1] where a link to injury is established, as described in Module 1 of the Sea Turtle Strategic Framework. The Trustee Implementation Groups (TIGs), working within the scope of the NRDA regulations under OPA,[2] can use this information to provide context for their consideration and selection of select specific projects and to help coordinate restoration planning efforts throughout the northern GOM. Where applicable, restoration would be coordinated with existing entities charged with conserving and recovering sea turtles, such as Endangered Species Act (ESA) recovery teams and the appropriate National Oceanic and Atmospheric Administration (NOAA) or U.S. Fish and Wildlife Service (USFWS) offices. Additionally, the Trustees envision working closely across Restoration Types, when beneficial, to identify opportunities to leverage sea turtle restoration needs with those of other resources (e.g., birds, marine mammals).

Module 4 may be updated based on additional knowledge obtained by DWH NRDA Trustee efforts, the broader science and conservation management community, or changes to relevant species recovery or management plans prepared under other statutes.

1.1 How to Use this Document

For the purposes of considering potential restoration activities to benefit northern GOM sea turtles, we arranged this document by the restoration approaches outlined in the PDARP/PEIS (DWH NRDA Trustees, 2016) and presented in Module 1. Section 2 describes the restoration approaches and provides more detail on the restoration techniques, building on those from the PDARP/PEIS, including relative priority according to federal recovery plans (where applicable), project sequencing, potential geographic scope, and example project concepts. Additionally, it is critical for each restoration project to include carefully chosen project-specific monitoring metrics. We have provided examples of potential project-level monitoring metrics under each technique, but a more general discussion on the selection and integration of appropriate metrics into projects

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1. Sea turtles are highly migratory species (HMS) and are known to move in and out of the GOM during various life stages. In Module 1, the Trustees state that we may use funds allocated to the restoration areas for restoration outside of the GOM as ecologically appropriate, and these funds may be used for resource- level planning, prioritization, implementation, and monitoring for resource recovery, among others.
2. For additional information, see Section 5.4 in the Final Programmatic Damage Assessment and Restoration Plan (PDARP) and Final Programmatic Environmental Impact Statement (PEIS).

is included in Section 3. Section 3 also provides information on resource-level monitoring and adaptive management that will inform restoration planning, implementation, and evaluation.

As a reference, when available, the federal recovery plan priority has been included for each potential restoration technique based on the review of all existing species-specific recovery plans.[3] This exercise relied primarily on the most recent recovery plans – loggerheads (NMFS and USFWS, 2008) and Kemp's ridleys (NMFS et al., 2011) – for which comprehensive threats assessments were performed. Threats to sea turtles generally affect multiple species, so the recovery plan priority presented in this document reflects the highest priority indicated for any species. Section 3 provides information for resource-level monitoring that will inform restoration planning, implementation, and evaluation.

This document is not intended to exhaustively present all possible restoration techniques and project concepts, nor to prescriptively describe the complete restoration plan for sea turtles across all TIGs. This document should provide relevant 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 or to state-specific project portals, as available.

A loggerhead sea turtle escapes from a trawl equipped with a turtle excluder device (TED) during TED testing.
TEDs are used to reduce bycatch of sea turtles in trawl nets.
Source: NOAA-NMFS, Southeast Fisheries Science Center.

2. Restoration Activities for Sea Turtles

Sea turtle restoration approaches aim to address known threats to sea turtles and to emphasize activities that are consistent with management priorities described in species' recovery plans (e.g., NMFS and USFWS, 2008; NMFS et al., 2011). Sea turtles face a variety of threats across different life stages and habitats. They spend the vast majority of their lives at sea where they are exposed to anthropogenic activities that threaten their survival. The most significant anthropogenic threat to sea turtle populations in the marine environment is bycatch in fishing gear – principally trawls, pelagic and bottom longlines, gillnets, and hook-and-line gear (NMFS and USFWS, 2008; NMFS et al., 2011). While on land, sea turtles face threats from coastal development which can alter or

3. Federal recovery plans for sea turtles are developed jointly by NOAA National Marine Fisheries Service (NMFS) and USFWS in accordance with the jurisdictional memorandum of understanding (MOU) between the agencies. Descriptions of recovery plans are presented in Module 3 of the Sea Turtle Restoration Strategic Framework.

destroy sea turtle nesting habitat, deter or disrupt nesting, and reduce embryo and hatchling survival.

To most effectively address the nature and extent of injuries to sea turtles, the Trustees plan to implement a portfolio of multiple approaches that address these threats in the geographic areas with the greatest potential to benefit to populations that were injured by the DWH spill. Restoration will be implemented in all five Gulf states, nearshore and offshore waters within the GOM, and could also occur in areas outside the GOM. The restoration portfolio for sea turtles will also include robust monitoring and scientific support for adaptive management of restoration planning and implementation. The portfolio of restoration approaches is consistent with the goals and approaches described in the PDARP (DWH NRDA Trustees, 2016) and summarized in Module 1 of the Sea Turtle Strategic Framework.

Furthermore, restoration activities developed under the approaches and techniques described below should be coordinated with similar restoration activities targeting other GOM resources to ensure efficiency and maximize benefits. For example, Trustees will coordinate bycatch reduction activities focused on fishing gear that have known interactions with more than one resource, such as shrimp trawls, gillnets for sea turtles and marine mammals or pelagic longlines for sea turtles and seabirds. Other examples where cross-resource coordination would be needed include beach restoration projects that could improve habitat for nesting sea turtles, nesting or wintering shorebirds, and beach mice.

2.1 At-a-Glance: Restoration Approaches and Benefits to Sea Turtles

There are seven restoration approaches for sea turtles in the PDARP/PEIS:

- Reduce sea turtle bycatch in commercial fisheries through identification (ID) and implementation of conservation measures
- Reduce sea turtle bycatch in commercial fisheries through enhanced training and outreach to the fishing communities
- Enhance sea turtle hatchling productivity, and restore and conserve nesting beach habitat
- Reduce sea turtle bycatch in recreational fisheries through development and implementation of conservation measures
- Reduce sea turtle bycatch in commercial fisheries through enhanced state enforcement efforts to improve compliance with existing sea turtle conservation requirements
- Increase sea turtle survival through enhanced mortality investigation, and early detection of and response to anthropogenic threats and emergency events
- Reduce injury and mortality of sea turtles from vessel strikes.

