Biological Opinion

Deepwater Horizon Spill Response

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Date

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CONSULTATION HISTORY

This section lists only key events and correspondence during the course of this emergency consultation between the U.S. Coast Guard (USCG) and the U.S. Fish and Wildlife Service (USFWS). The USCG also consulted with the National Marine Fisheries Service (NMFS) regarding marine resources protected under the Endangered Species Act. Appendix C of the USCG's Post-Response Biological Assessment (BA) documents the consultation history with both Services, which we incorporate by reference herein. This history is unusually lengthy, due to the extended duration and massive scale of the emergency response action. The events and correspondence listed below, selected from the more exhaustive USCG appendix, are the most relevant to the formulation of this Biological Opinion. A complete administrative record of the consultation between the USCG and the USFWS is on file in the USFWS Southeast Regional Office.

2010/4/20 Transocean's mobile offshore drilling unit, the Deepwater Horizon (DWH), situated above the Macondo well in the Northern Gulf of Mexico, exploded and sank. This event caused the Macondo well to flow uninterrupted for 87 days.

2010/5/12 USFWS offered Section 7 compliance assistance to federal agencies responding to the DWH spill. Attached to the letter was a generic list of recommended measures to avoid and minimize impacts to listed species, designated critical habitat, and candidate species.

2010, Late May to Late July USFWS and NMFS employees deployed to assist with response activities observed that the initial conservation recommendations for listed species were not being implemented. The recommendations lacked necessary specificity and a mechanism to insure their incorporation in applicable operations. In coordination with the USCG and other agencies, the Services developed a library of Best Management Practices (BMPs) for specific operations categories (air operations, on-water, on-shore, night operations, etc.). BMP checklists were developed for use with the Shoreline Treatment Recommendations and Daily Incident Action Plans. The Unified Area Command adopted one checklist of ESA-resources BMPs for the eastern States and one checklist for Louisiana.

2010/9/23 Letter from NMFS and USFWS to Rear Admiral Paul Zukunft, USCG, Unified Area Command. Following the closure of the Macondo well, the Services recommended continuing active emergency consultation as longer-term assessments and clean-up plans are prepared. Response activities may result in impacts to ESA listed species and designated critical habitats that were not previously identified; therefore, continuing emergency consultation is necessary to facilitate the development of appropriate conservation measures.

2010/10/10 The Federal On-Scene Coordinator (FOSC) issued the "Mississippi Canyon 252 Stage III SCAT Shoreline Implementation Framework; Mobile Sector." This document specifies treatment options for oiled conditions found on different shoreline types, and a consultation process with the Services for ensuring that appropriate BMPs are implemented.

2010/12/20 The FOSC issued the "Mississippi Canyon 252 Stage III SCAT Shoreline Implementation Framework; Louisiana Division." This document specifies treatment options for oiled conditions found on different shoreline types, and a consultation process with the Services for ensuring that appropriate BMPs are implemented.

2010, December The USFWS issued the "Deepwater Horizon Blue Book Guidance" to provide instructions for the BMP checklists. The Guidance clarifies the rationale for individual BMPs for all States, and includes references to additional BMP documentation and response plans.

2011/4/6 The USFWS and USCG met to begin planning for the post-response Biological Assessment.

2011/11/2 The Unified Command issued the "MC 252 Shoreline Cleanup Completion Plan." This document specifies processes for ceasing clean-up and patrol operations in segments that did not receive oil, where end points are already met, and where the FOSC finds that current conditions are no longer a threat, or where continued removal would do more harm than good.

2013/2/12 The USFWS reviewed the ongoing emergency consultation and determined it was procedurally appropriate to continue emergency consultation until the FOSC determined the emergency response was concluded.

2013/5/1 Emergency response actions were concluded in Mississippi and on Department of Interior lands in Florida and Mississippi.

2013/6/10 Emergency response actions were concluded in Florida and Alabama.

2014/3/27 Emergency response actions were concluded in Louisiana.

2016/4/15 The USCG provided "Deepwater Horizon Post-Response Biological Assessment; Protected Species and Critical Habitats" to NMFS and USFWS, and requested ESA Section 7 consultation.

2016/5/18 USFWS acknowledged receipt of the USCG BA, provided concurrence with not-likely-to-adversely-affect determinations, and accepted the request to initiate formal consultation for likely-to-adversely-affect determinations.

BIOLOGICAL OPINION

A biological opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) (collectively, the "Services") under section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA), as to whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

This BO addresses actions that the U.S. Coast Guard (USCG) authorized between April 20, 2010, and May 5, 2015, in response to the Deepwater Horizon (DWH) oil spill. It also addresses actions taken during this period without initial USCG authorization by the National Guard and the States to lessen the impacts of the spill. Hereafter, we refer to these actions collectively as the "Action." This BO considers the effects of the Action on the following species:

- loggerhead sea turtle, Northwest Atlantic Distinct Population Segment (DPS);
- Kemp's ridley sea turtle;
- green sea turtle, North Atlantic DPS;
- leatherback sea turtle;
- Alabama beach mouse;
- Choctawhatchee beach mouse;
- Perdido Key beach mouse;
- St. Andrew beach mouse; and
- piping plover.

This BO also considers the effects of the Action on designated critical habitat for the following species:

- Alabama beach mouse;
- Choctawhatchee beach mouse;
- Perdido Key beach mouse;
- St. Andrew beach mouse; and
- piping plover (winter range critical habitat).

The USFWS shares ESA consultation responsibilities with the NMFS for the four species of sea turtles listed above. Federal agencies consult with the USFWS for actions that may affect sea turtles on land (nesting beaches), and with the NMFS for actions that may affect sea turtles in the sea. The Action involved spill response activities in both environments. This BO considers effects to sea turtles in the terrestrial context. Although the USCG requested formal consultation also for the hawksbill sea turtle, this species does not nest in the area of the spill response, and the USCG determined that the Action had no effect on the species in the terrestrial environment. Therefore, only the NMFS will respond to the consultation request for the hawksbill sea turtle.

By letter dated May 18, 2016, the USFWS previously concurred with USCG determinations that the Action did not adversely affect the Gulf sturgeon, Louisiana black bear, rufa red knot, and West Indian manatee, and did not adversely affect designated critical habitat for the Gulf sturgeon. Critical habitat for the loggerhead sea turtle (Northwest Atlantic) was designated in July of 2014, after which response activities within the designated units was concluded; therefore, consultation for effects to this resource is not required, and there is no value to conducting an after-the-fact conference for effects that may have occurred while the critical habitat was proposed for designation. These species and critical habitats are not further addressed in this BO.

A BO evaluates the effects of a Federal action along with those resulting from interrelated and interdependent actions, and from non-federal actions unrelated to the proposed Action (cumulative effects), relative to the status of listed species and the status of designated critical habitat. A BO that finds a proposed Federal action is *not* likely to jeopardize species and is *not* likely to destroy or adversely modify critical habitat concludes the action agency's responsibilities under §7(a)(2) of the ESA.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). "*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR §402.02).

An emergency response action that may affect listed species and designated critical habitat is the sole circumstance under which Federal agencies may initiate ESA consultation *after* implementing the action. During the DWH emergency response, the USCG coordinated with the Services to obtain recommendations for avoiding and minimizing adverse effects of response activities to listed species and critical habitats. The USCG Biological Assessment of the Action (BA), which accompanied its request to initiate consultation, describes how these recommendations were implemented, and assesses the effects of the Action after-the-fact. Therefore, rather than serving as the document that prospectively examines whether an action is likely to jeopardize species or destroy critical habitat, this BO examines how the Action changed the status of the listed species and critical habitats, and provides conservation recommendations to inform planning for responding to future oil spills.

The Action is concluded and all discretionary USCG involvement is terminated. In a BO for a *proposed* Federal action, the Services determine whether an action *is likely to* jeopardize the continued existence of listed species or destroy/adversely modify critical habitat. For this BO, we must instead determine whether the *completed* Action jeopardized species or destroyed/adversely modified critical habitat. The effects of future non-federal actions in the Action Area, i.e., cumulative effects, are not relevant to this after-the-fact determination. Our assessments of the environmental baseline for species and critical habitats in this BO describe the present status of species and critical habitats in the Action Area, considering the effects of past and ongoing human and natural factors, including the oil spill itself and non-federal actions. Therefore, this BO omits the separate section(s) covering cumulative effects that a standard BO includes.

This BO uses hierarchical numeric section headings. Primary (level-1) sections are labeled sequentially with a single digit (e.g., 1. PROPOSED ACTION). Secondary (level-2) sections within each primary section are labeled with two digits (e.g., 1.1. Action Area), and so on for level-3 sections. The basis of our opinion for each listed species and each designated critical habitat identified in the first paragraph of this introduction is wholly contained in a separate level-1 section that addresses its status, baseline, effects of the action, cumulative effects, and conclusion.

1. PROPOSED ACTION

The Action is comprised of all activities that the USCG authorized between April 20, 2010, and May 5, 2015, in response to the DWH oil spill. The overall objective of the Action was to protect human health, safety, and the environment, including listed species. Response activities focused on minimizing the amount of spilled oil, protecting sensitive habitats, and removing recoverable oil. The Action also includes actions taken during this period without initial USCG authorization by the National Guard and the States to mitigate the impacts of the spill. The spill itself and its effects on the environment are not part of the Action and are not evaluated in this BO. Hazing, capturing, and handling listed species and other species for their protection or rehabilitation were among the spill response activities. Such activities are forms of take under the ESA, which are prohibited without special exemption; however, authorization for these activities was secured during the response. The Services have no authority to exempt the taking of listed species from ESA prohibitions after-the-fact.

The DWH Trustees (2016) assessed the injury to natural resources caused by the spill, including listed species and their habitats. Their methods and findings are documented in a Final Programmatic Damage Assessment and Restoration Plan and a Final Programmatic Environmental Impact Statement. Please refer to these documents for further information about the effects of the DWH spill on natural resources.

The USCG described the Action in its Biological Assessment (BA) dated April 15, 2016, which accompanied its request for consultation. Except where otherwise cited, this BO relies on information provided in the BA. We summarize key points of the BA that are necessary to support the conclusions of this BO, but we do not otherwise repeat the analyses of the BA.

For clarity and brevity, our analysis of the Action in this BO is limited to those activities that may have adversely affected the listed species and critical habitats under USFWS jurisdiction, which occurred in onshore or nearshore environments. The BA assesses the effects of many deeper-water offshore activities, such as *in-situ* oil burning near the source of the spill. The USFWS has previously concurred (see Consultation History) with the USCG's determinations that listed species and critical habitats under USFWS jurisdiction which could have been exposed to Action-caused stressors in deeper water away from the shoreline (e.g., Gulf sturgeon, West Indian manatee) were likely not adversely affected by response activities. Therefore, we do not further address these components of the Action in this BO. Please refer to the BA for a more complete description of all spill response activities.

The USCG categorized response activities that occurred in terrestrial or near-shore environments as follows:

1) *oil collection* by various methods;
2) placing *barriers* to oil movement;

3) *flushing and washing* oiled surfaces;
4) *habitat modification* to impede oil movement or facilitate other response activities;
5) *hazing and other direct measures* (e.g., relocation) *to protect wildlife*;
6) *patrolling and monitoring* areas for oil and adverse effects; and
7) *support activities* (e.g., staging equipment).

We briefly describe these activities in section 1.2, and describe the spatial extent and duration of these activities in section 1.3.

During the DWH emergency response, the USCG consulted with the Services to obtain conservation recommendations for avoiding and minimizing the adverse effects of response activities to listed species, designated critical habitats, and other habitats upon which listed species rely in the Action Area. The Services developed a set of Best Management Practices (BMPs) applicable to particular response activities, listed species, and their habitats. Responders used a checklist of these BMPs to facilitate implementation of the appropriate conservation measures; however, the USCG authorized deviations from BMPs as necessary. Appendix E of the USCG BA contains the checklist of all 52 BMPs adopted for the DWH spill response.

Interagency teams surveyed shoreline segments and prepared Shoreline Treatment Recommendations (STRs) that consisted of combinations of the response activities listed above and the applicable BMPs. These STRs served as operational work permits for responders. The subsequent record of response activities for each of over 4,400 terrestrial shoreline segments of the Action Area informed the USCG estimation of Action-caused effects to listed species and designated critical habitats in the BA.

1.1. Action Area

For purposes of consultation under ESA §7, the action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). The "Action Area" for this consultation includes the air space, offshore, nearshore (lakes, bays, and sounds), and onshore areas affected by the Federal actions taken in response to the spill, as shown in Figure 1-1. These areas include the northern Gulf of Mexico and its adjoining shorelines in Texas, Louisiana, Mississippi, Alabama, and Florida, between Galveston County, Texas, and Apalachee Bay of the Florida Panhandle. The straight-line distance from Galveston to Apalachee Bay across the Gulf is about 700 miles, within which responders surveyed 4,386 miles of shoreline for evidence of oiling (Michel *et al.* 2013).

Figure 1-1. The extent of DWH oiling, shown above, is the Action Area for this consultation (taken from the USCG BA; source: National Oceanic and Atmospheric Administration, 2014, http://response.restoration.noaa.gov/erma/).

1.2. Description of Response Activities

Oil Collection. Responders collected oil from beaches, vegetated coastlines, and armored coastlines. Surface collection methods in these areas involved rakes, shovels, boats, and all-terrain-vehicles, and where practicable and available, mechanical raking, chain raking, and surface sifters (including walk-behind surface sifters). Sub-surface collection methods from some beaches and vegetated coastlines involved auguring and digging pits/trenches using various beach-cleaning machines, excavators, track hoes, and wheeled/tracked vehicles.

Barriers. Responders deployed barriers to oil movement along beaches and vegetated coastlines. Barrier types included Tiger booms, sorbent mats, and Hesco baskets. Associated equipment included various vehicles, pumps, and front-end loaders.

Flushing and Washing. Using boats, pumps, walk ways, and hoses, responders flushed oil from vegetated coastlines. Front-end loaders facilitated oil washing from beaches by surf action.

Habitat Modification. In some segments, responders modified habitat features to prevent or reduce the impacts of oiling. The following table lists for each type of habitat modification the associated equipment and its context (beaches [B], vegetated coastlines [V], armored coastline [A]).

Habitat Modification	Associated Equipment	Context
sand deposition (barrier island building)	barges, excavating equipment	B
staging area (conversion, installation, removal)	lights, generators, surface material, front-end loaders, trucks	B, A
causeway (construction, maintenance, removal)	lights, generators, surface material, front-end loaders, trucks	B
boardwalk (installation/removal)	surface material, lights, trucks	B, V
vegetation cutting		V
tidal stream diversion		B
sediment relocation		B

The “barrier island building” listed above occurred along Scofield Island, Pelican Island, Shell Island, and the Chandeleur Islands of Louisiana. In May 2011, Louisiana’s Office of Coastal Protection and Restoration applied for U.S. Army Corps of Engineers permits to construct sand berms to reduce the landward movement of oil from the DWH spill. The Corps approved a scaled-back version of the original request for six stretches of berm of about 38 miles in length. Of the six reaches authorized in the emergency permit, only four reaches of a total length of 16 miles were actually constructed. Hopper dredges were equipped with screening on all inflows and outflows, and with draghead deflectors, to minimize impacts to sea turtles. NMFS-approved turtle observers were present to detect and document any take resulting from the dredging operations.

Hazing and Other Direct Measures to Protect Wildlife. In some vegetated coastline segments, responders hazed birds from oiled areas using cannons. The most extensive wildlife-protection activity of the spill response focused on sea turtle nests. Early during the spill, the USFWS believed that most, if not all, of the 2010 sea turtle hatchlings entering the waters of the northern Gulf of Mexico would encounter oil and die. The USFWS, NMFS, and the Florida Fish and Wildlife Conservation Commission, jointly recommended relocating all sea turtle nests from Alabama and Florida Panhandle beaches to the Atlantic Coast of Florida for final incubation and release of hatchlings. The USFWS provided a protocol for collecting, handling, transporting, and incubating the eggs, and for releasing the hatchlings. From June 25, 2010, through December 31, 2010, 274 nests (a total of 28,681 eggs) representing three species of turtles were collected and transported to the Kennedy Space Center on the Atlantic Coast of Florida for incubation and subsequent release along the Cape Canaveral National Seashore. Overall hatching success was 51.6 percent (Provancha and Mukherjee 2011).

Patrolling and Monitoring. To locate oiled areas, responders frequently patrolled the Action Area by boat, land vehicles, and aircraft.

Support Activities. The spill response required staging personnel and equipment in many locations throughout the Action Area. The BA shows the major staging locations in its Figures 2.3-7 through 2.3-10, many of which were adjacent to the shoreline. Staging areas that were not adjacent to the shoreline were located in developed areas where the increase in human activity had little or no effect on listed species or designated critical habitat.

1.3. Extent of Response Activities

The response involved activities that occurred in the air, on the water, within the water, and on land. Operations occurred mostly during daylight hours, but also at night. Crew sizes ranged from a few individuals to groups greater than 100 in some areas. With the exception of cleaning oiled individuals, hazing wildlife from oiled areas, and relocating turtle nests, all response activities directly affected habitats, and only indirectly affected individuals of listed species.

The greatest variety of activities occurred on land. The USCG delineated about 4,400 variable-length segments of coastal shoreline for purposes of administering the spill response. The BA reports the work effort of the spill response by State and by activity type in units of "segment days." One segment day is work of any activity type during a calendar day in a segment. The USCG impact assessment model developed for purposes of this consultation relies on segment days, activity type, the time interval between work days within the same segment, and other variables to characterize the likely response to the Action by listed species and features of critical habitat that were potentially present within a segment.

The BA does not report segment days for Texas shorelines, noting only that the response within Texas recovered 118 yd^3 of material. Table 1-1 summarizes the extent of the spill response activities in the other four States of the Action Area. It is based on total segment days reported in the BA for each State, and on the percentages of those totals reported by work type, from which we have computed the segment days by work type. For each of the four States, the BA reports that a "small percentage" (less than 1 percent) of the total segment days were devoted to sediment relocation and debris removal, which does not appear in Table 1-1. Most of the response activity (76 percent of the segment days) involved manual oil recovery.

Table 1-1. Spill response activity days per coastline segment (segment days) by State and activity type (computed from percentages of total State segment days reported in the BA). Less than 1 percent of the total segment days in each state were for sediment relocation and debris removal.

Activity Type	Louisiana	Mississippi	Alabama	Florida	Total	Percentage
Manual recovery	39,723	20,120	48,041	35,544	143,428	76%
Mechanical recovery	2,648	1,166	4,204	948	8,966	5%
Recovery that removed vegetation	1,589	1,166	1,802	948	5,505	3%
Patrol and monitor	9,004	6,707	6,005	9,952	31,668	17%
Total	52,964	29,159	60,051	47,392	189,566	

Michel *et al.* (2013) investigated the extent and degree of shoreline oiling from the DWH spill. Spill assessment teams documented oil on 1,102 miles (1,773 km) of shoreline, comprised of 560 miles (50.8%) on beaches, 495 miles (44.9%) on marshes, and 47 miles (4.3%) on other shoreline types. The USCG Federal On-Scene Coordinator authorized shoreline cleanup activities on 73.3% of the oiled beaches and 8.9% of the oiled marshes.

1.4. Interrelated and Interdependent Actions

A BO evaluates the effects of a proposed Federal action. For purposes of consultation under ESA §7, the effects of a Federal action on listed species or critical habitat include the direct and indirect effects of the action, plus the effects of interrelated or interdependent actions. "Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

In its BA, the USCG assessed all actions that contributed to the spill response, including support activities (which the USCG classified as "interrelated" to the Action) and actions that non-federal parties initiated prior to subsequent authorization and coordination under the Incident Command System. The Action is concluded. Therefore, all interrelated and interdependent actions are captured in the USCG description of the Action, and this BO does not further address the topic of interrelated or interdependent actions.

2. LOGGERHEAD SEA TURTLE

2.1. Status of Loggerhead Sea Turtle

This section summarizes best available data about the biology and current condition of the loggerhead sea turtle (*Caretta caretta*), Northwest Atlantic Distinct Population Segment (DPS), that are relevant to formulating this opinion about the Action. The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. The Services listed the species worldwide as threatened on July 28, 1978 (43 FR 32800). The Services revised this classification on September 22, 2011, identifying four DPSs classified as threatened and five DPSs classified as endangered (76 FR 58868-58952). The Action affected only the Northwest Atlantic DPS, which is classified as threatened.

2.1.1. Description of Loggerhead Sea Turtle

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. The carapace (top shell) is slightly heart-shaped and reddish-brown in adults and sub-adults, while the plastron (bottom shell) is generally a pale yellowish color. The neck and flippers are usually dull brown to reddish brown on top and medium to pale yellow on the sides and bottom. Hatchlings are a dull brown color. Mean straight carapace length of adults in the southeastern U.S. is approximately 36 inches; corresponding weight is about 250 lbs.

2.1.2. Life History of Loggerhead Sea Turtle

Loggerheads are long-lived, slow-growing animals that use multiple habitats across entire ocean basins throughout their life history. This complex life history encompasses terrestrial (nesting beaches), nearshore, and open ocean habitats. The loggerhead feeds on mollusks, crustaceans, fish, and other marine animals. The species is found hundreds of miles off shore, and in near-shore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and ship wrecks are often used as feeding areas. Table 2-1 summarizes key life history characteristics for loggerheads nesting in the U.S.

Table 2-1. Typical values of life history parameters for loggerheads nesting in the U.S. (NMFS and USFWS 2008).

Life History Trait	Data
Clutch size (mean)	100-126 eggs
Incubation duration (varies depending on time of year and latitude)	Range = 42-75 days
Pivotal temperature (incubation temperature that produces an equal number of males and females)	84˚F
Nest productivity (emerged hatchlings/total eggs) x 100 (varies depending on site specific factors)	45-70 percent
Clutch frequency (number of nests/female/season)	3-4 nests
Internesting interval (number of days between successive nests within a season)	12-15 days
Juvenile (<34 inches Curved Carapace Length) sex ratio	65-70 percent female
Remigration interval (number of years between successive nesting migrations)	2.5-3.7 years
Nesting season	late April-early September
Hatching season	late June-early November
Age at sexual maturity	32-35 years
Life span	>57 years

Nesting

For the Northwest Atlantic DPS, most nesting activity occurs from April through September, with a peak in June and July (Williams-Walls *et al*. 1983, Dodd 1988, Weishampel *et al*. 2006). Nesting occurs along the coasts of North America, Central America, northern South America, the Antilles, Bahamas, and Bermuda, but is concentrated in the southeastern United States and the Yucatán Peninsula of Mexico (Sternberg 1981; Ehrhart 1989; Ehrhart *et al*. 2003; NMFS and USFWS 2008).

Loggerheads nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. Females dig nests typically between the high-tide line and the dune front (Routa 1968, Hailman and Elowson 1992). Wood and Bjorndal (2000) evaluated four environmental factors (slope, temperature, moisture, and salinity) and found that slope had the greatest influence on loggerhead nest-site selection on a beach in Florida. Loggerheads appear to prefer relatively narrow, steeply sloped, coarse-grained beaches, although nearshore contours may also play a role in nesting beach site selection (Provancha and Ehrhart 1987).

Numbers of nests and nesting females are often highly variable from year to year due to a number of factors including environmental stochasticity, periodicity in ocean conditions, anthropogenic effects, and density-dependent and density-independent factors affecting survival, somatic growth, and reproduction (Meylan 1982; Hays 2000; Chaloupka 2001; Solow *et al.* 2002). Despite these sources of variation, and because female turtles exhibit strong nest-site fidelity, a nesting beach survey of sufficient duration and standardized methods provides a valuable indicator of changes in the adult female population (Meylan 1982; Gerrodette and Brandon 2000; Reina *et al*. 2002).

Early Development

The warmer the sand surrounding the egg chamber, the faster the embryos develop (Mrosovsky and Yntema 1980). Sand temperatures prevailing during the middle third of the incubation period determine the sex of hatchling sea turtles (Mrosovsky and Yntema 1980). Incubation temperatures near the upper end of the tolerable range produce only female hatchlings, while incubation temperatures near the lower end of the tolerable range produce only male hatchlings.

Loggerhead hatchlings pip and escape from their eggs over a 1- to 3-day interval and move upward and out of the nest over a 2- to 4-day interval (Christens 1990). The time from pipping to emergence ranges from 4 to 7 days with an average of 4.1 days (Godfrey and Mrosovsky 1997). Hatchlings emerge from their nests en masse almost exclusively at night, and presumably using decreasing sand temperature as a cue (Hendrickson 1958; Mrosovsky 1968; Witherington *et al.* 1990). Moran *et al*. (1999) concluded that a lowering of sand temperatures below a critical threshold, which most typically occurs after nightfall, is the most probable trigger for hatchling emergence from a nest. After an initial emergence, there may be secondary emergences on subsequent nights (Carr and Ogren 1960, Ernest and Martin 1993, Houghton and Hays 2001).

Hatchlings use a progression of orientation cues to guide their movement from the nest to the marine environments where they spend their early years (Lohmann and Lohmann 2003).

Hatchlings first use light cues to find the ocean. On naturally lighted beaches without artificial lighting, ambient light from the open sky creates a relatively bright horizon compared to the dark silhouette of the dune and vegetation landward of the nest. This contrast guides the hatchlings to the ocean (Limpus 1971; Salmon *et al.* 1992; Witherington and Martin 1996; Witherington 1997; Stewart and Wyneken 2004).

2.1.3. Numbers, Reproduction, and Distribution of Loggerhead Sea Turtle

The Northwest Atlantic DPS consists of loggerheads that occur in the Atlantic Basin north of the equator and east of 40°W (76 FR 58868-58952). Adult loggerheads migrate between nesting beaches in the southeast U.S. and Caribbean nations to foraging areas that are, in some cases, hundreds of miles away.

Researchers recognize five nesting subpopulations within the Northwest Atlantic DPS – four in the United States and one in Mexico and the Caribbean – based on mitochondrial DNA haplotype frequencies (Encalada *et al.* 1998; Pearce 2001). The Services delineated five Recovery Units for Northwest Atlantic loggerheads corresponding to these genetic differences and geopolitical boundaries in the 2008 Recovery Plan. Recovery units are subsets of the listed species that the USFWS identifies for purposes of establishing recovery goals and implementing management actions. More recent studies support the delineation of eight nesting subpopulations within the Northwest Atlantic DPS (Shamblin *et al*. 2014); however, for purposes of this BO, we refer to the five subpopulations recognized in the 2008 Recovery Plan.

The five recovery units of the Northwest Atlantic DPS are defined below.

1. Peninsular Florida Recovery Unit (**PFRU**) – loggerheads originating from nesting beaches from the Florida-Georgia border through Pinellas County on the west coast of Florida, excluding the islands west of Key West, Florida;
2. Northern Recovery Unit (**NRU**) –loggerheads originating from nesting beaches from the Florida-Georgia border through southern Virginia (the northern extent of the nesting range);
3. Greater Caribbean Recovery Unit (**GCRU**) –loggerheads originating from all other nesting assemblages within the Greater Caribbean (Mexico through French Guiana, The Bahamas, Lesser Antilles, and Greater Antilles);
4. Northern Gulf of Mexico Recovery Unit (**NGMRU**) –loggerheads originating from nesting beaches from Franklin County on the northwest Gulf coast of Florida through Texas; and
5. Dry Tortugas Recovery Unit (**DTRU**) –loggerheads originating from nesting beaches throughout the islands located west of Key West, Florida.

Figure 2-1 shows the distribution of nesting activity for most of the Northwest Atlantic DPS.

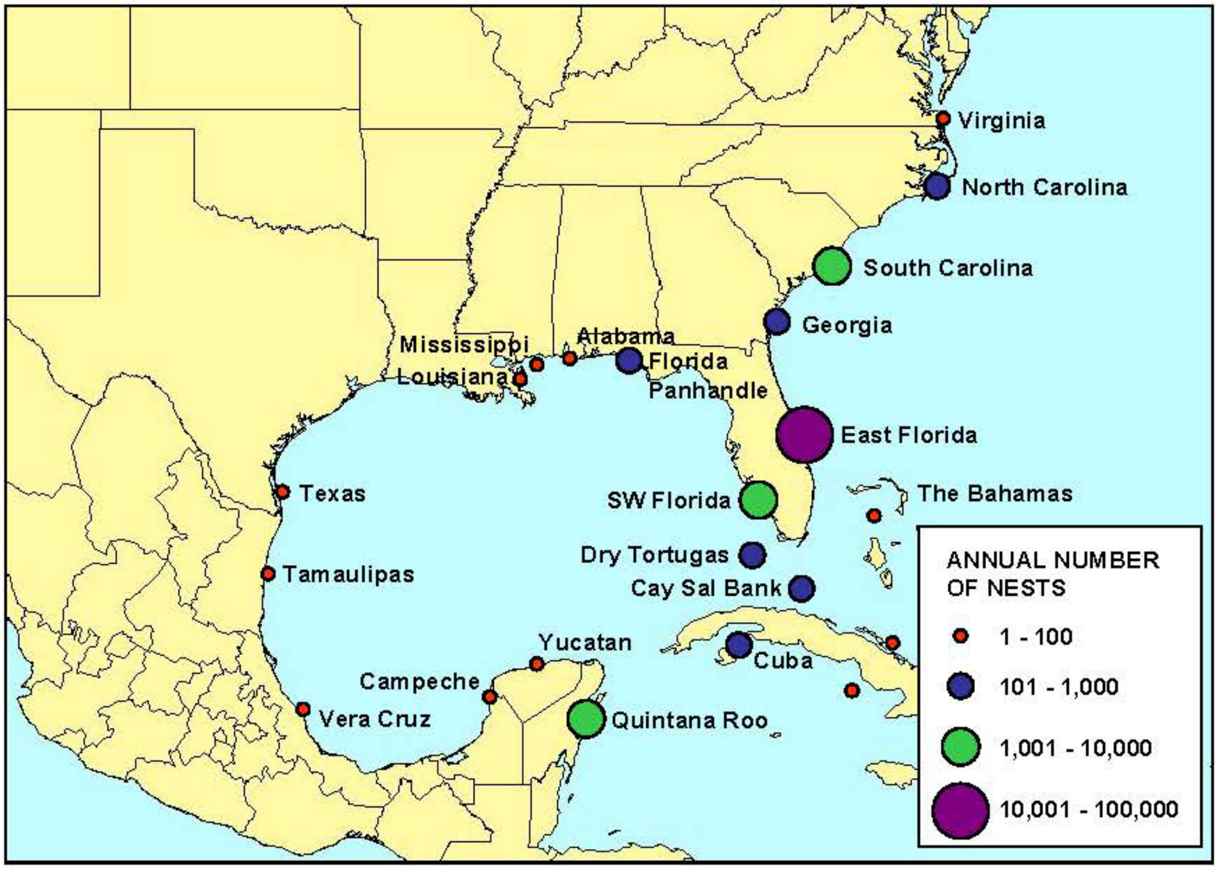

Figure 2-1. Estimated annual number of loggerhead nests in the southeast U.S., The Bahamas (Cay Sal Bank), Cuba, and Mexico, 2001-2008 (source: NMFS and USFWS 2008).

The Turtle Expert Working Group (TEWG 2009) compiled data for loggerhead populations in the western North Atlantic Ocean. Table 2-2, taken from the TEWG report, summarizes annual nesting data corresponding to the five Northwest Atlantic DPS recovery units and notes the apparent trend in nesting numbers. Whereas the annual nest numbers are from all available survey data collected 1989–2006, data the TEWG used to determine trends were limited to a consistently surveyed subsample of nesting beaches within each recovery unit. The annual average number of nests counted for the DPS was 73,985. The subsamples indicated a decreasing trend in all five recovery units. However, more recent data (2011-2016) from Florida, which hosts the majority of nesting activity in the DPS, suggest an increasing trend in both the PFRU and the NGRU. Total nests counted in Florida ranged from 68,609 in 2011 to 122,706 nests in 2016, with an average of 90,676 nests (http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead/).

Table 2-2. Annual average loggerhead nesting numbers and trends for recovery units of the Northwest Atlantic Distinct Population Segment (source: TEWG 2009).

Recovery Unit	Annual Average Number of Nests	Survey Years	Trend
Peninsular Florida	65,460	1989-2006	Decreasing
Northern U.S.	5,151	1989-2005	Decreasing
Greater Caribbean	1,674	1989-2005	Decreasing (data for Quintana Roo, Mexico, only)
Northern Gulf of Mexico	1,000	1995-2005	Decreasing (data for the Florida Panhandle only)
Dry Tortugas	700	1995-2004	Decreasing (data for Dry Tortugas Island only)
Total	73,985		

Research before the year 2000 suggested that the northern-most U.S. nesting beaches (NRU and NGMRU) produce a high percentage of males, and the more southern nesting beaches (PFRU, DTRU, and GCRU) produce a high percentage of females (e.g., Hanson *et al.* 1998, NMFS 2001, Mrosovsky and Provancha 1989). In 2002 and 2003, researchers studied loggerhead sex ratios for one of the northern and one of the southern recovery units (NGU and PFRU, respectively) (Blair 2005, Wyneken *et al.* 2005). The northern beaches produced more females and the southern beaches produced more males in 2002, contrary to prior findings, and vice versa in 2003, consistent with prior findings. Wyneken *et al.* (2005) speculated that the 2002 results were anomalous.

2.1.4. Conservation Needs of Loggerhead Sea Turtle

The Services 2011 final rule (76 FR 58868-58952) classifying the loggerhead as nine DPSs provides the most recent summary of the species' status and conservation needs range wide. The Services' 2008 Recovery Plan (NMFS and USFWS 2008), although it preceded this rule, was limited in scope to the Northwest Atlantic Population that was later designated as one of the nine DPSs. Due to its focus on the DPS, the Recovery Plan is the primary source for information in this section. We summarize the key points that are relevant to this consultation, but please refer to the full Plan for additional details.

Population Growth

Maximum intrinsic population growth rates of sea turtles are limited by the extremely long duration of the juvenile stage. Loggerheads require high survival rates in the juvenile and adult stages to achieve positive or stable long-term population growth (Congdon *et al.* 1993, Heppell 1998, Crouse 1999, Heppell *et al.* 1999, 2003, Musick 1999).

The Recovery Plan established the following demographic objectives, measured by number of nests sustained for 50 years, for each recovery unit of the Northwest Atlantic DPS.

Unit	# Nests
Peninsular Florida	106,100
Northern	14,000
Northern Gulf	4,000
Dry Tortugas	1,100
Greater Caribbean	100
Total	125,300

The Recovery Plan specifies criteria (e.g., statistical significance, distribution by state in multi-jurisdiction units) for each nesting objective, which must correspond to increases in numbers of nesting females estimated from nests, clutch frequency, and remigration interval (time between successive nesting migrations).

The Recovery Plan identifies two demographic criteria in addition to the recovery-unit-specific nesting objectives:

1) relative abundance is increasing for at least one generation, as measured in the water by a network of oceanic and neritic (waters where sunlight reaches the bottom) sites across the foraging range; and
2) the relative abundance trend of #1 above must exceed the rate of neritic stranding for similar age classes for at least one generation.

Reducing Threats

The loggerhead's use of a geographically broad range of beaches, near-shore, and marine habitats in the Northwest Atlantic basin exposes the species to a wide array of threats to individual survival, reproductive success, and population recovery. The Recovery Plan (NMFS and USFWS 2008) specifies the broad goals of strategies that will lessen or eliminate the most significant of these threats. The strategies that are most relevant to this consultation, which is limited to the terrestrial sea turtle environment, are intended to promote the following conservation outcomes:

- the percentage of nesting beaches free of barriers to nesting is stable or increasing;
- beach sand placement projects do not degrade or eliminate nesting habitat;
- nests are protected from natural and manmade impacts;
- less than 10 percent of U.S. nests are lost to predation; and
- artificial lighting disorients the hatchlings from less than 10 percent of U.S. nests.

Additional factors affecting loggerhead conservation in the terrestrial context include hurricanes, beach erosion, beach driving, climate change, and recreational beach use. Details regarding these factors are not relevant to this consultation; but are discussed in the Recovery Plan.

2.2. Environmental Baseline for Loggerhead Sea Turtle

This section is an analysis of the effects of past and ongoing human and natural factors leading to the present status of the loggerhead sea turtle, its habitat, and ecosystem within the Action Area. Ordinarily, the environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. However, the emergency response action of this consultation is concluded. We do not attempt to analyze the status of the species at the time the Action began in April 2010. Instead, this section summarizes best available data about the present status of the species in the Action Area, which reflects the effects of the oil spill, response activities, and other relevant factors. We discuss the relative contribution of the Action to the species' current Action-Area status in the "Effects of the Action" section, which follows this "Baseline" section.

2.2.1. Action Area Numbers, Reproduction, and Distribution of Loggerhead Sea Turtle

The nesting habitat of the Northern Gulf of Mexico Recovery Unit (NGRU) occurs in the Action Area. The NGRU includes loggerheads originating on nesting beaches between Franklin County of the Florida Panhandle and the Texas/Mexico border, which is the western extent of the U.S. nesting range. Annual nest totals for this recovery unit averaged 906 nests from 1995–2007 (NMFS and USFWS 2008).

The NGRU nesting totals reported in the 2008 Recovery Plan do not include nest counts from Texas, Louisiana, and Mississippi, where sea turtle nesting activity is low and not consistently monitored. Loggerhead nesting on Texas beaches is rare, and sparse on the Chandeleur Islands of Louisiana and the beaches and islands that bound Mississippi Sound. The beaches of Alabama and the Florida Panhandle support the vast majority of loggerhead nesting activity in the NGRU.