Table 1 summarizes the sea turtle species and life stages that would most likely benefit from these restoration approaches. Some project concepts identified within an approach may benefit species and life stages not explicitly highlighted below, but these details would be described when specific projects are developed.

Table 1. Sea turtle species and life stages most likely to benefit from a given restoration approach

Approach	Kemp's ridleys	Loggerheads	Greens	Hawksbills	Leatherbacks
Reduce bycatch in commercial fisheries through conservation measures	Adults, juveniles	Adults, juveniles	Juveniles		Adults, juveniles
Reduce bycatch through enhanced training and outreach	Adults, juveniles	Adults, juveniles			Adults, juveniles
Enhance hatchling productivity, and restore and conserve nesting beach habitat	Adults, eggs, hatchlings	Adults, eggs, hatchlings	Adults, eggs, hatchlings	Adults, eggs, hatchlings	
Reduce bycatch in recreational fisheries through development and conservation measures	Adults, juveniles	Adults, juveniles	Juveniles	Juveniles	
Reduce bycatch in commercial fisheries through enhanced state enforcement efforts	Adults, juveniles	Adults, juveniles	Juveniles		Adults, juveniles
Increase sea turtle survival through enhanced mortality investigation and detection, and response to threats and events	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles
Reduce injury and mortality from vessel strikes	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles	Adults, juveniles

For each restoration technique, we present considerations when conducting restoration planning. Table 2 presents the generalized format for how each technique is presented in Section 2.2 and includes definitions for the considerations provided.

Table 2. Template and definitions for the technique-specific tables.

Technique X: The name of the potential restoration technique within an approach	
Example project concepts	Considerations
• Technique description and example project concepts within a technique	Federal Recovery Plan priority Priority rating for the technique is based on the review of all existing species-specific recovery plans. Threats to sea turtles generally affect multiple species, so the recovery plan priority presented in this document reflects the highest priority indicated for any species.
	Potential geographic scope Description of where a project may be implemented geographically. This may be noted as a specific state's coastal waters or terrestrial environment, or Gulf-wide may be used if a project may be implemented in any/all Gulf states.
	Potential sequencing Time period for when a related project may be put forward in a draft restoration plan: Immediate: In the next 1–4 years Middle: Within 5–10 years Late: 11 years and beyond.

Technique X: The name of the potential restoration technique within an approach	
Example project concepts	Considerations
	Monitoring and adaptive management Desired outcome: Description of the anticipated outcome of a project within the technique Potential metrics: How the outcomes will be measured to show success.
	Current status: Description of existing funded projects or management actions related to a given technique that may affect the direction or sequencing of the technique. This will not be an exhaustive list.

2.2 Sea Turtle Restoration Approaches, Techniques, and Example Project Concepts

2.2.1 Approach 1: Reduce Sea Turtle Bycatch in Commercial Fisheries through Identification and Implementation of Conservation Measures

This restoration approach focuses on reducing the bycatch and mortality of sea turtles in GOM commercial fisheries by identifying, developing, and implementing sea turtle bycatch reduction measures. This approach could identify measures such as gear modifications (e.g., hook size and type), changes in fishing practices (e.g., reduced soak times), and/or temporal and spatial fishery management to reduce sea turtle bycatch in GOM commercial fisheries.

- Technique 1: Evaluate, develop, and implement conservation measures in commercial bottom longline fisheries
- Technique 2: Evaluate, develop, and implement conservation measures in commercial pelagic longline fisheries
- Technique 3: Evaluate, develop, and implement conservation measures in gillnet fisheries
- Technique 4: Evaluate, develop, and implement conservation measures in trawl (shrimp and non-shrimp) fisheries
- Technique 5: Evaluate, develop, and implement conservation measures in pot and trap fisheries
- Technique 6: Expand existing or develop new observer programs and enhance analytical capacity within the program
- Technique 7: Evaluate and implement options for vessel monitoring systems (VMS) and electronic monitoring

Technique 1: Evaluate, develop, and implement conservation measures in commercial bottom longline fisheries	
Example project concepts	Considerations
• Initial work to summarize and evaluate existing information from biological opinions, observer information, regulations, etc., concerning turtle bycatch and potential bycatch reduction approaches for development and implementation. • Based on initial data evaluation, develop, test as necessary, and implement bycatch reduction measures in commercial bottom	Federal Recovery Plan priority High
	Potential geographic scope Gulf-wide
	Potential sequencing Immediate (initial analyses, some project development)/Middle (further project development)
	Monitoring and adaptive management

longline fisheries. Potential bycatch reduction measures may include changes in fishing gear (e.g., size/type hook), fishing practices (e.g., soak times), and/or fishing areas.	Desired outcome: Reduction of sea turtle bycatch Potential metrics: Compliance rates with new conservation measures, changes in bycatch levels
	Current status: There is NOAA observer coverage of the fishery

Technique 2: Evaluate, develop, and implement conservation measures in commercial pelagic longline fisheries	
Example project concepts	**Considerations**
• Initial work to summarize and evaluate existing information from biological opinions, observer information, regulations, etc., concerning turtle bycatch and potential bycatch reduction approaches. • Based on initial data evaluation, develop, test as necessary, and implement bycatch reduction measures and management measures in commercial pelagic longline fisheries. Potential bycatch reduction measures may include changes in fishing gear (e.g., size/type hook), fishing practices (e.g., soak times), and/or fishing areas.	Federal Recovery Plan priority High
	Potential geographic scope GOM and Atlantic waters [within and outside the U.S. Exclusive Economic Zone (EEZ)]
	Potential sequencing Immediate (initial analyses, some project development)/Middle (further project development)
	Monitoring and adaptive management Desired outcome: Reduction of sea turtle bycatch Potential metrics: Compliance rates with new conservation measures, changes in bycatch levels
	Current status: There is a Phase IV Pelagic Longline Early Restoration project focused on bluefin tuna, and there are existing regulations of this fishery to reduce sea turtle bycatch and existing NOAA observer coverage