In 2010, 683 loggerhead nests were documented in Alabama (41 nests) and the Florida Panhandle (642 nests), which is 223 nests less than the 1995-2007 average for the NGRU. Nest surveys are generally conducted by walking the beach early in the morning during the nesting season to detect turtle "crawls," which are the trails in the sand left by nesting females during the previous night. Rain, wind, tides, and human activity on the beach may obscure turtle crawls, causing surveyors to miss nests. The number of missed nests on Alabama and Florida Panhandle beaches was likely greater than normal in 2010 due to oil clean-up operations on the beach that obscured crawls. Surveyors missed at least four nests in Alabama, which was evident by the presence of hatchlings at four separate locations on surveyed beaches where no nests had been identified (A.M. Lauritsen, personal communication 2017).

The BA (p. 136) notes that the USCG received no information about loggerhead nesting on Louisiana beaches during the course of the emergency response action. Before 2006, the National Park Service annually conducted aerial sea turtle nesting surveys once a week during the nesting season over the Mississippi District of Gulf Islands National Seashore. These surveys included Cat, Horn, West Ship, East Ship, and Petit Bois Islands. The total number of nests ranged from 0 to 15 per year. Petit Bois and Horn Islands had the most nests; the other islands had occasional nests. All nests/crawls sighted during these aerial surveys appeared to be loggerheads, but some may have been Kemp's ridley nests. We are aware of six reports of sea turtle hatchlings found on Mississippi beaches during the 2010 nesting season, and a report of one nest at a beach in Fontainebleau, Mississippi, where only shelled eggs were uncovered (A.M. Lauritsen, USFWS, personal communication, 2017).

Using the estimate of 4.1 nests per adult female during a reproductively active year (Murphy and Hopkins 1984), about 167 females produced the 683 nests documented for the 2010 NGRU nesting season. Adult female loggerheads do not nest every year. The mean remigration interval (time between successive nesting migrations) of females in the Northwest Atlantic DPS is 2.5–3.7 years (see Table 2-1). If equal numbers of females nest each year, the total number of adult females would be about 2.5–3.7 times the number nesting in a particular year. Adult females that nest each year represent a small fraction of the larger recovery unit population, which includes non-nesting adult females, adult males, and juveniles.

Due to the proximity of the DWH spill to the primary nesting areas for the NGRU, it is reasonable to infer that a large percentage of 2010 nesting loggerhead females and their hatchlings in the NGRU were exposed to oil and/or the associated spill response activities. However, among the 1,146 sea turtles found stranded or captured (both dead and alive) during wildlife search and rescue operations from April 26 – October 20, 2010, loggerhead sea turtles accounted only for about 4% of all live turtles recovered, and about 11% of all dead turtles recovered (NMFS 2014: Table 9). Relative to other sea turtle species in the Gulf, loggerhead populations are much larger, yet recoveries during the DWH oil spill response were much lower.

Action Area nesting surveys conducted in the years following the DWH Macondo well closure in late 2010 suggest that loggerhead nesting is increasing (Table 2-3). The 2,523 nests identified in 2016, the most recent year of data available, is more than double the 1995–2007 average of 906 nests for the NGRU reported in the recovery plan (NMFS and USFWS 2008). The NGRU average for 2011–2016 was 1,553 nests.

Table 2-3. Total number of loggerhead nests identified in surveys of Action Area beaches for the 2011-2016 nesting seasons.

State	2011	2012	2013	2014	2015	2016
Florida Panhandle[1]	886	1,601	1,298	1,009	1,499	2,290
Alabama[2]	84	149	81	80[3]	109	233
Total	970	1,750	1,379	1,089	1,608	2,523

[1] Data source: http://myfwc.com/media/4083100/loggerheadnestingdata11-15.pdf; for 2011-2015, and http://myfwc.com/research/wildlife/sea-turtles/nesting/statewide/; for 2016.
[2] Data source: http://www.alabamaseaturtles.com/nesting-season-statistics/
[3] Includes an unspecified, but likely small, number of Kemp's ridley nests.

DHW Oil Spill Injury Assessment

In the Programmatic Damage Assessment and Restoration Plan (PDARP), the Deepwater Horizon Natural Resource Damage Assessment Trustees (DWH Trustees) (2016: chapter 4.8.5) estimated that the spill killed about 10,400 small juvenile loggerheads and up to 3,600 large juveniles/adults, mostly in the marine environment. The DWH Trustees believe that spill response activities in marine areas (e.g., dredging to construct berms, collisions with response vessels, oil skimming and burning) likely killed hundreds of sea turtles, although the Trustees lacked data to estimate numbers by species. The Trustees attribute the loss of about 34,000 loggerhead hatchlings specifically to spill response activities (DWH Trustees 2016: Table 4.8-7) through nest relocation and deterrence of gravid females from nesting.

2.2.2. Action Area Conservation Needs of Loggerhead Sea Turtle

Conservation needs of the NGRU within the Action Area are a geographic subset of the DPS-wide needs described in section 2.1.4. The recovery goal for nesting in the recovery unit is 4,000 nests per year. The 1995–2007 recovery unit average is 906 nests (NMFS and USFWS 2008). Data for the past six nesting seasons suggests that nesting activity is increasing (Table 2-3). The vast majority of NGRU nesting activity is within the Action Area.

All of the threats listed in 2.1.4 are relevant in the Action Area. Coastal development has introduced a variety of difficulties and obstacles for adult females nesting on beaches, for safe incubation of nests, and for the survival of hatchlings emerging from nests. The Action Area includes about 4,400 miles of mainland and barrier island shoreline (see section 1.1, "Action Area"), of which 367 miles are sandy beaches that are generally managed in a manner that benefits sea turtles (NMFS and USFWS 2008, App. 4, total miles of protected beaches between Galveston County, Texas, and Franklin County, Florida).

The USCG BA describes the types of threats to sea turtles in the Action Area, which we summarize in this paragraph. A variety of human activities on beaches of the Action Area affect sea turtles, including beachfront development, beach grooming, beach renourishment, recreation, and vehicular traffic. Commercial and recreational fishing, shrimping, crabbing, oyster fishing, oil and gas exploration/extraction activities, and boat traffic affect sea turtles in the marine environment. The DWH spill and the Action itself disrupted many of these beach and marine activities. New oil drilling was halted until October 12, 2010, and 1 year after the spill, the Bureau of Ocean Energy Management was issuing fewer permits for new deep-water wells than before the spill. Fisheries in Federal waters of the Action Area were closed following the spill, and gradually reopened between July and November, 2010, as testing confirmed that seafood from specific areas was safe for consumption. Fisheries in State waters were also closed for several months. Although these fishery closures temporarily removed the impacts of sea turtle by-catch, the impacts of the spill itself on sea turtles and sea turtle resources likely far exceeded any offsetting benefit of the temporary closures.

2.3. Effects of the Action on Loggerhead Sea Turtle

This section analyzes the direct and indirect effects of the Action on the loggerhead sea turtle, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

Sea turtles are under USFWS jurisdiction only while on land; therefore, the effects of the Action on sea turtles that we consider in this BO are those caused by spill response activities conducted on turtle-nesting beaches. All seven of the categories of terrestrial response activities described in section 1.2 occurred to some extent on beaches (Oil Collection, Barriers, Flushing and Washing, Habitat Modification, Hazing and Other Direct Measures to Protect Wildlife, Patrolling and Monitoring, and Support Activities). Among the “Measures to Protect Wildlife,” the Action involved relocating loggerhead nests in 2010 from Alabama and Florida beaches of the Action Area to the Florida Atlantic coast, which is within the Peninsular Florida Recovery Unit of the loggerhead Northwest Atlantic DPS.

2.3.1. Response Pathways

The Action involved putting people, vehicles, and other equipment on the beaches of the Action Area, which introduced potential stressors (biologically relevant changes to the environment) to nesting female sea turtles, their nests, hatchlings, and the habitat resources upon which they rely. In this section, we describe the likely responses of individual sea turtles upon exposure to Action-caused stressors, and cite some specific examples documented during the spill response.

Human Disturbance

The majority of oil clean up was accomplished manually (see Table 1-1). Beach clean-up was conducted during both day and night hours throughout the sea turtle nesting and hatching season. During night hours, clean-up activity likely deterred females from crawling onto the beach to nest or disturbed the nesting process. A large volume of foot traffic compacts beach sand, increasing the effort necessary for adult females to dig a nest or for hatchlings to emerge from a nest (Hosier *et al.* 1981).

Along with the clean-up activities, a substantial fraction (17% overall; 15% in Alabama and Florida; see Table 1-1) of the total spill response effort involved patrolling and monitoring the Action Area for oil. On July 16, 2010, Deputies of the Escambia County (Florida) Sheriff "ran" a female turtle back into the surf to prevent the turtle from using an oiled beach (A.M. Lauritsen, USFWS, personal communication, 2017).

Driving on the beach during clean-up operations

Responders used various types of vehicles to carry workers and supplies, and used specialized beach-cleaning vehicles. In addition to deterring adult females from entering a beach to nest, the operation of vehicles and other equipment on the beach may affect sea turtles by:

- interrupting or striking a female turtle on the beach;

- disorienting emergent hatchlings with vehicle headlights;
- running over hatchlings attempting to reach the sea; and
- leaving tracks on the beach that disrupt hatchling movement to the sea.

Vehicle tracks appear to disrupt hatchling movement, not because they are physically unable to climb out of the rut (Hughes and Caine 1994), but because the walls of the track block the hatchlings' line of sight to the ocean horizon (Mann 1977). Negotiating tire tracks lengthens the journey from the nest to the sea, which increases hatchling susceptibility to dehydration and predation (Hosier *et al.* 1981). Beach driving compacts sand, which affects nest site selection, digging behavior, clutch viability, hatchling emergence, and may directly kill pre-emergent hatchlings (Mann 1977, Nelson and Dickerson 1987, Nelson 1988).

Vegetated dunes stabilize a beach and increase its elevation above sea level, which provides a greater range of turtle nesting opportunities. Higher nests are generally less prone to flooding and erosion. Driving on dunes causes physical changes and loss of plant cover that can lead to various degrees of instability and subsequent dune migration. As vehicles move either up or down a slope, sand is displaced downward, lowering the trail. Unvegetated sand dunes may migrate across stable areas as long as vehicular traffic continues. Traffic through dune breaches or low dunes on an eroding beach may accelerate beach erosion (Godfrey *et al.* 1978). Dune vegetation can quickly reestablish when the mechanical impact ceases. If beach driving must occur, driving in the zone between the normal extent of low and high tides causes the least impact.

The use of heavy machinery on beaches may have adverse effects on sea turtles in addition to or more severe than those caused by beach driving with smaller vehicles. Equipment left on the beach overnight can create barriers to nesting females emerging from the surf and crawling up the beach, causing a higher incidence of non-nesting emergences and unnecessary energy expenditure. Wildlife Observers assigned to the spill response reported instances of female turtles aborting nesting attempts apparently due to the presence of equipment on the beach (A.M. Lauritsen, personal communication, 2017). As with other vehicles, heavy equipment may crush nests, preclude hatchling emergence, or run over hatchlings. On June 20, 2010, heavy equipment was parked overnight directly above a sea turtle nest on Bon Secour National Wildlife Refuge in Alabama.

Artificial Lighting

Night-time response activities involved artificial lighting as necessary to accomplish the work safely. Artificial lights along a beach can deter females from coming ashore to nest or misdirect females trying to return to the surf after a nesting event. Witherington (1992) documented a significant reduction in sea turtle nesting activity on beaches illuminated with artificial lights. Visual cues are the primary means by which hatchling sea turtles find the sea upon nest emergence (Mrosovsky and Carr 1967, Mrosovsky and Shettleworth 1968, Dickerson and Nelson 1989, Witherington and Bjorndal 1991). Artificial lighting on or near the beach can misdirect hatchlings once they emerge from their nests and prevent them from reaching the ocean (Philibosian 1976, Mann 1977).

In the Unit Log on 9 August 2010, the Santa Rosa Island Authority, Escambia County Division, reported a turtle attempting to nest near nighttime clean-up operations. Below is an excerpt from that report.

> "Turtle crawled onto shoreline, however not far enough to make a good crawl. All tracks were washed away in the waves. Notified foreman and shut down operations within 200 feet of turtle sighting. All crews switched to red lights. Turtle went back into water. We waited 15 minutes and then resumed operations."

Barriers to Nesting

Structures and materials placed on beaches may act as barriers to nesting sea turtles by precluding access to areas landward of such barriers. Nests closer to the sea are more vulnerable to storm flooding and erosion. Witherington (1986) found that the lowest, i.e., most seaward, of three beach zones had the lowest hatching and emerging success.

On June 16, 2010, a loggerhead turtle on St. Joe beach in Florida encountered boom/plastic fencing installed parallel to the water, and then constructed a shallow nest with eggs laid between about 4–8 inches below the sand surface. Normally, loggerheads lay their eggs at about 20 inches deep (Moran *et al.* 1999). Nest depth influences factors that affect hatching success, including temperature, moisture, and gas exchange (Ackerman 1980).

On June 15, 2010, a loggerhead turtle on Beacon Hill beach in Florida dug and abandoned six body pits, apparently due to the presence of plastic bags filled with seaweed stretched parallel to the water. Responders had placed the bags to prevent oil from reaching the beach.

Nest Relocation

The DWH spill began on April 20, 2010, at the onset of the sea turtle nesting season in the northern Gulf. Responders estimated that the probability of oil washing ashore on Alabama and Florida Panhandle beaches, where most sea turtle nesting in the northern Gulf occurs, was 81–100%. From June 26 through August 18, 2010, various personnel under USFWS authorization and in coordination with the NMFS and state wildlife agencies collected 274 sea turtle nests (265 loggerhead, 5 Kemp's ridley, and 4 green) laid on Florida Panhandle and Alabama beaches (Provancha and Mukherjee 2011). Collection and transfer occurred near the end of incubation for the final days of incubation, hatching, and emergence in an incubation facility at the Kennedy Space Center (Florida), and subsequent release of hatchlings into the Atlantic Ocean. The USFWS, NMFS, and Florida Fish and Wildlife Conservation Commission (FFWCC) developed protocols for this emergency response effort, available at: http://www.fws.gov/home/dhoilspill/pdfs/TurtleNestHatchProgram.pdf.

This relocation effort involved substantial manipulation of, and risk to, eggs and hatchlings. Under normal circumstances, the Services consider relocating a loggerhead nest justifiable only when other measures to remove or minimize threats to the nest are unavailable (NMFS and USFWS 2008). Given the environmental catastrophe in the Gulf of Mexico, relocating nests provided the only feasible option to prevent Florida Panhandle and Alabama turtle hatchlings from swimming into oil, dispersants, or contaminated *Sargassum* in their developmental habitats of the Gulf, and was therefore warranted to prevent further harm to the species.

2.3.2. Estimation of Effects

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon the USCG BA and on the DWH Trustees (2016) damage assessment as our data sources.

USCG Take Score Model

Actual exposure of individuals of listed species to Action-caused stressors depended on the timing and location of spill-response activities, and other factors. The USCG "Take Score Model" (TSM) developed for the BA combined available data regarding the types of Action-caused stressors, the extent of listed species' exposure to these stressors, and the types of responses that listed species individuals most likely experienced.

The TSM used data for the approximately 4,400 segments of coastal shoreline that the USCG delineated for purposes of administering the spill response. These data covered:

- listed species that were likely present in the segment;
- habitat type of the segment and its sensitivity to spill-response actions;
- actions that occurred in the segment;
- timing and duration of actions; and
- applicable BMPs, and whether deviations from BMPs occurred.

For the listed species present in a segment, the TSM applied species-specific factors, including:

- the probability of the species' exposure to the action(s) taken in the segment;
- the species' relative tolerance to action-caused stressors; and
- impacts to the species' prey in the segment, if applicable.

Combining these data for each segment where listed species were likely present, the TSM generated a score indicating the severity of individual's responses to the Action. For each listed species, the USGC delineated the range of scores that corresponded to:

- behavioral responses (e.g., startle, alarm, avoidance, abandonment, displacement);
- sub-lethal responses (e.g., increased respiration, reduced feeding success, reduced growth rates, delayed age at sexual maturity, depressed autoimmune responses, reduced fecundity); and
- lethal (e.g., reproductive failure or death of any life stage).

Scores in the higher end of the behavioral response range to the lower end of the sub-lethal range are indicative of take in the form of harassment, if the actual response to the annoyance caused by the Action created the likelihood of injury to individuals. Scores above the lower end of the sub-lethal range are indicative of take in the form of harm, if the action actually killed or injured individuals.

For further details about the TSM, please refer to section 6.1 of the USCG BA.

Take Score Model Results

The USCG excluded shoreline segments in Texas and Louisiana from the loggerhead TSM analyses, due to the very low frequency and numbers of loggerhead nesting in these states. Although loggerhead nesting in Mississippi is similarly sparse, the USCG analyzed effects of the Action in Mississippi segments that have a record of nesting and that received spill response activity. Most of the loggerhead terrestrial effects analyses focused on Alabama and Florida beaches, where the majority of nesting in the Action Area occurs. Table 2-3 summarizes the extent of exposure (segment days of spill response activity) of loggerhead sea turtles to the Action, and the corresponding types of turtle responses estimated by the USCG TSM.

Table 2-3. Extent of exposure to spill response activity (segment days) by state and corresponding response type by loggerhead sea turtles.

State	Species' Response Type		
	Behavioral	Sub-lethal	Lethal
Mississippi	7	1	0
Alabama	293	6	19
Florida	140	4	0
Total Segment Days	440	11	19

The estimated extent of responses summarized above were generally due to night operations, mostly manual oil clean up, but some mechanical. The 19 segment days of potentially lethal responses occurred July 19, 2010, on about 6.2 miles (10 km) of Alabama beaches. This operation involved overnight staging of mechanical equipment and the activity of over 400 personnel, which could have destroyed loggerhead nests. This level of activity would have also caused any adult females emerging to nest to abandon the attempt and relocate. For further details about the results of the TSM for loggerheads, please refer to section 6.4.1.3 of the BA.

The USCG BA did not estimate actual numbers of loggerheads affected by the spill response activities corresponding to the TSM results summarized above. The DWH Trustees (2016: Table 4.8-7) attribute the loss of about 34,000 loggerhead hatchlings specifically to spill response activities. This total includes the loss of 265 loggerhead nests (27,618 eggs) that were relocated to the Atlantic Coast of Florida (see Nest Relocation discussion below). The total loss was included in the injury quantification of the Trustee's damage assessment.

Disrupted Nesting

The DWH Trustees (2016: chapter 4.8.5.2.3) estimated the scale of sea turtle nesting disrupted by spill response activities. Such disruption corresponds to behavioral responses identified by the TSM in the previous discussion of Take Score Results. The Trustees analyzed Action-Area nest numbers before and after the spill compared to data for southwest Florida beaches that were outside of the Action Area. The Trustees estimated that oil cleanup operations caused a probable reduction of about 280 loggerhead nests (250 on Florida beaches; 30 on Alabama beaches) by deterring adult females from coming ashore to nest. This level of nesting disruption would not have occurred without the spill; therefore, it was an injury attributed to the spill for damage assessment purposes.