Technique 3: Evaluate, develop, and implement conservation measures in gillnet fisheries	
Example project concepts	**Considerations**
• Initial work to summarize and evaluate existing information from biological opinions, observer information, regulations, etc., concerning turtle bycatch and potential bycatch reduction approaches. • Based on initial data evaluation, develop and test bycatch reduction measures. Potential bycatch reduction measures may include changes in fishing gear (e.g., lighted nets, mesh size), fishing practices (e.g., soak times), and/or fishing areas.	**Federal Recovery Plan priority** High **Potential geographic scope** Gulf-wide coastal waters with gillnet fishing effort **Potential sequencing** Immediate (initial analyses, some project development)/Middle (further project development) **Monitoring and adaptive management** Desired outcome: Reduction of sea turtle bycatch Potential metrics: Compliance rates with new conservation measures, changes in bycatch levels **Current status:** Existing data needs further evaluation to inform restoration

Technique 4: Evaluate, develop, and implement conservation measures in trawl (shrimp and non-shrimp) fisheries	
Example project concepts	**Considerations**
• Initial work to summarize and evaluate existing information from biological opinions, observer information, regulations, etc., concerning turtle bycatch and potential bycatch reduction approaches. • Based on initial data evaluation, develop and test bycatch reduction measures. Potential measures might include improved TED design or other gear modifications.	**Federal Recovery Plan priority** High **Potential geographic scope** Gulf-wide coastal and offshore waters with trawl fishing effort **Potential sequencing** Immediate (initial analyses, some project development)/Middle (further project development) **Monitoring and adaptive management** Desired outcome: Reduction of sea turtle bycatch Potential metrics: Compliance rates with new conservation measures, changes in bycatch levels **Current status:** There are existing TED regulations for otter trawl shrimp fishery, and proposed TED regulations for the skimmer trawl shrimp fishery

NOAA gear specialists demonstrate TED requirements and inspection procedures. Source: NOAA.

Technique 5: Evaluate, develop, and implement conservation measures in pot and trap fisheries	
Example project concepts	**Considerations**
• Initial work to summarize and evaluate existing information from biological opinions, observer information, regulations, etc., concerning turtle bycatch and potential bycatch reduction approaches; then develop and implement projects. • Based on initial evaluation of existing data, develop and test bycatch reduction measures and monitoring, including observer coverage (Technique 3).	**Federal Recovery Plan priority** Medium **Potential geographic scope** Gulf-wide coastal waters with pot/trap fishing effort **Potential sequencing** Immediate (initial analyses, some project development)/Middle (further project development) **Monitoring and adaptive management** Desired outcome: Reduction of sea turtle bycatch Potential metrics: Compliance rates with new conservation measures, changes in bycatch levels **Current status:** Existing data needs further evaluation to inform restoration

Technique 6: Expand existing or develop new observer programs and enhance analytical capacity within the program	
Example project concepts	**Considerations**
• Enhance federal observer coverage in fisheries that currently have insufficient levels of coverage (e.g., shrimp trawl fishery), and develop new observer programs in fisheries that are not currently observed (e.g., menhaden purse seine, fish trawl, bait shrimp, wing nets and butterfly nets for shrimp). – The expansion of coverage could include additional observers and improving the analytical capacity within the program for the estimation of sea turtle bycatch. • Build state observer program capacity to deploy additional observers and collect data necessary to inform management of interactions between protected species and fisheries.	**Federal Recovery Plan priority** High **Potential geographic scope** Gulf-wide coastal and offshore waters **Potential sequencing** Immediate (initial analyses, some project development)/Middle (further project development) **Monitoring and adaptive management** Desired outcome: Improved observer coverage Potential metrics: Reduced uncertainty associated with bycatch estimates, increased percentage of observer coverage by fishery and number of new observer programs piloted **Current status:** NOAA's Phase IV Early Restoration sea turtle project currently includes the addition of 300 observer days annually in the shrimp trawl fishery Mississippi will implement a new observer program on otter trawls in state waters through a Gulf Environmental Benefit Fund (GEBF) grant

Technique 7: Evaluate and implement options for VMS and electronic monitoring	
Example project concepts	**Considerations**
• Evaluate the use and feasibility of VMS and other forms of electronic monitoring (e.g., e-logbooks, video) in the federally managed shrimp fishery, and other fisheries as appropriate, to provide accurate, near real-time, spatial and temporal fishing effort and bycatch information to understand distribution of fishing effort relative to sea turtle bycatch. Implementation may require increased capacity for data analysis.	**Federal Recovery Plan priority** High **Potential geographic scope** Gulf-wide coastal and offshore waters **Potential sequencing** Immediate (initial analyses, some project development)/Middle (further project development) **Monitoring and adaptive management** Desired outcome: Improved characterization of fishing effort relative to bycatch Potential metrics: % of vessels using VMS or electronic monitoring **Current status:** In the Southeast United States, electronic logbooks are required on selected shrimp trawl vessels and VMS are required on Gulf reef fish vessels, South Atlantic rock shrimp vessels, and various HMS vessels

2.2.2 Approach 2: Reduce Sea Turtle Bycatch in Commercial Fisheries through Enhanced Training and Outreach to the Fishing Communities

This approach could expand the successful NOAA Gear Monitoring Team (GMT) program, which operates in the Gulf States out of the NMFS Southeast Fisheries Science Center's Pascagoula Lab. This expansion could allow similar programs to be implemented at the state level.