<u>Nest Relocation</u>

From the 28,681 sea turtle eggs relocated from beaches in the Action Area to the incubation facility at the Kennedy Space Center, 14,796 hatchlings emerged (14,326 loggerheads, 345 greens, 125 Kemp's ridley) and were released on the Florida Atlantic coast (Provancha and Mukherjee 2011). This represents an overall hatching success for all sea turtle eggs of 51.6%. The net effect of the relocation on populations of these three species is the difference between hatchling survival rates with and without this intervention. Without intervention, hatchling survival in the Gulf before August 2010 was highly unlikely, due to the amount and extent of the spill and the level of potentially injurious spill-response activity.

We cannot estimate survival rates following hatchling release into the Atlantic, but regardless, the relocation may affect the relative abundance among Northwest Atlantic DPS subpopulations. Female sea turtle hatchlings generally return to their natal beaches as breeding adults (Encalada *et al.* 1998). Because the relocated hatchlings entered the Atlantic Ocean (Peninsular Florida Recovery Unit) and not the Gulf, it is unknown whether females that survive to breeding age will return to the Northern Gulf Recovery Unit for nesting (Provancha and Mukherjee 2011). The DWH Trustees (2016; chapter 4.8.5.2.2) considered these hatchlings lost to the northern Gulf breeding population in their assessment of injury caused by the spill.

Of the 265 relocated loggerhead nests, 189 had some hatching success (at least one live hatchling). Effects of the relocation on subsequent fitness and long-term survival of the hatchlings released are unknown. However, the relocation accomplished its goal of preventing hatchlings from entering oiled waters. It is our judgement at this time that this spill-response activity reduced the overall impact of the spill on the Northwest Atlantic loggerhead DPS.

The Services suspended nest relocations in mid-August, 2010. Once responders capped the Macondo well on July 15, 2010, and as the extent of surface oil diminished, all Federal and State agencies involved considered the risks of allowing hatchlings from later nests to enter the Gulf less serious than the risks of relocating these eggs and releasing hatchlings in the Atlantic. At that time, 409 sea turtle nests identified in 2010 nesting surveys, mostly loggerhead nests, remained on Action Area beaches.

2.4. Conclusion for Loggerhead Sea Turtle

In this section, we summarize and interpret the findings of the previous sections for the loggerhead sea turtle (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Status

Our description of the status of the loggerhead sea turtle Northwest Atlantic DPS in section 2.1 notes that from 1989–2006, the annual average number of nests counted throughout the DPS was 73,985. Data for consistently surveyed beaches during this period indicated a declining trend in all five recovery units. More recent data (2011-2016) from Florida, which hosts the majority of nesting activity in the DPS, suggest a short-term increasing trend in both the Peninsular Florida and Northern Gulf recovery units. Total nests counted in Florida ranged from 68,609 in 2011 to 122,706 nests in 2016 (average 90,676). The recovery goal is to sustain 125,300 nests annually for 50 years. By this criterion, recovery is at least 50 years in the future.

Baseline

In section 2.2 (Environmental Baseline), we note that the Action Area is within the Northern Gulf of Mexico Recovery Unit (NGRU) for the loggerhead Northwest Atlantic DPS. Loggerhead nesting in the NGRU is generally limited to the Alabama and Florida portions of the Action Area. Annual nest totals for this recovery unit averaged 906 nests from 1995–2007. In 2010, 683 loggerhead nests were documented in the Action Area. Surveys conducted in the years since (2011–2016) indicate that loggerhead nesting in the Action Area is increasing, with an annual average of 1,553 nests. The demographic recovery goal for the NGRU is 4,000 nests annually, sustained for 50 years.

Coastal development range-wide and in the Action Area has introduced a variety of difficulties and obstacles for adult loggerhead females nesting on beaches, for safe incubation of nests, and for the survival of hatchlings emerging from nests. The Action Area includes about 4,400 miles of mainland and barrier island shoreline, of which 367 miles are sandy beaches that are managed generally in a manner that benefits sea turtles. Recovery goals in the terrestrial context focus on removing barriers to nesting, and reducing the impacts of beach nourishment projects, predation, artificial lighting, and other factors on nesting success.

Effects

Our analysis of the effects of the Action in section 2.3 combines information from the Take Score Model results of the USCG Biological Assessment and the DWH Trustees damage assessment. The DWH Trustees attribute the loss of about 34,000 loggerhead hatchlings specifically to spill response activities. This loss includes the relocation of 14,326 loggerhead eggs (265 nests) from the Action Area to the Florida Atlantic Coast. Oil clean-up operations account for the remaining loss in this total estimate, primarily by deterring adult females from coming ashore to nest, which the Trustees estimate caused a probable reduction of about 280 loggerhead nests as the females likely aborted the eggs and did not nest elsewhere. The Coast Guard reported a total of 451 segment days of activity that could have caused behavioral (440 segment days) and sub-lethal (11 segment days) loggerhead responses, such as deterring females from nesting, and 19 segment days of activity that could have caused lethal responses, if loggerhead nests were present.

The loss of about 34,000 hatchlings (mainly from nest relocation and deterrence of gravid females) equates to the loss of about 270–340 nests, using an average clutch size of 100–126 eggs. This one-time loss of nests represents 18–22 percent of the annual average of 1,533 nests for the Action Area in recent years, and 0.3–0.4 percent of the Florida-wide annual average of 90,676 nests in recent years. Florida accounts for the majority of nesting in the DPS, and these recent Florida nesting data exceed the DPS-wide nesting data collated before the DWH spill in 2010 (see section 2.1.3). However, the estimated loss of 34,000 hatchlings includes the nests relocated during 2010, from which 14,216 hatchlings were released on the Florida Atlantic coast. Whether these hatchlings will recruit at normal rates to the breeding population of the Northwest Atlantic DPS, and if so, to which recovery unit (NGRU or PFRU), is unknown. Using annual nesting as the primary metric, the status of the DPS as of the end of the 2016 nesting season is slightly improved compared to the beginning of the 2010 nesting season.

The Action temporarily increased threats to loggerhead nesting success by introducing barriers and disturbance that would not otherwise have occurred, but it also removed oil that could deter nesting and harm turtles. BMPs applicable to turtle nesting beaches contributed to limiting the effects of most of these activities to behavioral responses for loggerheads (440 segment days of potential responses out of 107,443 segment days worked in Alabama and Florida; see Tables 1.1 and 2.3), most of which were not likely to cause injury.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

The USFWS shares consultation responsibilities for sea turtles with the NMFS. As we noted on page 1 of the introduction, this BO considers effects of the Action to sea turtles in the terrestrial context, and the NMFS BO considers effects in the marine context. After reviewing the current status of the species, the environmental baseline for the Action Area, and the effects of the Action in the terrestrial environment, it is the USFWS biological opinion that the Action did not jeopardize the continued existence of the loggerhead sea turtle.

3. KEMP’S RIDLEY SEA TURTLE

3.1. Status of Kemp’s Ridley Sea Turtle

This section summarizes best available data about the biology and current condition of Kemp’s Ridley Sea Turtle (*Lepidochelys kempii*) throughout its range that are relevant to formulating an opinion about the Action. The Services published its decision to list Kemp’s Ridley Sea Turtle as endangered on December 2, 1970 (35 FR 18320). The Services completed the most recent 5-year review of the species’ status in July, 2015, recommending that the Kemp’s ridley remain classified as endangered throughout its range (NMFS and USFWS 2015).

3.1.1. Description of Kemp’s Ridley Sea Turtle

The Kemp's ridley turtle is the smallest of the sea turtles, with adults reaching about 2 feet in length and weighing up to 100 pounds. The adult Kemp's ridley has an oval carapace that is almost as wide as it is long and is usually olive-gray in color. Hatchlings are black on both sides. The Kemp's ridley has a triangular-shaped head and a hooked beak with large crushing surfaces. This turtle is a shallow-water benthic feeder with a diet consisting primarily of crabs.

3.1.2. Life History of Kemp’s Ridley Sea Turtle

Nesting

Snover *et al*. (2007) report that the Kemp’s ridley age at sexual maturity is between 10 to 17 years. Available evidence suggests that mature females begin migrating along relatively shallow corridors toward the nesting beach in the late winter in order to arrive at the nesting beach by early spring (NMFS and USFWS 2015). Based on observations of captive animals, Rostal (2007) believes that mating occurs about 3 to 4 weeks prior to the first nesting of the season during late March through early to mid-April. Morreale *et al*. (2007) and Rostal (2007) suggest that mating takes place near the nesting beach.

Nesting occurs from April through July on ocean beaches. Multiple nesting females may emerge onto a beach during the same relatively brief period, apparently triggered by high winds and changes in barometric pressure (Jimenez *et al*. 2005). This phenomenon, called an *arribada* (Spanish for “arrival”), included an estimated 40,000 turtles during 1947 on the beaches near Rancho Nuevo, Mexico, which is the primary nesting location for the species (Carr 1963; Hildebrand 1963). Nesting occurs primarily during daylight hours. Clutch size averages about 100 eggs, which typically take 45–58 days to hatch, depending on incubation temperature and other conditions (Marquez-Millan 1994; Rostal 2007).

During a nesting season, adult females lay an average of 2.5 clutches (TEWG 1998). Approximately 20% of adult females will nest every year, 60% every 2 years, 15% every 3 years, and 5% every 4 years (Márquez *et al*. 1989; TEWG 2000). These data suggest a mean inter-annual remigration rate for female Kemp's ridleys of approximately 1.8 (Rostal 2007) to 2.0 years (Márquez *et al*. 1989; TEWG 2000).

Early Development

After leaving the nesting beaches of the western Gulf of Mexico, Gulf currents carry Kemp’s ridley hatchlings to various developmental waters. Most likely remain within the Gulf, but some enter the southward Loop Current and then move eastward on the Florida Current into the Gulf Stream (Collard and Ogren 1990; Putman *et al*. 2010). Juvenile Kemp’s ridleys spend an average of about 2 years in the open ocean, where they likely feed in floating algal communities until reaching about 8 inches in length (NMFS *et al*. 2011), at which time they migrate to coastal shallow-water habitats (Ogren 1989).

3.1.3. Numbers, Reproduction, and Distribution of Kemp's Ridley Sea Turtle

The range of the Kemp's ridley is smaller than that of most other sea turtles, which typically spans the tropical and temperate zones of oceans worldwide. The Kemp's ridley primarily inhabits the Gulf of Mexico, but may disperse into Atlantic waters as far north as Newfoundland, Canada, and as far east as the Azores Islands, Portugal. The species is occasionally observed in the Mediterranean Sea.

The vast majority of Kemp's ridley nesting occurs on beaches of the western Gulf of Mexico, with the greatest number of nests in Tamaulipas, Mexico (NMFS *et al*. 2011). Nesting occurs consistently, but at lower numbers, in south Texas, especially Padre Island, and infrequently in other Gulf and south Atlantic U.S. states. Figure 3-1 shows the locations of nesting sites and the relative proportion of total nests documented in 2009.

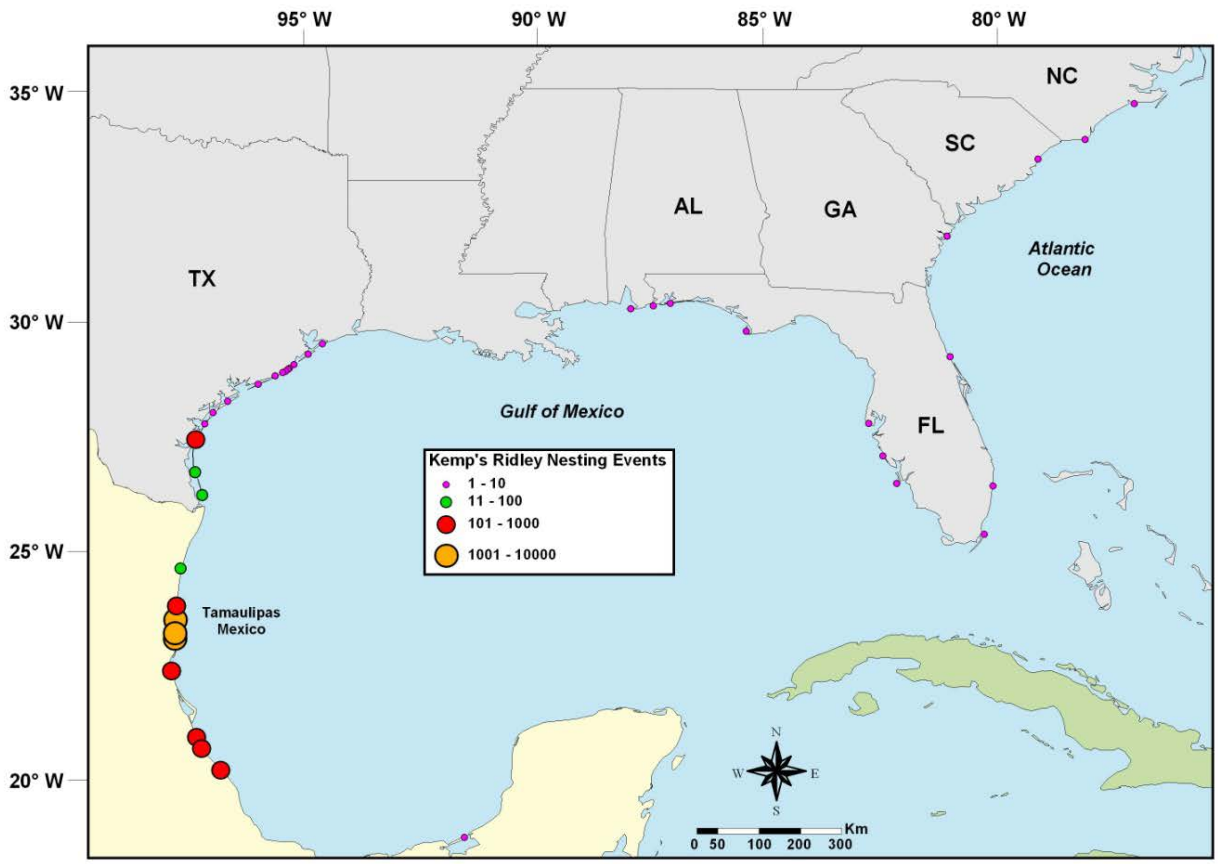

Figure 3-1. Kemp's ridley nesting beaches (source: NMFS *et al.* 2011).

During the late 1940s, tens of thousands of Kemp's ridley nested near Rancho Nuevo, Mexico (Hildebrand 1963). Numbers dramatically declined between the late-1940s and the mid-1980s. The total number of nests per nesting season at Rancho Nuevo was below 1,000 throughout the 1980s, but began to increase in the 1990s (Heppell *et al.* 2005). By 2009, monitored beaches in

Mexico produced 21,144 Kemp's nests, of which the 18.6-mile Rancho Nuevo coastline accounted for 16,273 nests (77 percent) (USFWS 2010a). In 2011, the total number of Kemp's ridley nests counted on Mexico beaches was 20,570, with the Rancho Nuevo beach contributing 81 percent, or about 16,600 nests (Burchfield and Peña 2011). Surveys of U.S. beaches in 2010 and 2011 identified 153 and 199 Kemp's ridley nests, respectively, primarily in Texas (A.M. Lauritsen, USFWS, 2017 personal communication). The increase in nesting from the low in the mid-1980s is attributed to full protection of nesting females and their nests in Mexico, requirements for Turtle Excluder Devices (TEDs) on shrimp trawls in both U.S. and Mexico waters of the Gulf, and decreased shrimping effort (NMFS *et al*. 2011, Heppell *et al*. 2005).

Gallaway *et al.* (2016) developed a stock assessment model to estimate Kemp's ridley population size and age structure based upon annual nesting data and assumptions/inferences about various demographic parameters (e.g., remigration interval, sex ratios, nests per female, juvenile mortality, etc.). The estimated population size for 2012 was 152,357 female turtles of age 2 and older (ages 2+), with a standard deviation of 25,015, of which 28,113 were ages 9+, which represents potential nesting individuals in the 2010, 2011, and 2012 nesting seasons (Gallaway *et al.* 2016: Table 2). The Turtle Expert Working Group (1998, 2000) estimated that females constitute 76 percent of the Kemp's ridley total population (a female:male sex ratio of 3.17:1); therefore, the total 2012 age 2+ population was about 152,357 ÷ 0.76 = 200,470 turtles. The annual number of hatchlings may exceed the age 2+ population size in some years, but mortality during the first two years is high. In 2009, over 1 million hatchlings were released from the three primary nesting beaches in Mexico, but the number released dropped to 519,273 in the 2014 nesting season (NMFS and USFWS 2015: Table 1).

3.1.4. Conservation Needs of Kemp's Ridley Sea Turtle

Representatives for the two Services and for the three principal conservation agencies of Mexico signed the "Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)" in 2011 (NMFS *et al.* 2011). The Plan's basic demographic recovery goal is to maintain over a 6-year period an annual average population of at least 40,000 nesting females, as estimated by nest counts and clutch frequency per female per season. During a nesting year, adult females lay an average of 2.5 nests; therefore, 40,000 nesting females represents a count of about 100,000 nests. The average remigration interval (time between nesting seasons for an individual adult female) is 2 years; therefore, 40,000 nesting females each year represents a total adult female population of at least 80,000 turtles.

The stock assessment model of Gallaway *et al.* (2016) estimated the size of the adult female population in 2012 as 28,113 turtles, or about 35 percent of the level the population must exceed for 6 years to achieve the demographic recovery goal. A trend of steadily increasing annual nest numbers (the primary measure for population growth) abruptly halted after 2009, and the species is highly unlikely to meet demographic recovery goals by 2024 (forecast based on the earlier trend) unless survival rates substantially improve (NMFS and USFWS 2015).

The majority of Kemp's ridley nesting occurs on the beaches near Rancho Nuevo, Mexico, which are relatively undeveloped. Other nesting beaches in Mexico are closer to cities and more vulnerable to human disturbance and habitat alteration. In the U.S., most nesting occurs on protected public lands in south Texas.

Overutilization of eggs in Mexico was a factor in the decline of the Kemp's ridley, but extensive protection measures along all of the main nesting beaches in Mexico have eliminated this threat. The Services identify fisheries interactions (e.g., bycatch mortality), climate change, marine debris, dredging in near-shore areas, contaminants, boat collisions, and other factors in in the marine environment as the principal ongoing threats to the species (NMFS and USFWS 2015).