- Technique 1: Expansion of NOAA GMT
- Technique 2: Development of state-level programs similar to the NOAA GMT

Technique 1: Expansion of NOAA GMT	
Example project concepts	**Considerations**
• Enhance the capacity of the NOAA GMT, which provides education and outreach to the shrimp trawl fishing community through workshops, and courtesy at-sea and dockside boardings to check compliance with existing TED regulations. Project concepts may include the continuation of NOAA's Phase IV Sea Turtle Early Restoration GMT component beyond the current 10-year project, or further expansion of the GMT beyond the capacity of the project to focus on additional fisheries or geographic areas.	**Federal Recovery Plan priority** No recovery action directly applies **Potential geographic scope** Gulf-wide, Atlantic **Potential sequencing** Middle to Late (after completion of NOAA's Phase IV Early Restoration project) **Monitoring and adaptive management** Desired outcome: Increased compliance with existing bycatch regulations Potential metrics: Number of trainees; degree of compliance (baseline vs post-implementation) **Current status:** NOAA's Phase IV Early Restoration Project includes the expansion of the NOAA GMT, through the addition of two teams (two people each) to focus on TED education, outreach, and compliance in the GOM

Technique 2: Development of state-level programs similar to the NOAA GMT	
Example project concepts	**Considerations**
• Establish state programs similar to the NOAA GMT to ensure compliance with existing regulations. The state GMT would work with the NOAA GMT to target underrepresented areas within their state to provide education and outreach to improve compliance with existing federal and state sea turtle bycatch reduction regulations.	**Federal Recovery Plan priority** No recovery action directly applies **Potential geographic scope** Gulf-wide, within each state program **Potential sequencing** Immediate (at state level) to Middle/Late (after completion of the Phase IV Early Restoration project) **Monitoring and adaptive management** Desired outcome: Increased compliance with existing bycatch regulations Potential metrics: Number of trainees; degree of compliance (baseline vs post-implementation) **Current status:** NOAA's Phase IV Early Restoration project provided funding for collaboration on TED outreach within Louisiana through the funding of a Louisiana Department of Wildlife and Fisheries TED outreach coordinator

2.2.3 Approach 3: Enhance Sea Turtle Hatchling Productivity, and Restore and Conserve Nesting Beach Habitat

This approach will focus on reducing natural and anthropogenic threats on the nesting beach, such as artificial lighting, removable beach equipment, and permanent barriers or changes to the coastline that prevent access by nesting sea turtles. The approach may also include the acquisition of lands and beach user education and outreach to help protect and conserve sea turtle nesting beach habitat.

- Technique 1: Land acquisition/conservation easements with binding conservation agreements that protect sea turtle nesting habitat
- Technique 2: Reduce beachfront lighting by implementing programs and coordinating with local municipalities to minimize artificial lighting visible from the nesting beach
- Technique 3: Beach user education and outreach to increase awareness about sea turtles and threats to their survival
- Technique 4: Nest and nesting beach protection
- Technique 5: Enhance nesting beach restoration and resiliency
- Technique 6: Shoreline barrier reduction including programs to reduce permanent barriers

Kemp's ridley sea turtle nesting at Padre Island National Seashore. Source: National Park Service.

Technique 1: Land acquisition/conservation easements with binding conservation agreements that protect sea turtle nesting habitat

Example project concepts	Considerations
• Identify and purchase areas of high conservation value for nesting beach preservation (e.g., to address coastal armoring and shoreline fortification). • Enter into conservation easement agreements to preserve nesting beaches in the long-term. • Coordinate with other resource types to acquire land that will benefit both sea turtles and other species (e.g., beach mouse, birds) such that efforts benefiting from coastal land acquisition/habitat protection will be leveraged.	Federal Recovery Plan priority High Potential geographic scope Predominately Florida, Alabama, and Texas, Potential sequencing Immediate Monitoring and adaptive management Desired outcome: Increased nesting beach protection and hatchling production Potential metrics: Length of beach in public ownership or in conservation easement, number of nests protected, number of hatchlings emerged from nests Current status: Some available beaches already identified and some projects associated with this restoration approach could begin immediately

Technique 2: Reduce beachfront lighting by implementing programs and coordinating with local municipalities to minimize artificial lighting visible from the nesting beach

Example project concepts	Considerations
• Identify and prioritize areas that would benefit from lighting reduction projects. Lighting assessments of shoreline areas may be needed as a first step to address the threat over the long-term. Potential to follow-up on the Phase II Early Restoration efforts in Florida and Alabama. Expand the current standard certified lighting program Gulf-wide with a web interface. • Collaborate with local governments in Florida and Alabama on lighting ordinances in various stages of development and implementation. – Establish expertise to review lighting plans and conduct lighting workshops. – Develop and conduct lighting ordinance enforcement training, including outreach materials to municipalities and partners in Florida and Alabama.	Federal Recovery Plan priority Medium Potential geographic scope Predominately Florida, Alabama, and Texas, where appropriate Potential sequencing Immediate Monitoring and adaptive management Desired outcome: Reduce sea turtle disorientation due to artificial lighting Potential metrics: Length of beach with suitable light levels, degree of compliance with existing lighting ordinances, disorientation rates (baseline vs post-implementation Current status: Potential to build on the Phase II Early Restoration project (Restoring the Night Sky) and Florida's GEBF projects to reduce light pollution in the Florida Panhandle

Technique 3: Beach user education and outreach to increase awareness about sea turtles and threats to their survival

Example project concepts	Considerations
• Identify and prioritize areas that could benefit from beach user education and outreach to increase awareness about sea turtles and threats to their survival. Identify existing education projects and outreach programs, then implement or enhance as warranted. Consider emerging technologies as well as traditional outreach techniques. • Work with municipalities to implement best management practices for beach maintenance and beach use, in areas where sea turtle nesting occurs, including infrequent nesting (e.g., in Mississippi). Project could include developing and conducting workshops for municipalities, police departments, natural resource agencies and nonprofits, to educate them on sea turtles, how to reduce threats, and best practices. Could be done in conjunction with Nesting Beach Protection (Technique 4). – Create beach signage and/or pamphlets to distribute at tourist spots/hotels to educate visitors about sea turtle life history, ecological importance, threats, and how to help.	Federal Recovery Plan priority Medium Potential geographic scope Predominately Florida, Alabama, and Texas, where appropriate Potential sequencing Immediate/Middle Monitoring and adaptive management Desired outcome: Increase turtle-friendly practices by beachgoers Potential metrics: Number of trainings and outreach materials distributed Current status: Existing resources available for beach user outreach