3.2. Environmental Baseline for Kemp's Ridley Sea Turtle

This section is an analysis of the effects of past and ongoing human and natural factors leading to the present status of the kemp's ridley sea turtle, its habitat, and ecosystem within the Action Area. Ordinarily, the environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. However, the emergency response action of this consultation is concluded. We do not attempt to analyze the status of the species at the time the emergency and the Action began in April 2010. Instead, this section summarizes best available data about the present status of the species in the Action Area, which reflects the effects of the oil spill, response activities, and other relevant factors. We discuss the relative contribution of the Action to the species' present status in the "Effects of the Action" section, which follows this "Baseline" section.

3.2.1. Action Area Numbers, Reproduction, and Distribution of Kemp's Ridley Sea Turtle

A few Kemp's ridley sea turtles nest in portions of the Action area, primarily Alabama and Florida, but not necessarily every year. The number of Kemp's ridley nests documented on Alabama and Florida Panhandle beaches from 2003 through 2009 ranged from 0–11 nests, with an average of 5 nests (A.M. Lauritsen, USFWS, 2017, personal communication). During the 2010 nesting season, surveyors identified 1 Kemp's ridley nest in Alabama and 6 in Florida (A.M. Lauritsen, USFWS, 2017, personal communication). The Coast Guard reports the locations of 4 and 5 Kemp's ridley nests in 2011 and 2012, respectively, within the Florida portion of the Action Area.

At the western end of the Action Area, Seney and Landry (2008) documented 9 Kemp's ridley nests near Galveston, Texas, in 2006. We have no records of Kemp's ridley nesting in Louisiana. We have one record of a single nest on East Ship Island, Mississippi, laid in June 2012 (USCG BA: p. 154).

Although the Action Area supports a tiny fraction of Kemp's ridley nesting activity range wide, the species figured prominently in the offshore effects of the DWH oil spill on sea turtles. Among the 1,146 sea turtles found stranded or captured (both dead and alive) during wildlife search and rescue operations from April 26–October 20, 2010, Kemp's ridley sea turtles accounted for about 61% of all live turtles recovered, and about 79% of all dead turtles recovered (NMFS 2014: Table 9). Relative to other sea turtle species in the Action Area, Kemp's ridley populations are much smaller, yet recoveries during the DWH oil spill response were much higher.

DHW Oil Spill Injury Assessment

In the Programmatic Damage Assessment and Restoration Plan (PDARP), the Deepwater Horizon Natural Resource Damage Assessment Trustees (DWH Trustees) (2016: chapter 4.8.5) estimated that the spill killed up to 86,500 small juvenile Kemp's ridley turtles and up to 3,100 large juveniles/adults, mostly in the marine environment. The DWH Trustees believe that spill response activities in marine areas (e.g., dredging to construct berms, collisions with response vessels, oil skimming and burning) likely killed hundreds of sea turtles, although the Trustees lacked data to estimate numbers by species. The Trustees attribute the loss of about 125 Kemp's ridley hatchlings specifically to spill response activities (DWH Trustees 2016: Table 4.8-7).

The Trustees also concluded that the spill caused a decrease in reproduction for Kemps ridley turtles in the species' primary nesting areas, which are outside the Action Area. They estimated "unrealized" production of 65,000–95,000 hatchlings by breeding Kemp's ridley turtles that the DWH oil spill killed. As we noted in section 3.1.4, Kemp's ridley nesting activity abruptly and substantially declined in 2010. However, the authors of the Services' 2015 status review noted that the timing of Kemp's ridley mating is late-March through mid-April, which preceded the start of the spill on April 20, 2010, and suggested that more plausible explanations of the drop in 2010 nest numbers were unrelated to the spill (NMFS and USFWS 2015: p. 26). Regardless of the causes of the 2010 Kemp's ridley nesting decline, Caillouet (2011) expressed the view that the DWH spill may have lasting effects on the species' population dynamics, depending the life stages exposed to oil and dispersants used in the spill response.

3.2.2. Action Area Conservation Needs of Kemp's Ridley Sea Turtle

Because the Action Area supports a very small contribution to the range-wide nesting activity of the Kemp's ridley, but the species occurs regularly in its Gulf waters, the species' primary conservation needs in the Action Area involve improving juvenile and adult survival in the marine environment. We discuss threats to sea turtle nesting in the Action Area and strategies to address these threats in section 2.2.2 relative to loggerhead sea turtles, and this discussion applies generally to the Kemp's ridley as well. However, adult female Kemp's ridley generally nest during daylight hours; therefore, the threat of artificial lighting on beaches is a lesser concern, but human activity on beaches is a greater concern.

The Services' recent status review summarizes data about various sources of mortality in the marine environment, including fishery interactions, channel dredging operations, contaminants, boat collisions, marine debris entanglement, and other factors (NMFS and USFWS 2015). These sources of mortality are outside the scope of this BO, which addresses effects to sea turtles in their terrestrial (nesting) habitats.

3.3. Effects of the Action on Kemp's Ridley Sea Turtle

This section analyzes the direct and indirect effects of the Action on the Kemp's Ridley Sea Turtle, which includes the direct and indirect effects of interrelated and interdependent actions.

Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

Sea turtles are under USFWS jurisdiction only while on land; therefore, the effects of the Action on sea turtles that we consider in this BO are those caused by spill response activities conducted on turtle-nesting beaches. All seven of the categories of terrestrial response activities described in section 1.2 occurred to some extent on beaches (Oil Collection, Barriers, Flushing and Washing, Habitat Modification, Hazing and Other Direct Measures to Protect Wildlife, Patrolling and Monitoring, and Support Activities). Among the "Measures to Protect Wildlife," the Action involved relocating Kemp's ridley nests in 2010 from Alabama and Florida beaches of the Action Area to the Florida Atlantic coast.

3.3.1. Response Pathways

The pathways between Action-caused stressors and the responses of individual Kemp's ridley sea turtles are the same as those described in section 2.3.1 for the loggerhead sea turtle. Responses to human disturbance, driving on the beach during clean-up operations, and barriers to nesting are comparable between Kemp's and loggerheads. As primarily day-time nesters, Kemp's are less likely to avoid beaches with artificial lighting, but more likely to abandon nesting attempts due to day-time human disturbance. The spill response action of relocating sea turtle nests from Alabama and Florida Panhandle beaches, also described in section 2.3.1, included five Kemp's ridley nests.

3.3.2. Estimation of Effects

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon the USCG BA and on the DWH Trustees (2016) damage assessment as our data sources. Our previous description of the "USCG Take Score Model" (TSM) in section 2.3.2 for the loggerhead sea turtle also applies to the USCG estimation of effects to the Kemp's ridley sea turtle.

<u>Take Score Model Results</u>

The USCG excluded shoreline segments of the Action Area in Texas and Louisiana from the Kemp's ridley terrestrial TSM analyses. The most recent documented Kemp's ridley nesting in the Texas portion of the Action Area was in 2006 (Seney and Landry 2008), before the spill, and no nesting records are known for Louisiana. The USCG reports in the BA one documented Kemp's ridley nest on East Ship Island, Mississippi, discovered in June 2012. This report represents the only record of the species' nesting in Mississippi of which we are aware. Spill response operations that may have affected sea turtles on East Ship Island occurred on July 3, 2010, 2 years earlier (USCG BA: p. 154). Due to the extreme rarity of Kemp's ridley nesting in Mississippi, the USCG considered the probability of adverse effects resulting from beach clean-up operations discountable. The USFWS agrees.

Surveyors documented a single Kemp's ridley nest on Alabama beaches in 2010 before the spill occurred (see "Nest Relocation" discussion below). The USFWS is unaware of any evidence of

Kemp’s ridley nesting in Alabama thereafter in 2010. Kemp’s ridley nesting occurs from April through July. Spill response activity on Alabama beaches from May–June, 2010, consisted entirely of patrol and monitoring. During the daytime hours of a week in mid-July 2010, large numbers of response personnel worked various Alabama shoreline segments. However, absent evidence of further Kemp’s ridley nesting that year, the Coast Guard considered the potential for take of Kemp’s ridley resulting from these manual clean-up operations very low. The USFWS agrees.

Responders relocated five Kemp’s ridley nests from beaches in the Florida portion of the Action Area in 2010 (see “Nest Relocation” discussion below). Two known Kemp’s ridley nests of the 2010 nesting season in Florida were not relocated. Results of the USCG TSM analysis suggest that the scale and nature of clean-up operations on August 15, 2010, in one shoreline segment located in the Fort Pickens Unit of Gulf Island National Seashore, would have harmed Kemp’s ridley nests, if present.

The USCG BA did not estimate actual numbers of Kemp’s ridley turtles affected by the spill response activities corresponding to the TSM results summarized above. The DWH Trustees (2016: Table 4.8-7) attribute the loss of 125 Kemp’s ridley hatchlings specifically to spill response activities. This loss was included in the injury quantification of the damage assessment.

Nest Relocation

The relocation of five Kemp’s ridley nests out of the Action Area in 2010 included 483 eggs, of which 125 hatched and were released on the Florida Atlantic coast (Provancha and Mukherjee 2011). As we discussed for the loggerhead sea turtle in section 2.3.2, hatchling survival in the Gulf before August 2010 was highly unlikely, due to the amount and extent of the spill and the level of potentially injurious spill-response activity. As for the loggerhead, it is unknown whether any Kemp’s ridley hatchlings released into the Atlantic that survive to adulthood will return to Gulf waters and beaches for breeding. The species nests occasionally on a few beaches of Florida’s Atlantic coast. At the time the Services suspended nest relocations in mid-August 2010, only two known Kemp’s ridley nests remained in the Action Area. It is our judgement at this time that the relocation of the five Kemp’s ridley nests very slightly reduced the overall impact of the spill on the species.

3.4. Conclusion for Kemp’s Ridley Sea Turtle

In this section, we summarize and interpret the findings of the previous sections for the Kemp’s ridley sea turtle (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

“*Jeopardize the continued existence*” means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Status

Our description of the status of the Kemp's ridley sea turtle in section 3.1 notes that the vast majority of Kemp's ridley nesting occurs on beaches of the western Gulf of Mexico, with the greatest number of nests in Tamaulipas, Mexico. Populations plummeted in the mid-20th century, but began a steady increase in the late 1980s. A recent stock assessment model estimated the 2012 total age 2+ population at about 200,470 turtles, of which 28,113 were adult females. The basic demographic goal of the Kemp's ridley Recovery Plan is to sustain for at least 6 years an annual average population of at least 40,000 nesting females. The annual number of hatchlings may exceed the age 2+ population size in some years, but mortality during the first two years is high. In 2009, over 1 million hatchlings were released from the three primary nesting beaches in Mexico, but the number released dropped to 519,273 in the 2014 nesting season.

Baseline

In section 3.2 (Environmental Baseline), we note that a few Kemp's ridley sea turtles nest in portions of the Action area, primarily Alabama and Florida, but not necessarily every year. The number of Kemp's ridley nests documented on Alabama and Florida Panhandle beaches from 2003 through 2009 ranged from 0–11 nests, with an average of 5 nests. Although the Action Area supports a tiny fraction of Kemp's ridley nesting activity range wide, the species figured prominently in the offshore effects of the DWH oil spill on sea turtles. Among the 1,146 sea turtles found stranded or captured (both dead and alive) during wildlife search and rescue operations from April 26–October 20, 2010, Kemp's ridley sea turtles accounted for about 61% of all live turtles recovered, and about 79% of all dead turtles recovered. Relative to other sea turtle species in the Action Area, Kemp's ridley populations are much smaller, yet recoveries during the DWH oil spill response were much higher.

Coastal development range-wide and in the Action Area has introduced a variety of difficulties and obstacles for adult Kemp's ridley females nesting on beaches, for safe incubation of nests, and for the survival of hatchlings emerging from nests. The Action Area includes about 4,400 miles of mainland and barrier island shoreline, of which 367 miles are sandy beaches that are managed generally in a manner that benefits sea turtles. Because the Action Area supports a very small contribution to the range-wide nesting activity of the Kemp's ridley, but the species occurs regularly in its Gulf waters, the species' primary conservation needs in the Action Area involve improving juvenile and adult survival in the marine environment.

Effects

Our analysis of the effects of the Action in section 3.3 combines information from the Take Score Model (TSM) results of the USCG Biological Assessment and the DWH Trustees damage assessment. The DWH Trustees attribute the loss of 125 Kemp's ridley hatchlings to spill response activities, specifically to the 125 hatchlings released on the Florida Atlantic Coast from the 5 Kemp's ridley nests relocated from the Action Area in 2010. Whether these hatchlings will recruit at normal rates to the Kemp's ridley breeding population, and if so, to which nesting subpopulation, is unknown. Two known Kemp's ridley nests of the 2010 nesting season in Florida were not relocated. Results of the USCG TSM analysis suggest that the scale and nature of clean-up operations on August 15, 2010, in one shoreline segment located in the Fort Pickens Unit of Gulf Island National Seashore, would have harmed Kemp's ridley nests, if present.

The Action temporarily increased threats to Kemp's ridley nesting success by introducing barriers and disturbance that would not otherwise have occurred, but it also removed oil that could deter nesting and harm turtles. BMPs applicable to turtle nesting beaches contributed to limiting the effects of most of these activities to behavioral responses, if Kemp's ridleys were present.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

The USFWS shares consultation responsibilities for sea turtles with the NMFS. As we noted on page 1 of the introduction, this BO considers effects of the Action to sea turtles in the terrestrial context, and the NMFS BO considers effects in the marine context. After reviewing the current status of the species, the environmental baseline for the Action Area, and the effects of the Action in the terrestrial environment, it is the USFWS biological opinion that the Action did not jeopardize the continued existence of the Kemp's ridley sea turtle.

4. GREEN SEA TURTLE

4.1. Status of Green Sea Turtle

This section summarizes best available data about the biology and current condition of the green sea turtle (*Chelonia mydas*), North Atlantic Distinct Population Segment (DPS), that are relevant to formulating an opinion about the Action. The green sea turtle has a worldwide distribution in tropical and subtropical waters. The Services classified the species as threatened range-wide in 1978, except for the Florida and Mexican Pacific coast breeding populations, which we classified as endangered (43 FR 32800). The Services currently recognize eleven DPSs of the species, and published a final rule to classify three of these as endangered and eight as threatened on April 6, 2016 (81 FR 20058-20090). The Action affects only the North Atlantic DPS, which is classified as threatened.

4.1.1. Description of Green Sea Turtle

The green sea turtle grows to a maximum length of about 4 feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. The carapace is smooth and colored gray, green, brown, and black. Hatchlings are black on top and white on the bottom. Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae.

4.1.2. Life History of Green Sea Turtle

Except when migrating or nesting, green sea turtles generally inhabit reefs, bays, and inlets. The green turtle is attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with minimal disturbance are required for nesting.

The nesting season varies with the locality. In the Southeastern U.S., it is roughly June through September. Adult females nest at night and at 2-, 3-, or 4-year intervals, but occasionally in successive years (NMFS and USFWS 1991). A female may lay as a many as nine clutches within a nesting season (overall average is 3.3 nests per season) at about 13-day intervals (Hirth 1997). Clutch size varies from 75–200 eggs, with an average clutch size of 136 eggs reported for Florida nests (Witherington and Ehrhart 1989). Incubation ranges from about 45–75 days, depending on incubation temperatures. Hatchlings generally emerge at night. Age at sexual maturity is 20–50 years (Hirth 1997).

4.1.3. Numbers, Reproduction, and Distribution of Green Sea Turtle

The range of the North Atlantic DPS spans the full width of the Atlantic Ocean between latitudes 48°N and 19°N, with additional area south of 19°N in the Caribbean Basin. In the Caribbean, the North Atlantic DPS encompasses the Greater Antilles (including Puerto Rico) and Central America, and the South Atlantic DPS encompasses the Lesser Antilles (including all islands of the U.S. Virgin Islands) and South America.

The Services estimate that the North Atlantic DPS population consists of 167,424 adult females nesting at 73 sites (Seminoff et al. 2015). More than 100,000 females nest at Tortuguero, Costa Rica, and more than 10,000 females nest at Quintana Roo, Mexico. Nesting data indicate long-term increases at all major nesting sites. Genetic substructure within the DPS is not evident, and turtles from multiple nesting beaches share common foraging areas. Nesting is geographically widespread and occurs at a diversity of mainland and island sites.

Within the U.S., North Atlantic DPS green turtles nest in small numbers in Puerto Rico, and in larger numbers in Florida. Nesting in Florida occurs on beaches throughout the state, except the Big Bend area of the Gulf Coast, and is concentrated along the Atlantic coast in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties (NMFS and USFWS 1991).

Green turtle nesting in Florida is on a generally increasing trend. The annual mean number of nests was 5,055 from 2001–2005 (Meylan *et al.* 2006), and 18,302 from 2011–2016 (http://myfwc.com/media/4083100/greenturtlenestingdata11-15.pdf; for 2011–2015, and http://myfwc.com/research/wildlife/sea-turtles/nesting/statewide/) for 2016, although the statewide total for 2016 was only 5,393 nests.

The steady increase in nesting in Florida over the past several decades is likely due to several factors, including:

- a Florida statute enacted in the early 1970s that prohibited the killing of green turtles in Florida;

- ESA listing in 1978, which afforded complete protection to eggs, juveniles, and adults in all U.S. lands and waters;
- Florida's 1994 constitutional amendment banning large fishing nets in State waters;
- the likelihood that most adult green turtles breeding in Florida also forage within Florida waters; and
- the species' addition to Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which stopped legal international trade of green turtles and green turtle products (NMFS and USFWS 2007).

4.1.4. Conservation Needs of Green Sea Turtle

The Services' 1991 Recovery Plan for the population of the green turtle in U.S. Atlantic waters (NMFS and USFWS 1991) predates the Services' 2016 reclassification of the species as eleven Distinct Population Segments (DPS) (81 FR 20058-20090). When the Recovery Plan was approved, Florida populations of the green turtle were classified as endangered. The 2016 final rule determined that the Florida populations were part of the larger North Atlantic DPS that warranted classification as threatened.

Past and ongoing threats contributing the North Atlantic DPS's status as a threatened taxon that the Services cited in the 2016 final rule include:

- coastal development, armoring, erosion, lighting, beach driving, and other human activities that degrade nesting habitats and reduce nesting success;
- pollution and other impacts to foraging habitats;
- harvest of green turtles and their eggs, which is legal in some countries and occurs illegally in many areas;
- the chronic and often lethal disease Fibropapillomatosis;
- egg and hatchling predation;
- mortality as fisheries bycatch;
- vessel strikes;
- marine debris entanglement; and
- sea level rise that alters nesting habitats and warming temperatures that may addle eggs or skew temperature-determined sex ratios.

Ongoing conservation efforts to address these threats include bycatch reduction measures, nesting beach acquisitions, and nest protection programs to reduce harvest and predation. These efforts have likely contributed to population growth within the DPS in recent years, but have not reduced the threats listed above to a degree that warrants removing the protections afforded as a threatened taxon under the ESA.