Technique 4: Nest and nesting beach protection

Example project concepts	Considerations
• Hire a GOM-wide data manager for nesting data, provide nesting beach training with possible additional focuses on: addressing threats on the nesting beach in real time (e.g., lighting, nesting obstacles), evaluating techniques to protect nests, and supporting the enhancement and coordination of nesting beach surveys region-wide. • Add beaches to the index nesting beach program, if/where needed, to improve trend assessments for the northern GOM Recovery Unit. • Develop an Alabama-based position to enhance a robust nesting beach survey program through standardized data collection and analysis, training, and coordination. • Enhance the nesting beach survey program in Texas through training and coordination to ensure consistency in data collection. Assess anthropogenic threats (e.g., lighting, predation) to nesting beaches along the Texas coast. Reduce anthropogenic threats on stretches of beach where nests could remain protected in situ, reroute beach driving corridors, and reduce other anthropogenic threats. • Partner with the USFWS' International Sea Turtle Coordinator, who administers the Marine Turtle Conservation Act to identify focused projects outside the United States to protect essential nesting beaches used by turtles outside the GOM. • Enhance efforts in Tamaulipas, Mexico, to protect nesting Kemp's and their nests and phase into in situ protection, and improve collection of demographic information on nesting females. • Develop Florida-based positions to focus on statewide sea turtle hatchling production through the Fish and Wildlife Research Institute (FWRI) Nest Productivity Assessment (NPA) program and reducing predation on sea turtle eggs and hatchlings.	Federal Recovery Plan priority High Potential geographic scope Predominately Florida, Alabama, and Texas, where appropriate Potential sequencing Immediate/Middle Monitoring and adaptive management Desired outcome: Increased number of nests and increased number of hatchlings reaching water Potential metrics: Total number, frequency, and duration and distance of patrols; number of nests protected; number of nests in-situ; number of nests in corrals; number of hatchlings released to water; nesting success (number of successful nesting attempts by female turtles) Current status: The U.S. Department of the Interior (DOI) and the Texas Phase IV Early Restoration project is currently implemented to protect Kemp's ridley nests in Texas and Mexico Some existing resources are available for nest and nesting beach protection (e.g., Florida statewide Index Nesting Beach Survey program and predation control measures measured by the NPA Program in Florida)

Technique 5: Enhance nesting beach restoration and resiliency	
Example project concepts	**Considerations**
• Identify, prioritize, and implement measures to reduce impacts to sea turtles as a result of infrastructure projects adjacent to the nesting beach. In the face of potential effects of climate change (e.g., sea level rise, increased storm frequency), assess where coastal systems are altered anthropogenically and explore measures to restore natural coastal processes for the protection of sea turtle nesting beaches. • Support counties and municipalities in establishing an active Beach Management Program that addresses inlet management, and vulnerable property emergency response efforts with options to include appropriate sand placement, conservation easements, and other strategic planning techniques to address sea level rise.	Federal Recovery Plan priority Medium Potential geographic scope Predominately Florida, Alabama, and Texas, where appropriate Potential sequencing Immediate/Middle Monitoring and adaptive management Desired outcome: Increased suitable nesting beach habitat Potential metrics: Length of beach preserved, length of beach restored to suitable habitat Current status: Some studies have been conducted regarding effects of climate change on sea turtles; some coastal entities have coastal management plans but further analyses are needed

Technique 6: Shoreline barrier reduction, including programs to reduce permanent barriers	
Example project concepts	**Considerations**
• Develop and implement a certification program to reduce non-permanent shoreline barriers to nesting (e.g., cabanas, beach furniture, recreational equipment) at hotels and multi-unit dwellings on nesting beaches (e.g., replacing beach furniture with lightweight items that can be easily moved at night). • Identify permanent barriers (man-made or natural) along the nesting beach and target the removal of these barriers with nesting beach restoration alternatives such as dune repair with native planting, conservation easements, or land acquisition.	Federal Recovery Plan priority High Potential geographic scope Predominately Florida, Alabama, and Texas, where appropriate Potential sequencing Immediate Monitoring and adaptive management Desired outcome: Increased suitable nesting beach habitat Potential metrics: Number of barriers removed, length of beach preserved, length of beach restored to suitable habitat Current status: Some studies/surveys have been conducted on the effects of permanent and non-permanent shoreline barriers

2.2.4 Approach 4: Reduce Sea Turtle Bycatch in Recreational Fisheries through Development and Implementation of Conservation Measures

This approach would first focus on improving the understanding of bycatch in recreational fisheries in the GOM (for example: characterization of sea turtle bycatch on hook-and-line gear). Once identified, potential bycatch reduction measures could be experimentally implemented to determine their effectiveness.

- Technique 1: Evaluate, develop, and implement conservation measures to reduce bycatch in pier- and shore-based recreational fisheries
- Technique 2: Evaluate, develop, and implement conservation measures to reduce bycatch in vessel-based recreational fisheries

Technique 1: Evaluate, develop, and implement conservation measures to reduce bycatch in pier- and shore-based recreational fisheries

Example project concepts	Considerations
• Identify, develop, and implement bycatch reduction measures on fishing piers and at other shore-based structures in the northern GOM with high incidences of sea turtle hook and line bycatch. This concept could be developed in three phases: (1) characterization of piers/structures coupled with angler surveys to evaluate factors that may contribute to shore-based bycatch, (2) development of bycatch reduction strategies/management options with pilot testing and education/outreach, and (3) implementation of bycatch reduction measures. • Enhance outreach, education, and coordination among state, federal, and nongovernmental organization (NGO) stakeholders on the bycatch of sea turtles at piers. This may include specific enhancements to the Sea Turtle Stranding and Salvage Network (STSSN) to allow for increased response efforts resulting from increased outreach and signage on piers.	**Federal Recovery Plan priority** High **Potential geographic scope** Gulf-wide piers and coastal waters **Potential sequencing** Immediate (initial analyses) to Middle/Late **Monitoring and adaptive management** Desired outcome: Reduce sea turtle bycatch Potential metrics: Number of sites assessed, fishermen surveyed, fishermen who receive outreach materials, reports of bycaught turtles **Current status:** NOAA is working on a standardized pier survey form that may be useful for this effort The National Fish and Wildlife Foundation (NFWF) is funding a pier survey effort in Mississippi that will provide valuable information

Technique 2: Evaluate, develop, and implement conservation measures to reduce bycatch in vessel-based recreational fisheries

Example project concepts	Considerations
• Identify, develop, and implement bycatch reduction measures for recreational vessel-based fishing (including charter boats and commercial headboats) in the GOM. This concept could be developed in three phases: (1) characterization of incidental captures of sea turtles by recreational fishing vessels and a characterization of common vessel-based fishing practices to evaluate factors that may contribute to bycatch rates, (2) development of bycatch reduction strategies/management options with pilot testing and education/outreach, and (3) implementation of bycatch reduction measures. • Enhance outreach, education, and coordination among state, federal, and NGO stakeholders on the bycatch of sea turtles at piers. This may include specific enhancements to the STSSN to accommodate increased response efforts resulting from increased outreach.	**Federal Recovery Plan priority** High **Potential geographic scope** Gulf-wide coastal waters **Potential sequencing** Immediate (initial analyses, some project development) to Middle (further project development) **Monitoring and adaptive management** Desired outcome: Reduce sea turtle bycatch Potential metrics: Number of sites assessed, fishermen surveyed, fishermen who receive outreach materials, reports of bycaught turtles **Current status:** NOAA has conducted a pilot survey to begin to capture data on sea turtle interactions with the charter boat and headboat recreational sectors

Measuring a loggerhead turtle captured at sea. Source: NOAA.

2.2.5 Approach 5: Reduce Sea Turtle Bycatch in Commercial Fisheries through Enhanced State Enforcement Efforts to Improve Compliance with Existing Sea Turtle Conservation Requirements

State enforcement efforts are important for reducing sea turtle bycatch. In order to enhance these efforts, training and increased resources (e.g., additional personnel, equipment and vessels) would be provided to state enforcement agencies to increase knowledge and capacity.

- Technique 1: Provide training for and outreach to state fishery enforcement personnel
- Technique 2: Increase state enforcement resources

Technique 1: Provide training for and outreach to state fishery enforcement personnel	
Example project concepts	**Considerations**
• Enhance frequency and quality of training opportunities to improve state enforcement capacity regarding existing bycatch reduction regulations. Develop and implement a training program for compliance, species ID, ESA status, and other relevant information. • Create species ID cards to carry aboard vessels for enforcement personnel. Information included can be species ID, ESA status, conservation concerns, contact info for STSSN, and other resources as identified.	**Federal Recovery Plan priority** High **Potential geographic scope** Gulf-wide, within state enforcement programs **Potential sequencing** Immediate **Monitoring and adaptive management** Desired outcome: Increased enforcement of fisheries regulations to reduce bycatch Potential metrics: Number of individuals trained per year, number of individuals receiving continuing enforcement education **Current status:** Mississippi to increase training of Marine Patrol personnel through GEBF grant

Technique 2: Increase state enforcement resources	
Example project concepts	**Considerations**
• Increase state enforcement efforts on water through increased officers, vessels, overtime opportunities, etc. This includes increasing the ability of state enforcement officers to assist with on-water rescues of sick or injured sea turtles and with reporting or recovery of dead sea turtles. • Potential continuation of the Texas Phase IV Sea Turtle Early Restoration TED enforcement project component beyond the current 10-year project, or extension of the current period of enhanced enforcement patrols that occurs from February through mid-May.	**Federal Recovery Plan priority** High **Potential geographic scope** Gulf-wide, within state enforcement programs **Potential sequencing** Immediate/Middle (Texas) **Monitoring and adaptive management** Desired outcome: Increased enforcement of fisheries regulations to reduce bycatch and to improve compliance with regulations Potential metrics: Number of patrols during peak fishing and stranding periods, number of overtime hours (baseline vs. post-implementation **Current status:** The Texas Phase IV Sea Turtle Early Restoration project includes enhanced capacity of Texas enforcement Mississippi to enhance the capacity of the marine patrol through a GEBF grant

2.2.6 Approach 6: Increase Sea Turtle Survival through Enhanced Mortality Investigation, and Early Detection of and Response to Anthropogenic Threats and Emergency Events

This approach will work to improve our understanding of sea turtle mortality and improve our ability to detect and respond to anthropogenic threats.