4.2. Environmental Baseline for Green Sea Turtle

This section is an analysis of the effects of past and ongoing human and natural factors leading to the present status of the green sea turtle, its habitat, and ecosystem within the Action Area. Ordinarily, the environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

However, the emergency response action of this consultation is concluded. We do not attempt to analyze the status of the species at the time the emergency and the Action began in April 2010. Instead, this section summarizes best available data about the present status of the species in the Action Area, which reflects the effects of the oil spill, response activities, and other relevant factors. We discuss the relative contribution of the Action to the species' present status in the "Effects of the Action" section, which follows this "Baseline" section.

4.2.1. Action Area Numbers, Reproduction, and Distribution of Green Sea Turtle

Small numbers of green sea turtles nest in the Action Area, primarily on beaches of the Florida Panahandle, and occasionally in Alabama. We could find no recent nesting records for green turtles in the Texas, Louisiana, and Mississippi portions of the Action Area.

During the course of the Action, a single nest in Alabama was confirmed as a green turtle nest in August 2013 (USCG BA: p. 148). Green turtles nest in all seven coastal counties of the Florida Panhandle, where the annual average number of nests from 2010–2016 was 23 (range 9–58) (USCG BA; p. 149 for 2010; http://myfwc.com/media/4083100/greenturtlenestingdata11-15.pdf for 2011–2015, and http://myfwc.com/research/wildlife/sea-turtles/nesting/statewide/ for 2016).

Although the Action Area supports a tiny fraction of North Atlantic DPS green turtle nesting activity, the species figured prominently in the offshore effects of the DWH oil spill on sea turtles. Among the 1,146 sea turtles found stranded or captured (both dead and alive) during wildlife search and rescue operations from April 26–October 20, 2010, green turtles were the second-most abundant (after Kemp's ridley), accounting for about 18% of the turtles recovered (NMFS 2014: Table 9).

4.2.2. Action Area Conservation Needs of Green Sea Turtle

The Action Area supports a minor contribution to nesting for the North Atlantic DPS of the green sea turtle. Producing an average of 23 nests annually in recent years (see section 4.2.1), and assuming an average number of clutches per female of 3.3 nests (Hirth 1997), the Florida Panhandle may provide nesting habitat for about 7 females per year. However, broadly dispersed nesting contributes to the species' resilience and supports the overall population growth that the North Atlantic DPS has experienced in recent decades (81 FR 20058-20090).

We discuss threats to sea turtle nesting in the Action Area and strategies to address these threats in section 2.2.2 relative to loggerhead sea turtles, and this discussion applies generally to the green turtle as well. These threats include coastal development, armoring, erosion, lighting, beach driving, and other human activities that degrade nesting habitats and reduce nesting success. Green turtles nest on the same beaches in the Florida Panhandle as loggerheads, and conservation efforts to protect and enhance nesting habitat conditions for sea turtles in these areas will benefit both species.

The Services' 2016 final rule classifying eleven DPS of the green turtle summarizes data about various sources of mortality in the marine environment, including fishery interactions, channel dredging operations, contaminants, boat collisions, marine debris entanglement, and other factors

(81 FR 20058-20090). These sources of mortality are outside the scope of this BO, which addresses effects to sea turtles in their terrestrial (nesting) habitats.

4.3. Effects of the Action on Green Sea Turtle

This section analyzes the direct and indirect effects of the Action on the Green Sea Turtle, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

Sea turtles are under USFWS jurisdiction only while on land; therefore, the effects of the Action on sea turtles that we consider in this BO are those caused by spill response activities conducted on turtle-nesting beaches. All seven of the categories of terrestrial response activities described in section 1.2 occurred to some extent on beaches (Oil Collection, Barriers, Flushing and Washing, Habitat Modification, Hazing and Other Direct Measures to Protect Wildlife, Patrolling and Monitoring, and Support Activities). Among the "Measures to Protect Wildlife," the Action involved relocating green turtle nests in 2010 from Alabama and Florida beaches of the Action Area to the Florida Atlantic coast.

4.3.1. Response Pathways

The pathways between Action-caused stressors and the responses of individual green sea turtles are the same as those described in section 2.3.1 for the loggerhead sea turtle. Responses to human disturbance, driving on the beach during clean-up operations, and barriers to nesting are comparable between greens and loggerheads. The spill response action of relocating sea turtle nests from Alabama and Florida Panhandle beaches, also described in section 2.3.1, included four green turtle nests.

4.3.2. Estimation of Effects

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon the USCG BA and on the DWH Trustees (2016) damage assessment as our data sources. Our previous description of the "USCG Take Score Model" (TSM) in section 2.3.2 for the loggerhead sea turtle also applies to the USCG estimation of effects to the green sea turtle.

Take Score Model Results

The USCG excluded shoreline segments of the Action Area in Texas, Louisiana, and Mississippi from the green turtle terrestrial TSM analyses, because the species is not known to nest in these areas in recent decades. Relative to the single record of a green turtle nest in Alabama in 2013, the USCG noted that no spill response actions occurred in that segment during 2013.

Responders relocated four green nests from beaches in the Florida portion of the Action Area in 2010 (see "Nest Relocation" discussion below). Another 10 known green turtle nests of the 2010 nesting season in Florida were not relocated (USCG BA; p. 149).

The USCG estimated that 87 segment days of activity in 45 separate segments could have caused sub-lethal impacts to green turtles in Florida during August 2010. In 39 separate segments, 9 segment days in August 2010, and 33 segment days in August 2011, could have caused lethal impacts. These operations involved mechanical beach clean-up operations at night that could have harmed or disoriented hatchlings emerging from nests laid 45-75 days earlier. While these operations covered a large area, responders completed the activity in all but a few segments in one night. The USCG believes that the use of multiple wildlife spotters, as specified in the BMPs applicable to these operations, most likely prevented any impacts to hatchlings. For further details about the results of the TSM for green turtles, please refer to section 6.4.2.3 of the BA.

The USCG BA did not estimate actual numbers of green turtles affected by the spill response activities corresponding to the TSM results summarized above. The DWH Trustees (2016: Table 4.8-7) attribute the loss of 455 green turtle hatchlings specifically to spill response activities. This loss was included in the injury quantification of the damage assessment.

Nest Relocation

The relocation of four green turtle nests out of the Action Area in 2010 included 580 eggs, of which 345 hatched and were released on the Florida Atlantic coast (Provancha and Mukherjee 2011). As we discussed for the loggerhead sea turtle in section 2.3.2, hatchling survival in the Gulf before August 2010 was highly unlikely, due to the amount and extent of the spill and the level of potentially injurious spill-response activity. As for the loggerhead, it is unknown whether any green turtle hatchlings released into the Atlantic that survive to adulthood will return to Gulf waters and beaches for breeding. Most green turtle nesting in Florida occurs on the beaches of Florida's Atlantic coast. When the Services suspended nest relocations in mid-August 2010, ten known green turtle nests remained in the Action Area. It is our judgement at this time that the relocation of the four green turtle nests very slightly reduced the overall impact of the spill on the North Atlantic DPS.

4.4. Conclusion for Green Sea Turtle

In this section, we summarize and interpret the findings of the previous sections for the green sea turtle (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Status

Our description of the status of the green sea turtle North Atlantic DPS in section 4.1 notes that the most recent population estimate is 167,424 adult females nesting at 73 sites. More than

100,000 females nest in Costa Rica, and more than 10,000 females nest in Quintana Roo, Mexico. Nesting data indicate long-term increases at all major nesting sites.

Baseline

In section 4.2 (Environmental Baseline), we note that small numbers of green sea turtles nest in the Action Area, primarily on beaches of the Florida Panahandle. During the course of the Action, a single nest in Alabama was confirmed as a green turtle nest in August 2013. Green turtles nest in all seven coastal counties of the Florida Panhandle, where the annual average number of nests from 2010–2016 was 23 (range 9–58). Although the Action Area supports a tiny fraction of North Atlantic DPS green turtle nesting activity, the species figured prominently in the offshore effects of the DWH oil spill on sea turtles. Among the 1,146 sea turtles found stranded or captured (both dead and alive) during wildlife search and rescue operations from April 26–October 20, 2010, green turtles were the second-most abundant (after Kemp's ridley), accounting for about 18% of the turtles recovered.

Coastal development range-wide and in the Action Area has introduced a variety of difficulties and obstacles for adult green females nesting on beaches, for safe incubation of nests, and for the survival of hatchlings emerging from nests. The Action Area includes about 4,400 miles of mainland and barrier island shoreline, of which 367 miles are sandy beaches that are managed generally in a manner that benefits sea turtles. Recovery goals in the terrestrial context focus on removing barriers to nesting, and reducing the impacts of beach nourishment projects, predation, artificial lighting, and other factors on nesting success.

Effects

Our analysis of the effects of the Action in section 4.3 combines information from the Take Score Model results of the USCG Biological Assessment and the DWH Trustees damage assessment. The DWH Trustees attribute the loss of 455 green turtle hatchlings specifically to spill response activities. This loss includes the release of 345 hatchlings on the Florida Atlantic Coast from four green turtle nests relocated from the Action Area in 2010. Whether these hatchlings will recruit at normal rates to the North Atlantic DPS breeding population, and if so, to which nesting subpopulation, is unknown.

Oil clean-up operations account for the remaining green turtle losses in the Trustees' estimate. The USCG reports that 87 segment days of activity in 45 separate segments could have caused sub-lethal impacts to green turtles in Florida during August 2010. In 39 separate segments, 9 segment days in August 2010, and 33 segment days in August 2011, could have caused lethal impacts. These operations involved mechanical beach clean-up operations at night that could have harmed or disoriented hatchlings emerging from nests laid 45-75 days earlier.

The Action temporarily increased threats to green turtle nesting success by introducing barriers and disturbance that would not otherwise have occurred, but it also removed oil that could deter nesting and harm turtles. The USCG believes that BMPs applicable to operations on turtle nesting beaches most likely prevented most impacts to green turtles.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

The USFWS shares consultation responsibilities for sea turtles with the NMFS. As we noted on page 1 of the introduction, this BO considers effects of the Action to sea turtles in the terrestrial context, and the NMFS BO considers effects in the marine context. After reviewing the current status of the species, the environmental baseline for the Action Area, and the effects of the Action in the terrestrial environment, it is the USFWS biological opinion that the Action did not jeopardize the continued existence of the green sea turtle.

5. LEATHERBACK SEA TURTLE

5.1. Status of Leatherback Sea Turtle

This section summarizes best available data about the biology and current condition of the leatherback sea turtle (*Dermochelys coriacea*) that are relevant to formulating an opinion about the Action. The Services published the decision to list the leatherback sea turtle as endangered throughout its range on June 2, 1970 (35 FR 8491). The leatherback occurs in Atlantic, Pacific, and Indian Oceans.

5.1.1. Description of Leatherback Sea Turtle

The leatherback is the largest, deepest diving, most migratory, and most wide ranging of all sea turtles. Adults may grow to 4–8 feet long and weigh 500–2000 pounds. The shell is a mosaic of small bones covered by firm, rubbery skin with seven longitudinal ridges. The skin is predominantly black with varying degrees of pale spotting. The paddle-like clawless limbs are black with white margins and pale spotting. Various physiological and anatomical adaptations allow the leatherback to exploit waters far colder than other sea turtle species (Frair *et al.* 1972, Greer *et al.* 1973).

5.1.2. Life History of Leatherback Sea Turtle

The leatherback is the most pelagic [open ocean dwelling] of the sea turtles. Jellyfish are the main staple of the leatherback diet, but the species feeds also on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed.

Age at sexual maturity is unclear. Researchers using different methods report a range from 2–29 years, with most estimates falling between 12–16 years (NMFS and USFWS 2013: p. 16). For nesting, adult females require sandy beaches backed with vegetation. Both nesting and hatchling emergence occurs at night, although daylight nesting does occur.

Eckert *et al.* (2012) compiled available biological data on the leatherback, which vary regionally across the species' trans-global range. We cite data from Florida (Stewart 2007; Stewart and

Johnson 2006), which is of greatest relevance to this BO. The nesting season is from March–June, with peak activity in May. Estimated clutch frequency per season is 4.2. The average inter-nesting interval is 10.1 days. Average clutch size is 73 eggs (plus about 25 unfertilized yolkless eggs), and average incubation duration is 66.9 days. Eckert *et al.* (2012) do not cite remigration data for Florida, but elsewhere in the Western Atlantic, the observed number of years between consecutive nesting seasons ranged from 1–5 years, with most studies showing 2–3 years.

5.1.3. Numbers, Reproduction, and Distribution of Leatherback Sea Turtle

The leatherback turtle occurs in tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans. It is found in small numbers in waters as far north as British Columbia, Newfoundland, and the United Kingdom, and as far south as Australia, the Cape of Good Hope (South Africa), and Argentina. Characterizing the present status of leatherback populations throughout this global range in great detail is not necessary for this BO. Eckert *et al.* (2012) and the Services' 2013 status review (NMFS and USFWS 2013) provide the most recent synthesis of the species' numbers, reproduction, and distribution range-wide. We summarize key points from these sources in this section, but please refer to these sources for additional details.

Pacific leatherback populations have dramatically declined in recent decades. The population nesting on Mexico's Pacific beaches was considered the species' largest, supporting more than half the worldwide population. Since the 1980's, it has lost more than 90 percent of its breeding females. Similarly, nesting numbers in Pacific Costa Rica have plummeted by 95 percent in the past 3 decades. In the western Pacific, 28 sites in Papua Indonesia, Papua New Guinea, the Solomon Islands, and Vanuatu collectively host about 5,000–9,200 nests annually, which represents a gradual decline since the 1980s. The Philippines, Japan, and Vietnam either no longer support leatherback nesting or report that nesting is very rare.

Atlantic populations appear generally stable or increasing. Researchers describe the Atlantic region's largest colony in French Guiana as slightly increasing over the past three decades, hosting about 5,000–63,000 nests during the years 1967–2005. However, some nesting colonies, including many in the eastern Caribbean, have experienced dramatic declines. The beaches of Gabon in West Africa supported an estimated 30,000 nests during the 1999–2000 nesting season. The Turtle Expert Working Group (2007: Table 19) estimated a population size of 34,000–95,000 adult leatherbacks (males and females) in the North Atlantic system, including the West Africa stock. In the U.S., areas that support more than 100 nests annually include the Atlantic coast of Florida, Sandy Point in the U.S. Virgin Islands, Puerto Rico's Islands of Culebra and Vieques, and Puerto Rico itself.

In the Indian Ocean and Southeast Asia region, only Sri Lanka and India's Andaman and Nicobar Islands host more than 100 nesting females per year. Mainland India, Thailand, Myanmar, Bangladesh, Seychelles, Somalia, and Kenya, either no longer support leatherback nesting or report that nesting is very rare. About 50–60 females nest annually in South Africa. Nesting in Australia is limited to the Northern Territory. No nesting has been recorded on the east coast of Australia since 1996, and nesting in Western Australia is unknown.

5.1.4. Conservation Needs of Leatherback Sea Turtle

As noted in section 5.1, the Services classify the leatherback as an endangered species throughout its range worldwide. In the Services' most recent 5-year status review for the species, we indicated that application of the Distinct Population Segment policy is possibly warranted, pending further analysis of new data on population structure and distribution (NMFS and USFWS 2013: p. 4). The status review noted also that the 1998 recovery plan for the U.S. Pacific populations, and the 1992 recovery plan for the U.S. Atlantic populations, do not define recovery criteria that correspond to the species' classification as "endangered wherever found." However, the assessment of threats and the strategies to promote recovery outlined in both plans have informed conservation actions for the leatherback turtle within the geographic scope of each plan.

The threats to leatherback populations are comparable to those discussed previously for the loggerhead (section 2.1.4), Kemp's ridely (section 3.1.4), and green sea turtle (section 4.1.4), such as mortality in fisheries bycatch, coastal development, and nest harvest and predation. Ongoing conservation efforts to address these threats include bycatch reduction measures, nesting beach acquisitions, and nest protection programs to reduce harvest and predation. Such efforts have contributed to the stability or limited growth of several Atlantic leatherback populations, but are lacking or ineffective for many Pacific and Indian Ocean populations.

5.2. Environmental Baseline for Leatherback Sea Turtle

This section is an analysis of the effects of past and ongoing human and natural factors leading to the present status of the leatherback sea turtle, its habitat, and ecosystem within the Action Area. Ordinarily, the environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. However, the emergency response action of this consultation is concluded. We do not attempt to analyze the status of the species at the time the emergency and the Action began in April 2010. Instead, this section summarizes best available data about the present status of the species in the Action Area, which reflects the effects of the oil spill, response activities, and other relevant factors. We discuss the relative contribution of the Action to the species' present status in the "Effects of the Action" section, which follows this "Baseline" section.

5.2.1. Action Area Numbers, Reproduction, and Distribution of Leatherback Sea Turtle

Florida is the only state in the continental U.S. where leatherback turtles regularly nest. The statewide average number of nests per year from 2011–2016 was 1,402 (http://myfwc.com/media/4148332/leatherbacknestingdata12-16.pdf). Most of these nests are in St. Lucie, Martin, and Palm Beach counties on the Atlantic coast. Small numbers of leatherback sea turtles nest in the Action Area on beaches of the Florida Panhandle. The TEWG (2007) estimated the size of the Florida adult leatherback stock (males and females) at about 580 turtles. We could find no nesting records for leatherback turtles in the Texas, Louisiana, Mississippi, and Alabama portions of the Action Area.

The number of leatherback nests documented in the Florida Panhandle from 2003–2009 ranged from 0-7 nests per year with an average of 3 nests. No nests were discovered in in 2010. The average number of nests per year from 2011–2016 was again 3, with a range of 0–9 (http://myfwc.com/media/4148332/leatherbacknestingdata12-16.pdf). The mean number of clutches per nesting season for Florida leatherbacks is 4.2; therefore, it is possible that only 1–3 female leatherbacks are nesting in the Panhandle during most years, and none in some years.

Spill responders found no leatherbacks stranded, or captured any leatherbacks, during wildlife search and rescue operations from April 26–October 20, 2010; however, responders sighted leatherbacks on several occasions during these operations (DWH Trustees 2016: p. 4-572). The Trustees relied on these sightings, and findings by the Turtle Expert Working Group (2007) that the northern Gulf of Mexico is important habitat for leatherback migration and foraging, to conclude that leatherbacks were exposed to DWH oil, and that some portion of those exposed likely died.

5.2.2. Action Area Conservation Needs of Leatherback Sea Turtle

The Action Area supports a very small contribution to nesting for the leatherback sea turtle. The Florida Panhandle may provide nesting habitat for about 1–3 females in most years, and none in some years.

We discuss threats to sea turtle nesting in the Action Area and strategies to address these threats in section 2.2.2 relative to loggerhead sea turtles, and this discussion applies generally to the leatherback turtle as well. These threats include coastal development, armoring, erosion, lighting, beach driving, and other human activities that degrade nesting habitats and reduce nesting success. Leatherback turtles nest on the same beaches in the Florida Panhandle as loggerheads, and conservation efforts to protect and enhance nesting habitat conditions for sea turtles in these areas will benefit both species.

NMFS and USFWS (2013), and Eckert *et al.* (2012) summarize data about various sources of mortality in the marine environment, including fishery interactions, channel dredging operations, contaminants, boat collisions, marine debris entanglement, and other factors. These sources of mortality are outside the scope of this BO, which addresses effects to sea turtles in their terrestrial (nesting) habitats.

5.3. Effects of the Action on Leatherback Sea Turtle

This section analyzes the direct and indirect effects of the Action on the leatherback sea turtle, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

Sea turtles are under USFWS jurisdiction only while on land; therefore, the effects of the Action on sea turtles that we consider in this BO are those caused by spill response activities conducted on turtle-nesting beaches. Six of the seven of the categories of terrestrial response activities described in section 1.2 occurred to some extent on beaches (Oil Collection, Barriers, Flushing and Washing, Habitat Modification, Patrolling and Monitoring, and Support Activities). Spill response activities did not include any direct “Measures to Protect Wildlife” for the leatherback. Surveyors did not identify any leatherback nests during the 2010 nesting season; therefore, the Action did not involve relocating leatherback nests from beaches of the Action Area to the Florida Atlantic coast, as for loggerheads, Kemp’s ridleys, and green turtles.

5.3.1. Response Pathways

The pathways between Action-caused stressors and the responses of individual leatherback turtles are the same as those described in section 2.3.1 for the loggerhead sea turtle. Responses to human disturbance, driving on the beach during clean-up operations, and barriers to nesting are comparable between leatherbacks and loggerheads.

5.3.2. Estimation of Effects

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon the USCG BA and on the DWH Trustees (2016) damage assessment as our data sources. Our previous description of the “USCG Take Score Model” (TSM) in section 2.3.2 for the loggerhead sea turtle also applies to the USCG estimation of effects to the leatherback sea turtle.

<u>Take Score Model Results</u>

The USCG excluded shoreline segments of the Action Area in Texas, Louisiana, Mississippi, and Alabama from the leatherback turtle terrestrial TSM analyses, because the species is not known to nest in these areas in recent decades. All TSM analyses involved shoreline segments in Florida.

Florida Panhandle beach surveyors detected no leatherback nests during the 2010 nesting season. The USCG determined that clean-up operations during July 2010 in nine segments along Panama City Beach could have caused behavioral and sub-lethal leatherback responses, if present. Mechanical clean-up operations in six Walton County segments during May 2011, the peak of the leatherback nesting season, could have caused high-behavioral to lethal leatherback responses, if present. However, the single leatherback nest reported for the Panhandle in 2011 was in Franklin County. For further details about the results of the TSM for leatherback turtles, please refer to section 6.4.5.3 of the BA.

The USCG BA did not estimate actual numbers of leatherback turtles affected by the spill response activities corresponding to the TSM results summarized above. The DWH Trustees (2016: section 4.8.5.4.3) were unable to estimate leatherback abundance and exposure to oil and in the Action Area, and did not attribute a quantified injury specifically to spill response activities.

5.4. Conclusion for Leatherback Sea Turtle

In this section, we summarize and interpret the findings of the previous sections for the leatherback sea turtle (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

<u>Status</u>

Our description of the status of the leatherback sea turtle North Atlantic DPS in section 5.1 notes that Pacific Ocean populations have dramatically declined in recent decades, Atlantic Ocean populations appear generally stable or increasing, and Indian Ocean populations are at low levels. The estimated size of the North Atlantic population is 34,000–95,000 adult leatherbacks (males and females), which includes the largest nesting colony in French Guiana and the second-largest colony nesting in Gabon, West Africa. Threats to the species' survival and recovery include mortality in fisheries bycatch, coastal development, and nest harvest and predation.

<u>Baseline</u>

In section 5.2 (Environmental Baseline), we note that small numbers of leatherback sea turtles nest in the Florida-portion of the Action Area. The number of leatherback nests documented in the Florida Panhandle from 2003–2016 ranged from 0-9 nests per year with an average of 3 nests. No nests were discovered in in 2010. It is possible that only 1–3 female leatherbacks are nesting in the Panhandle during most years, and none in some years. Spill responders found no leatherbacks stranded, or captured any leatherbacks, during wildlife search and rescue operations from April 26–October 20, 2010; however, responders sighted leatherbacks on several occasions during these operations.

Coastal development range-wide and in the Action Area has introduced a variety of difficulties and obstacles for adult leatherback females nesting on beaches, for safe incubation of nests, and for the survival of hatchlings emerging from nests. The Action Area includes about 4,400 miles of mainland and barrier island shoreline, of which 367 miles are sandy beaches that are managed generally in a manner that benefits sea turtles. Recovery goals in the terrestrial context focus on removing barriers to nesting, and reducing the impacts of beach nourishment projects, predation, artificial lighting, and other factors on nesting success.

<u>Effects</u>

Our analysis of the effects of the Action in section 5.3 notes that the USCG determined that clean-up operations during July 2010 in nine segments along Panama City Beach, Florida, could have caused behavioral and sub-lethal leatherback responses, if present. Mechanical clean-up operations in six Walton County, Florida, segments during May 2011, could have caused high-behavioral to lethal leatherback responses, if present. No leatherback nests were identified during these two nesting seasons in these two counties. No leatherback nests were relocated in 2010 for release on the Florida Atlantic coast. The DWH Trustees were unable to estimate leatherback abundance and exposure to oil and in the Action Area, and did not attribute a quantified injury specifically to spill response activities.

The Action temporarily increased threats to leatherback turtle nesting success by introducing barriers and disturbance that would not otherwise have occurred, but it also removed oil that could deter nesting and harm turtles. The USCG believes that BMPs applicable to operations on turtle nesting beaches most likely prevented any impacts to leatherback turtles.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

The USFWS shares consultation responsibilities for sea turtles with the NMFS. As we noted on page 1 of the introduction, this BO considers effects of the Action to sea turtles in the terrestrial context, and the NMFS BO considers effects in the marine context. After reviewing the current status of the species, the environmental baseline for the Action Area, and the effects of the Action in the terrestrial environment, it is the USFWS biological opinion that the Action did not jeopardize the continued existence of the leatherback sea turtle.

6. ALABAMA BEACH MOUSE

6.1. Status of Alabama Beach Mouse

This section summarizes best available data about the biology and current condition of the Alabama beach mouse (ABM) (*Peromyscus polionotus ammobates*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the ABM as endangered on June 6, 1985 (50 FR 23872). The USFWS completed the most recent 5-year review of the species' status in November 2009, recommending that the ABM remain classified as endangered throughout its range (USFWS 2009a).

6.1.1. Description of Alabama Beach Mouse

The ABM is one of five subspecies of the oldfield mouse that inhabit coastal dune communities along the northern coast of the Gulf of Mexico. Head and body length range from 68–88 mm; tail length from 42–60 mm; and total length from 122–153 mm. Adults weigh 10–17 g, and pregnant females reach 22–25 g. Coloration is pale gray with a faint dark stripe running down the upper surface of the tail. The abdomen is white.

6.1.2. Life History of Alabama Beach Mouse

The ABM is a nocturnal and burrowing mouse of the coastal dune and scrub habitats in Alabama east of Mobile Bay. Burrows provide protection from predators, heat, and other harsh environmental conditions, a refuge for birthing and resting, and a cache for food items. The ABM is an opportunistic omnivore, feeding on a variety of seeds, acorns, insects, and spiders.

Beach mice are sexually mature at an age of around 55 days (Weston 2007), and form monogamous pairs for mating. Gestation averages 28–30 days (Weston 2007) and the average litter size is four pups (Fleming and Holler 1990). Rave and Holler (1992) and Swilling and Wooten (2002) both observed a 1:1 sex ratio in captured beach mice.

ABM populations reach peak numbers in late autumn through early spring (Rave and Holler 1992; Holler, *et al.* 1997). Breeding is year-round (Moyers *et al.* 1999), but breeding activity and reproductive success are higher in winter than in summer, likely due to seasonal food abundance (Rave and Holler 1992). Swilling (2000) estimated that the average life span of beach mice along the Gulf Coast of Florida and Alabama is about nine months.

Moyers' (1996) study of the food habits of the ABM and two other subspecies of beach mice found that they eat a wide variety of seeds, fruits, insects and arachnids (spiders). Seeds included those of sea oats (*Uniola paniculata*) and maritime bluestem (*Schizachryium maritimum*). Sneckenberger (2001) found that ABM frequently selected scrub oak acorns in food preference trials.

Trapping studies show that ABM use the primary dunes (closest to the shoreline with the youngest plant communities) and tertiary dunes (farthest from the shoreline supporting scrub plant communities) that bound the secondary dunes within their home range. Beach mice prefer to burrow on the slopes of dunes and in areas with greater vegetative cover, less soil compaction, and higher elevation (Lynn 2000a, Sneckenberger 2001). An individual maintains more than one burrow within its home range.

Novak (1997) and Lynn (2000a) estimated the home range size of beach mice using trapping and telemetry methods at 1–5 acres. The availability of storm refugia within or adjacent to the home range, especially tertiary dune (scrub) habitat and relatively open interior scrub habitat, is critical to the species' persistence through hurricanes (Swilling *et al.* 1998; Sneckenberger 2001). The transition from scrub to maritime forest or perennially inundated wetlands defines the inland extent of suitable beach mouse habitat (Swilling 2000, Sneckenberger 2001).

6.1.3. Numbers, Reproduction, and Distribution of Alabama Beach Mouse

The ABM historically occupied 33.5 miles along the Gulf Coast of Baldwin County, Alabama, from the tip of the Fort Morgan Peninsula (western limit) to Ono Island (eastern limit) (50 FR 23872). By 1982, the species was extirpated from Ono Island. The USFWS estimated that the species' range in 2008 comprised 2,450 acres of dune and interior scrub habitat along 13 miles of the Baldwin County coastline west of Little Lagoon Pass, plus adjacent areas to the east of Little Lagoon Pass in Gulf State Park (USFWS 2011).

ABM numbers in a particular area fluctuate by orders of magnitude within and between years due to varying food availability, predation pressure (especially free-roaming and feral cats), and catastrophic events (Rave and Holler 1992; Holler, *et al.*1997; Swilling *et al.* 1998; Sneckenberger 2001). By flooding and altering their dune habitat, hurricanes have a profound impact on beach mice. Hurricane Ivan in 2004, followed by Hurricane Katrina in 2005, destroyed 90–95 percent of the primary and secondary dunes within the range of the ABM, causing ABM populations to plummet. The habitat and populations have gradually recovered, and by 2010, USFWS personnel found the ABM in all habitat types occupied before Hurricane Ivan (USFWS 2011).

The substantial seasonal and inter-annual variability in local population size preclude a statistically robust and meaningful estimation of ABM numbers range-wide. Beach mice are short-lived (about 9 months) and breed year-round with several generations per year. Numbers at any given time are a function of recent survival, fecundity, and recruitment rates, which vary with food availability, predation pressure, and other factors. The monitoring associated with seven Incidental Take Permits (ITPs) provides data from three live-trapping events per year. The USFWS conducts grid-based sampling intermittently on the Bon Secour National Wildlife Refuge. Figure 6-1 shows average annual trap success from seven ITPs and three sites under public ownership from 2004–2015. These data are not suited to estimating the species' population size, but provide an index of abundance between years and between sites.

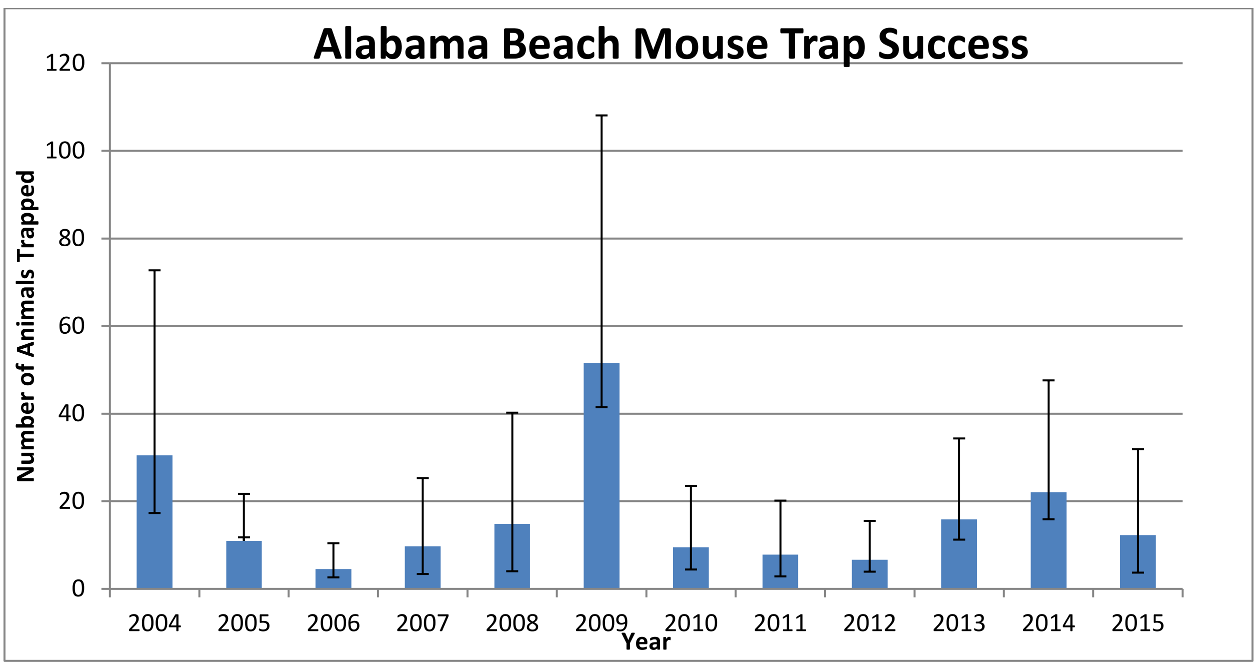

Figure 6-1. Average trap success (number of ABM captured per trapping effort) on seven private and three public properties 2004–2015. Error bars on each average indicate the range of ABM captures each year.

An acre of suitable ABM habitat can support about 5 adult pairs (W. Lynn, USFWS, personal communication). We estimated that the range of the ABM was limited to about 2,450 acres of variable-quality dune and interior scrub habitat in 2008. At most, this habitat would support an adult population of about 10 mice per acre, or 24,500 individuals. The total population size likely varies from year to year at a level less than 24,500 adults in a manner proportional to the trapping success data shown in Figure 6-1, as these data come from seven sites distributed throughout the current range. If so, and assuming for illustrative purposes that the 2009 average capture rate of about 50 animals corresponds to a total population of 24,500 adult mice (10 per acre), the 2006 average capture rate of about 5 animals would represent a total population of 2,450 adult mice (1 per acre). However, coastal development in the range of the ABM has continued since 2008. More recent estimations of the extent of occupied ABM habitat are not available.

6.1.4. Conservation Needs of Alabama Beach Mouse

The most recent 5-year status review for the ABM (USFWS 2009a) noted that the 1987 ABM Recovery Plan was under revision. At present, this revision is not yet completed. Both the Recovery Plan and 2009 status review identify habitat loss associated with residential and commercial real estate development as the primary threat to the ABM. Holliman (1983) estimated that 62 percent of beach mouse habitat in Alabama was lost to development between 1921 and 1983. Douglass *et al.* (1999) and the South Alabama Regional Planning Commission (2001) report substantial additional beach development in the years since 1983.

The habitat loss caused by coastal development is not limited to a single portion of the ABM range. The development is dispersed and has fragmented the remaining beach mouse habitat, such that several populations are effectively isolated. Without gene flow between populations, small isolated populations loose genetic diversity, and may suffer inbreeding effects. Isolated beach mouse populations are more vulnerable to extirpation by storms, disease, competition with introduced house mice, predation, and other factors.

Habitat fragmentation is also a serious threat at the scale of a local ABM population and an individual home range, because beach mice require resources from both the frontal dunes and adjoining scrub, and the home range of an individual beach mouse is only 1–5 acres. The frontal dunes support a greater diversity of high-quality foods, but these resources are primarily grasses and annual plants that produce large quantities of small seeds during brief periods. When available, this food resource fuels higher fecundity and recruitment that allows a population to expand. The larger and more persistent seeds, acorns, and fruits of the scrub are produced and available over longer periods, which sustain mice during other times. When hurricanes destroy the food resources of the frontal dunes, beach mice must rely exclusively on food from the scrub until the frontal dunes reform (Swilling *et al*. 1998; Sneckenberger 2001). The population that persists in the scrub following a hurricane, perhaps several generations later, may then exploit the return of productivity in the frontal dunes.

Residential beachfront development often reduces scrub habitat to patches that are too small or too widely separated to sustain beach mouse populations. Individuals must forage over greater distances, which reduces survival, because individuals are more vulnerable to predation and other hazards, and reduces reproductive success, because of the added energy cost. The pets, trash that attracts native predators and competitors, human activity, and artificial lighting that accompany residential development introduce further stressors to beach mice populations in these areas.

Therefore, large contiguous tracts containing both frontal dune and scrub habitat types are necessary to conserve the ABM. The remaining large tracts of ABM habitat are primarily on public lands that must also accommodate increasing recreational use. Where the protection of large contiguous tracts of beach mouse habitat is not possible, establishing multiple separate, but widely distributed, local populations is likely the next best defense against range-wide extinction caused by a hurricane or other catastrophic event (Shaffer and Stein 2000; Oli *et al.* 2001; Danielson 2005; 71 FR 5515; 71 FR 44976).

6.2. Environmental Baseline for Alabama Beach Mouse

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the present status of a listed species, its habitat, and ecosystem within the Action Area. It is a “snapshot” of the species’ health in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

However, the Action Area of this consultation encompasses the entire range of the ABM; therefore, we have described the status of the species within the Action Area in the previous section, “6.1 Status of Alabama Beach Mouse.”

6.3. Effects of the Action on Alabama Beach Mouse

This section analyzes the direct and indirect effects of the Action on the ABM, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

The effects of the Action that we consider in this section are limited to spill response activities conducted on beaches and adjacent habitats within the current range of the ABM. The sandy beaches in this area were more heavily oiled than sandy beaches further east, which necessitated a more intensive response effort. Three of the BMPs applicable to these operations were intended to avoid and minimize impacts to beach mice (USCG BA: p. 239):

- BMP 34–Check travel corridors for evidence of beach mice before work.
- BMP 39–Avoid dunes, and establish a 10-foot work buffer around dune vegetation.
- BMP 46–No more than three workers using small hand tools may remove tarballs from dunes authorized for clean up.

6.3.1. Response Pathways

The Action involved putting people, vehicles, and other equipment on the beaches of the Action Area, which introduced potential stressors (biologically relevant changes to the environment) to beach mice and the habitat resources upon which they rely. In this section, we describe the likely responses of individual ABM upon exposure to Action-caused stressors. In addition to the USCG BA, we rely on information from the Wetland Sciences (2014) report that the USFWS commissioned to assess impacts to beach mouse habitats throughout the Action Area resulting from the spill response.