- Technique 1: Enhancement of STSSN for Response and Coordination
- Technique 2: Development of an emergency response network
- Technique 3: Enhanced investigation of mortality sources
- Technique 4: Enhanced rehabilitation capability
- Technique 5: Enhanced communication and coordination between rehabilitation facilities and USFWS/STSSN
- Technique 6: Reduce marine debris

Technique 1: Enhancement of STSSN for Response and Coordination

Example project concepts	Considerations
• Enhance the STSSN through continuation of the Phase IV Sea Turtle Early Restoration STSSN project component beyond the current 10-year project, and provide additional enhancements as needed (e.g., bolster state partnerships and stranding network responder capacity). • Develop and implement standardized STSSN surveys in areas that are remote and/or are not heavily populated (e.g., strandings unlikely to be observed and reported by the public).	Federal Recovery Plan priority High Potential geographic scope Gulf-wide Potential sequencing Immediate (development of sea turtle stranding and response network in Alabama) to Late (for continuing elements of Phase IV Sea Turtle Early Restoration project) Monitoring and adaptive management Desired outcome: Improve the STSSN response capacity Potential metrics: Number of standardized surveys per area Current status: NOAA's Phase IV Sea Turtle Early Restoration project includes Gulf-wide enhancements to the STSSN targeted at improving coordination, data access, and data availability The Texas Phase IV Sea Turtle Early Restoration project includes specific enhancements to the STSSN response organizations in Texas Mississippi is maintaining and enhancing STSSN capacity with its current GEBF grant

Technique 2: Development of an emergency response network

Example project concept	Considerations
• Provide additional enhancements to the Sea Turtle Emergency Response Network through improved equipment needs, training opportunities for responders, protocol development, and increased coordination. This may include the development of resource-specific emergency response and Hazardous Waste Operations and Emergency Response (HAZWOPER) training for biologists and responders.	Federal Recovery Plan priority Medium Potential geographic scope Gulf-wide Potential sequencing Immediate Monitoring and adaptive management Desired outcome: Improve readiness to respond to emergency events in the GOM Potential metrics: Number of individuals trained and available to respond Current status: NOAA's Phase IV Early Restoration project includes the formalization of an Emergency Response Network

Technique 3: Enhanced investigation of mortality sources	
Example project concept	**Considerations**
• Develop state-based sea turtle (or protected species) programs focused on bycatch reduction and mortality investigation to link between marine-based activities in state waters and sea turtle presence data, stranding data, observer data, and/or other sources of information on mortality and nesting in relevant states.	Federal Recovery Plan priority Medium Potential geographic scope Gulf-wide Potential sequencing Immediate Monitoring and adaptive management Desired outcome: Enhanced communication, collaboration, and training across the sea turtle management and conservation landscape Potential metrics: Number of individuals trained and available to respond, increased capacity for necropsies and mortality investigations Current status: A Florida GEBF project will enhance the investigation of sea turtle mortality sources through an increased number of detailed necropsies during the next 10 years NOAA's Phase IV Early Restoration project includes enhanced mortality investigation throughout the GOM through the addition of a necropsy coordinator and enhanced investigation of mortality factors

Technique 4: Enhanced rehabilitation capability	
Example project concept	**Considerations**
• Evaluate the need for new facilities and/or the enhancement of existing facilities based on geographic gaps and needs within the current STSSN structure. This could be addressed in multiple separate projects (e.g., by state) or as one comprehensive project.	Federal Recovery Plan priority No direct recovery action applies Potential geographic scope Gulf-wide Potential sequencing Immediate (evaluate needs) to Middle (improving or increasing infrastructure) Monitoring and adaptive management Desired outcome: Better understanding of rehabilitation facility needs and capacity across the Gulf; provide enhancements as needed Potential metrics: Number of enhancements made, equipment purchased, and level of increased rehabilitation capacity Current status: Sea turtle rehabilitation facilities currently exist in Texas, Louisiana, Mississippi, and Florida The Texas Phase IV Sea Turtle Early Restoration project includes enhancements to rehabilitation efforts in Texas

Technique 5: Enhanced communication and coordination between rehabilitation facilities and USFWS/STSSN	
Example project concepts	**Considerations**
• Hire a national rehabilitation coordinator position (likely within USFWS) to oversee rehabilitation facilities in the GOM, maintain regular communication with the rehabilitation facilities on their needs, perform annual visits/inspections for sea turtle rehabilitation facilities, troubleshoot problems, facilitate placement of animals during unusual stranding events, develop training programs for meeting rehabilitation guidelines and protocols. • Develop and implement a rehabilitation database to track the intake and disposition of sea turtles that enter rehabilitation, which would be linked to the STSSN database.	Federal Recovery Plan priority No direct recovery action applies Potential geographic scope Gulf-wide Potential sequencing Immediate Monitoring and adaptive management Desired outcome: Improve communication and coordination with GOM rehabilitation facilities to ensure appropriate care for sea turtles Potential metrics: Evaluation of project milestones such as hiring, number of trainings provided, and availability and use of database Current status: Some rehabilitation and release data are captured in the STSSN database, but they are inconsistent and often incomplete

Technique 6: Reduce marine debris	
Example project concept	**Considerations**
• Develop or enhance marine debris programs, focused mainly on derelict fishing gear to prevent entanglement and/or entrapment of sea turtles in the abandoned gear. A project may focus on a specific area or environment (e.g., around a fishing pier) where sea turtles are known to become entangled in discarded gear.	Federal Recovery Plan priority No recovery action directly applies Potential geographic scope Gulf-wide Potential sequencing Middle Monitoring and adaptive management Desired outcome: Reduce the incidence of marine debris entanglements and/or entrapments Potential metrics: Number of removals or cleanups of identified derelict gear/debris Current status: Several Trustee agencies have existing marine debris removal programs that may be useful to project development

2.2.7 Approach 7: Reducing Injury and Mortality of Sea Turtles from Vessel Strikes

This approach will work to address mortality to sea turtle from vessel strikes in the nearshore and offshore waters.

This approach currently consists of two sequential techniques:

- Technique 1: Enhanced understanding of the temporal and spatial distribution of vessel strikes, and variables that may influence the frequency of vessel strikes
- Technique 2: Development of management strategies to reduce the frequency of vessel strikes.

Technique 1: Enhanced understanding of the temporal and spatial distribution of vessel strikes, and variables that may influence the frequency of vessel strikes

Example project concept	Considerations
• Initiate a basic characterization (by state and region) of vessel activity and conduct analyses of existing data to determine temporal and spatial distribution of vessel strikes and factors that may influence the frequency of vessel strikes. The purpose of this project concept would be to highlight geographic areas of particular concern.	Federal Recovery Plan priority High/Medium
	Potential geographic scope Gulf-wide coastal waters
	Potential sequencing Immediate: Outcomes of this technique will inform project development under Technique 2
	Monitoring and adaptive management Desired outcome: Characterization of areas of high vessel strike impacts to inform potential future management measures Potential metrics: Number and proportion of stranded sea turtles with vessel collision injuries
	Current status: Florida is currently evaluating vessel strike data collected from strandings within the state The analysis includes a determination of some of the general temporal and spatial distributions of vessel strikes, and assessment of additional factors that may influence the frequency of vessel strikes

Technique 2: Development of management strategies to reduce the frequency of vessel strikes

Example project concept	Considerations
• Based on the characterization (see Technique 1), identify management strategies to reduce the frequency of vessel strikes, test the effectiveness of potential measures (e.g., slow zones, no wake zones), and implement conservation measures in appropriate geographical locations.	Federal Recovery Plan priority High
	Potential geographic scope Based on outcome of characterization in Technique 1
	Potential sequencing Medium-term: Projects will be developed based on the results of state and regional analyses
	Monitoring and adaptive management Desired outcome: Reduce vessel strike injuries of sea turtles, reduce mortalities caused by vessel strikes Potential metrics: Number and proportion of stranded sea turtles with vessel collision injuries
	Current status: See above for Florida's current efforts

3. Monitoring and Adaptive Management Considerations

3.1 Project-Level Monitoring and Adaptive Management Considerations

When developing restoration projects for sea turtles, it is critical for each restoration project to include carefully chosen project-specific monitoring metrics. Project-level monitoring will be used to evaluate restoration success and to ensure that each project is meeting its restoration goals and objectives, so that it can successfully contribute to the full scope of restoration for sea turtles. Although project-level objectives will vary, common metrics will be used, where possible, to evaluate and compare the performance success of sea turtle restoration projects. Performance monitoring for specific projects may rely on existing and/or enhancement of existing programs like fishery observer programs, and use of electronic monitoring and surveys and data collection during project implementation. Examples of possible project-level outcomes and metrics are presented in Section 2 for all restoration approaches and potential techniques. 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 sea turtle 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.

3.2 Resource-Level Monitoring and Adaptive Management Considerations

The resource-level monitoring concepts presented here are intended to provide information that will inform restoration planning, implementation, and evaluation, by gathering monitoring data across the resource. These concepts may include establishing baseline numbers, where missing, from which to measure resource-level restoration, and may evolve over time as the Trustees gain insight from the restoration activities.

A loggerhead turtle is returned to the sea following capture and attachment of a satellite tag. Source: NOAA.

Monitoring and scientific support are necessary to address key information needs and data gaps, and to help inform the temporal and spatial implementation of future restoration projects. Because sea turtles are broadly distributed within and outside of the northern GOM, coordinated monitoring of restoration activities across sites, states, and potentially beyond the GOM will be necessary to enable the detection of effects of successful restoration. In particular, Gulf-wide monitoring of sea turtle populations and the implementation of standardized monitoring protocols for specific activities and life stages (e.g., nest productivity, nest abundance, in-water abundance) would provide important context for project-level monitoring at individual sites where restoration is implemented and would allow comparisons across multiple projects.

Below are examples of the types of projects that have been considered so far:

- Population surveys and/or research directed at sea turtles at sea during their oceanic and neritic life stages to address temporal and spatial gaps in our understanding of sea turtle population trends, population structure, spatiotemporal distribution, life history parameters (e.g., survival rates, sex ratios, growth rates), migration patterns, and habitat use. This type of information will help inform future restoration actions as well as help evaluate the effects of the portfolio of sea turtle restoration projects.
- Characterization of the spatiotemporal overlap between the distribution of sea turtles and the recreational and commercial fishing effort to identify areas and fisheries of greatest bycatch concern.
- Development of a near-real time "sea turtle GOM atlas" tool integrating primary datasets on sea turtle presence and habitat use, including nesting data, aerial survey and in-water capture data, telemetry, and stranding data. The atlas could provide a means to integrate sea turtle data with oceanographic information, including real-time or near-real time remotely sensed data, as well as ways to integrate threat data, including fishing effort. It could also include the development of a user-friendly interface for ease of use. The development of the atlas would include the evaluation of existing tools and the development of a coordinated plan for integration/expansion [e.g., the Florida Online Sea Turtle Information System (OSIS) and the Florida Fish and Wildlife Conservation Commission (FFWCC) nesting atlas, the NOAA/Bureau of Ocean Energy Management (BOEM) Marine Cadastre, the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP)] and dissemination/widespread use of these data to inform restoration planning, conservation management, and emergency response.
- Standardized measurements of nest productivity, nest depredation, and hatchling orientation needed to objectively prioritize restoration needs and urgency.

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.

NMFS and USFWS. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtles (*Caretta caretta*), 2nd revision. National Marine Fisheries Service, Silver Spring, MD, and U.S. Fish and Wildlife Service, Atlanta, GA.

NMFS, USFWS, and SEMARNAT. 2011. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. National Marine Fisheries Service, Silver Spring, MD.

Acknowledgements

A team of Trustee scientists and resource experts developed the material in this strategic framework. Cooperating agencies included:

Alabama Department of Conservation and Natural Resources

Florida Department of Environmental Protection

Florida Fish and Wildlife Conservation Commission

Louisiana Coastal Protection and Restoration Authority

Louisiana Department of Environmental Quality

Louisiana Department of Natural Resources

Louisiana Department of Wildlife and Fisheries

Louisiana Oil Spill Coordinator's Office

Mississippi Department of Environmental Quality

National Oceanic and Atmospheric Administration

Natural Resources Geological Survey of Alabama

Texas Commission on Environmental Quality

Texas General Land Office

Texas Parks and Wildlife Department

U.S. Department of Agriculture

U.S. Department of the Interior

U.S. Environmental Protection Agency.

The Regionwide TIG reviewed this document and provided critical feedback. Scientists and editors from Abt Associates assisted with the development and preparation of the document.

Cover photograph: National Park Service.