Physical Modifications to Dune Habitat

The spill response physically modified dune habitats within the range of the ABM by clearing or enlarging existing beach access points across the dunes, and in some shoreline segments, by removing dune vegetation during oil-clean up operations. Physical modification of dunes may directly kill or injure beach mice, if their burrows are present. We discuss this and other potential ABM responses to this Action-caused stressor in the following paragraphs.

Supporting beach clean-up operations required staging areas for personnel and equipment (see section 1.2; Support Activities). Staged equipment included tractors, UTVs, latrines, trash receptacles, oil recovery dumpsters, large buses and other vehicles. Mess tents in the staging areas fed the workers. Land access to the beach from these staging areas required that personnel and equipment pass through the zone that supports dune habitat.

Eight of the staging areas shown in Figure 2.3-9 of the BA are located near the shore within the range of the ABM. Using pre-spill aerial photography, Wetland Sciences (2014: p. 14) found that the access points located within and to the west of Gulf State Park exhibited discernable dune vegetation loss totaling 0.24 acre. One of these access points, located on the Ft. Morgan Peninsula within Bon Secour National Wildlife Refuge, appeared as intact dune habitat on 2009 aerial photography. The other access points were present before the spill response, but were larger than in 2009, which Wetland Sciences attributed to vehicular traffic and increased use during the spill response.

The beach mouse response to introducing or enlarging an unvegetated pathway through occupied dune habitat depends on the size of the pathway and its longer-term influence on dune stability. Traffic through dune breaches or low dunes on an eroding beach may accelerate beach erosion (Godfrey *et al.* 1978). Beach mice use vegetation as cover from predators, and dune breaches create a gap between vegetated areas. Beach mice are known to travel substantial distances during one night (up to 1 mile). However, Smith (2003) observed that longer travel distances for Santa Rosa beach mice (one the 5 Gulf Coast subspecies) were associated with greater habitat fragmentation, and that individuals preferred to use vegetated travel corridors with few, if any, large gaps. Beach mice actively avoid expanses of unvegetated sand greater than 85 feet (Wilkinson *et al*. 2010). Avoiding open areas is likely a behavioral adaptation that reduces predation risk.

In summary, removing dune vegetation may crush or smother beach mice within their burrows, if present, which represents take in the form of harm. Displacing beach mice from burrows during vegetation removal represents take in the form of harassment, because it creates the likelihood of injury by predation or exposure to other hazards. Dune vegetation removal has an indirect impact on habitat quality and carrying capacity for beach mice by reducing food and cover.

Human Disturbance / Artificial Lighting

Some operations involved hundreds of workers, multiple vehicles, and other equipment within a shoreline segment at the same time. Spill responders installed generator-powered portable lighting at staging areas near beaches to support round-the-clock clean-up operations for several periods during the first 12 months of the response. In 2010, clean-up methods included mechanical sand sifting conducted at night when temperatures were cooler and the oil was less likely to clog sieves (DWH Trustees: p. 4-411).

Foot and vehicle traffic within the vegetated portions of primary and some secondary dunes may crush mice in their burrows. BMP 39 established a 10-ft activity exclusion zone around the vegetated portions of dunes, although authorized and unauthorized deviations from this BMP occurred (see following section 6.3.2).

The larger potential for spill response activities affecting beach mice was via disturbance in close proximity to dune habitats, especially activities conducted at night. As a small, secretive, nocturnal mammal vulnerable to numerous predators, sustained disturbance near or within a home range (noise, foot and vehicle traffic, artificial light) is likely to cause a beach mouse to abandon or shift its home range away from the disturbance. Citing several studies on how human noise, lighting, and other disturbance factors alter nearby animal activity, Wetland Sciences (2014) used a distance of 300 ft from staging areas to represent the spatial extent of disturbance caused by activities in staging areas near dune habitats. The area of a 300-ft diameter circle is 1.6 acres. The home range size of an ABM is from 1–5 acres (Novak 1997; Lynn 2000a); therefore, sustained disturbance extending 300 ft into dune habitat could affect all or a substantial fraction of a beach mouse home range located within that buffer.

Displacing a beach mouse into the home range of another beach mouse reduces its probability of survival, especially during the summer, when food resources are less abundant and established burrows are essential refugia from the extreme heat of the day and various predators. VanZant and Wooten (2003) found that Choctawhatchee beach mice introduced into the established home range of other mice had only a 16 percent chance of survival.

Researchers of mainland populations of *Peromyscus* species (*e.g.*, Brillhart and Kaufman 1991) have reported that bright moonlight reduces movement, and this effect is greater in areas with sparse vegetative cover (Orreck *et al.* 2004). Moving less when ambient light is high reduces vulnerability to predators that hunt by sight. Artificial lighting in or near beach mouse habitats subjects beach mice to increased predation or modifies their foraging, dispersal, and breeding behaviors (Bird *et al*. 2004).

Disturbance that causes an ABM to abandon or shift its home range would constitute take in the form of harassment, because it creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering.

6.3.2. Estimation of Effects

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon the USCG BA and on the Wetland Sciences (2014) report that the USFWS commissioned to assess impacts to beach mouse habitats resulting from the spill response. Our previous description of the "USCG Take Score Model" (TSM) methodology in section 2.3.2 applies to the USCG estimation of effects to the ABM.

The BA reports 22,149 segment days of spill response activity on beaches within range of the ABM, of which 2,097 segment days occurred within dunes or the dune buffer zone (10 ft from dune vegetation) established by BMP 39. Segment days of work in the dunes were comprised of 86 percent manual cleanup, 12 percent mechanical, and 2 percent patrol and monitor.

Of these 2,097 segment days in the dunes, the TSM assigns one segment day of activity (15 November 2010 in ALBA1-002 on the Fort Morgan Peninsula) to a potentially lethal ABM response (USCG BA: p. 240). The BA does not describe the specific mechanism behind this model result, but the discussion implies it involved the potential for crushing mice within burrows. The USCG attributes sub-lethal responses to 43 segment days of daytime mechanical work, and 1 segment day of nighttime work. Behavioral responses are attributed to the remaining 2,053 segment days of work in the dunes.

Oil clean up in ABM habitat included 19 segment days of manual vegetation removal, all within two segments, mostly during April–June 2012. According to the USCG BA, this activity included both authorized and unauthorized departures from BMP 39. The USCG does not describe the extent of the vegetation removal, but the BA notes that it could have affected "potential ABMs in the nest." The BA does not categorize the ABM response to this vegetation removal activity as lethal, sub-lethal, or behavioral, or indicate why it was necessary, because oil deposition at the elevation of vegetated dunes would be unusual. Because ABM pups are either unlikely to flee, or to survive fleeing, a direct impact to the nest chamber of an occupied burrow, dune vegetation removal is appropriately categorized as a potential lethal response. Burrow destruction may also kill or injure adult mice, or cause them to flee and expose them to predation or injury.

The USCG BA did not estimate numbers of ABM affected by the spill response activities corresponding to the TSM results summarized above. Although the DWH Trustees described in general terms some impacts to dune habitats, they did not quantify an injury to beach mice specifically resulting from either the spill or spill response activities. The TSM results for potential ABM responses supported a "likely to adversely affect" determination for the BA. However, interpreting the meaning of these results relative to ABM numbers, reproduction, and distribution within the Action Area is difficult without additional information.

Wetland Sciences (2014) estimated 0.24-acre direct impact to dune habitats (vegetation loss) at beach access pathways within ABM habitat. This estimate does not include the 19 segment days of vegetation removal activity described in the USCG BA, for which the USCG did not quantify the acreage affected. Wetland Sciences estimated the extent of indirect (disturbance) impacts using a 300-ft buffer around staging areas at 44.8 acres (total for staging areas located between

Fort Morgan and Gulf State Park). Assuming that ABM were present in all of the quantified direct and indirect impact areas, and assuming ABM densities of 1–10 adult mice per acre, the Action would have affected about 50–500 adult ABM, most likely by modifying behavior or home range in the vicinity of the disturbance. Such behavioral modification could have created the likelihood of injury (see Response Pathways described in section 6.3.1), representing take in the form of harassment.

Although we cannot determine whether the Action harmed or harassed 50–500 ABM near staging areas, we cannot discount the possibility that spill response activity influenced ABM population dynamics to some degree, due its range-wide scale and duration (22,149 segment days over about 3 years). The ABM response to disturbance described in section 6.3.1 was probably not limited to staging areas and access points. The width of the beach from the water's edge to the toe of the primary dunes in this area is about 150 ft, which places dunes well within the 300-ft zone used to quantify the extent of disturbance effects around staging areas.

During 2009, before the spill, the average number of ABM trapped in standard surveys conducted since 2004 reached a peak of about 50 animals per survey (Figure 6-1). This average abruptly dropped in 2010 to about 10 animals per survey, and declined further in 2011 and 2012. The years corresponding to the majority of spill response activity on ABM beaches (2010–2012) are 3 of the 4 lowest trapping success years from 2004–2015. The fourth low year, 2006, followed Hurricane Katrina in 2005. No hurricanes made landfall in or near Alabama during 2010–2012.

6.4. Conclusion for Alabama Beach Mouse

In this section, we summarize and interpret the findings of the previous sections for the ABM (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

c) jeopardize the continued existence of species listed as endangered or threatened; or
d) result in the destruction or adverse modification of designated critical habitat.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

<u>Status</u>

In our description of the status of the ABM in section 6.1, we noted that in 2008, the range of the ABM in 2008 comprised 2,450 acres of dune and interior scrub habitat. ABM numbers in a particular area fluctuate by orders of magnitude within and between years due to varying food availability, predation pressure (especially free-roaming and feral cats), and catastrophic events. By flooding and altering their dune habitat, hurricanes have a profound impact on beach mice.

Range-wide ABM population estimates are not available. Trapping data for seven sites during 2004–2015 provide an index of relative abundance between years and between sites. These data range from an average of about 50 animals per survey in 2009 to a low of about 5 animals per survey in 2005, following extensive damage to ABM habitats caused by Hurricanes Ivan and Katrina.

An acre of suitable ABM habitat can support about 5 adult pairs. The 2,450 acres of dune and interior scrub habitat of variable quality comprising the species' extant range in 2008 would support, at most, an adult population of about 10 mice per acre, or 24,500 individuals. Using the available trapping data as a gauge of range-wide trends, which varies between years by a factor of 10, years of low abundance may support only 1 adult mouse per acre, or about 2,450 individuals.

Habitat loss and fragmentation associated with residential and commercial real estate development are the primary threats to the ABM. Conserving large contiguous tracts of habitat is the best strategy for recovering the ABM. The remaining large tracts of ABM habitat are primarily on public lands that must also accommodate increasing recreational use. Where the protection of large contiguous tracts of beach mouse habitat is not possible, establishing multiple separate, but widely distributed, local populations is likely the next best defense against range-wide extinction caused by a hurricane or other catastrophic event.

Baseline

As we noted in section 6.2, a separate assessment of the status of the species in the Action Area, i.e., the environmental baseline, is not necessary for the ABM, because the Action Area encompasses the species' entire range.

Effects

In our discussion of the effects of the Action in section 6.3, we describe two primary pathways by which the Action may have affected beach mice: physical modifications to dune habitat, and human disturbance. The USCG BA reports 22,149 segment days of spill response activity on beaches within the range of the ABM, of which 2,097 segment days occurred within dunes or the dune buffer zone (10 ft from dune vegetation) established by BMP 39. The USCG attributed potentially lethal ABM responses to only 1 segment day of work, and 44 segments days to sub-lethal responses. However, we include in the potentially lethal category an additional 19 segment days of vegetation removal in the dunes that was limited to two segments.

We supplement the USCG effects analysis with findings from a USFWS-commissioned assessment of spill-response impacts to beach mouse habitats. This assessment examined habitat alterations and disturbance at staging areas and beach access points, from which we infer that the Action may have harassed 50–500 ABM, and possibly harming a small fraction of these, depending on densities in the areas exposed to this disturbance.

Due to its range-wide scale and intensity (22,149 segment days over about 3 years), we cannot discount the possibility that spill response activity influenced ABM population dynamics to some degree. The ABM response to disturbance described in section 6.3.1 was probably not limited to the staging areas and access points identified in the USFWS-commissioned assessment. Due to the proximity of the dunes to intensive beach clean-up operations, both day and night, mechanical and manual, sustained for weeks at a time over 3 years, ABM were likely exposed to increased levels of noise, artificial light, and movements. An adverse effect of spill response operations on ABM populations is consistent with a dramatic drop in trapping success observed during those years.

However, we have no evidence that would support a plausible causal link besides increased disturbance between the Action and the magnitude of the observed drop in trapping success (from about 50 to 10 animals per survey). The physical modifications of dune habitat were relatively limited in scale. It seems unlikely that increased disturbance on the open beaches alone could explain a five-fold decline in abundance. In the years before and after the spill response, ABM beaches supported substantial recreational use, and the disturbance associated with crowds of people. Trapping success in 2013–2015 was higher (2–3 times more) than in 2010–2012, but still lower than in 2009; so the adverse effect of spill response operations on ABM population dynamics, if any, appears temporary.

With exception of a single new beach access cut through the dunes on the Ft. Morgan Peninsula, the Action did not exacerbate the primary threat to the species recovery, which is habitat loss and fragmentation. We presume the limited vegetation removal in the dunes described in the BA was necessary to remove oil, a potential hazard to beach mice. The Action caused no long-term impacts to the likelihood of recovery.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

After reviewing the current status of the species and the effects of the Action, it is the USFWS biological opinion that the Action did not jeopardize the continued existence of the Alabama beach mouse.

7. PERDIDO KEY BEACH MOUSE

7.1. Status of Perdido Key Beach Mouse

This section summarizes best available data about the biology and current condition of the Perdido Key Beach Mouse (PKBM) (*Peromyscus polionotus trissyllepsis*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the PKBM as endangered on June 6, 1985 (50 FR 23872). The USFWS completed the most recent 5-year review of the species' status in December 2014, recommending that the PKBM remain classified as endangered throughout its range (USFWS 2014).

7.1.1. Description of Perdido Key Beach Mouse

The PKBM is the smallest of five subspecies of the oldfield mouse that inhabit coastal dune communities along the northern coast of the Gulf of Mexico. Total length is about 140 mm. Head and body length ranges from 70–85 mm, and tail length 45–54 mm. Adults weigh 10–17 g, with pregnant females reaching 22–25 g. The fur is gray-colored on the back extending between the eyes, with white cheeks, tail, and abdomen. The tail lacks the black stripe characteristic of the Alabama Beach Mouse.

7.1.2. Life History of Perdido Key Beach Mouse

The PKBM is a nocturnal and burrowing mouse of the coastal dune and scrub habitats on Perdido Key. Burrows provide protection from predators, heat, and other harsh environmental conditions, a refuge for birthing and resting, and a cache for food items. The PKBM is an opportunistic omnivore, feeding on a variety of seeds, acorns, insects, and spiders.

Due to a relatively recent common ancestry, the five subspecies of beach mice along the northern Gulf of Mexico share, with minor differences, many life history characteristics, such as age at sexual maturity, gestation duration, average litter size, monogamous pairing, average life span, etc. Our description of the life history of the Alabama beach mouse in section 6.1.2, some of which relies on inferences from studies of the PKBM and other beach mouse subspecies, applies also to the PKBM. Please refer section 6.1.2 for further details.

7.1.3. Numbers, Reproduction, and Distribution of Perdido Key Beach Mouse

The PKBM historically inhabited coastal dune habitats throughout the 17-mile length of Perdido Key, which is the barrier island between the mouths of Perdido Bay and Pensacola Bay. The western end of Perdido Key is within Alabama, and eastern end is within Florida.

The 2014 status review (USFWS 2014) describes the dynamic history of the numbers and distribution of the PKBM during 1979–2014. Hurricane Fredrick in 1979 severely damaged the beaches and dunes of Perdido Key, extirpating the PKBM from most of the island. At the time of the 1985 listing decision, the PKBM persisted only at the western-most tip of the island within the Florida Point Unit of Gulf State Park. By 1986, the species’ numbers had declined to less than 30 animals.

From November 1986 to April 1988, state and federal biologists reintroduced the PKBM to the Johnson Beach Unit of Gulf Islands National Seashore (GINS) on the eastern half of the island. Shortly thereafter, a series of storms and a significant increase in predation by feral and free-roaming domestic cats extirpated the Florida Point population. In 2000, biologists reintroduced the PKBM to Perdido Key State Recreation Area, situated mid-way between Florida Point and GINS. In the months before Hurricane Ivan in 2004, surveys estimated a range-wide population of 500–800 mice, which again abruptly declined, but without complete extirpation of the populations within GINS and the State Recreation Area. In 2010, biologists reintroduced the PKBM to Florida Point, the area in which the species survived Hurricane Frederick, marking the first time since 1979 that the PKBM inhabited all three tracts of publicly managed on the island.

Without recent hurricanes, a slowing rate of residential and commercial development, and active predator management throughout the island, the status review reports that PKBM numbers and distribution have increased since Hurricane Ivan. A current estimate of population size is not available, but as of 2013, the species was detected in 85–95 percent of tracking tubes set across suitable habitat in all three public land tracts on Perdido Key.

The three tracts of public lands on Perdido Key span about 60 percent of its 17-mile length, including the western and eastern ends of the island. The PKBM occurs on some privately owned tracts between the three public areas. The USFWS has issued Incidental Take Permits associated with Habitat Conservation Plans on 12 privately owned parcels.

7.1.4. Conservation Needs of Perdido Key Beach Mouse

The most recent 5-year status review for the PKBM (USFWS 2014) noted that the 1987 PKBM Recovery Plan was under revision. At present, this revision is not yet completed. Both the Recovery Plan and 2014 status review identify habitat loss associated with coastal development as the primary threat to the PKBM.

Since the species' listing as endangered in 1985, storms and other stressors have extirpated populations of PKBM within each of the three tracts at various times. Through translocation, at least one population remained at all times, and PKBM currently occupy all three tracts. These three populations are separated by intervening commercial and residential development, which reduces the species' resilience to periodic hurricanes and other stressors, such as disease, competition with introduced house mice, and predation (especially feral and free-roaming domestic cats).

The range of the PKBM has a higher proportion of lands in public ownership than the Alabama beach mouse, but otherwise, the threats to, and the conservation needs of, the PKBM are comparable to those we described for the Alabama beach mouse in section 6.1.4. The primary need is to conserve large contiguous tracts containing both frontal dune and scrub habitat types, and to establish separate smaller populations wherever possible elsewhere as a defense against range-wide extinction caused by a hurricane or other catastrophic event. Please refer to section 6.1.4 for further details.

7.2. Environmental Baseline for Perdido Key Beach Mouse

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the present status of a listed species, its habitat, and ecosystem within the Action Area. It is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

However, the Action Area of this consultation encompasses the entire range of the PKBM; therefore, we have described the status of the species within the Action Area in the previous section, "7.1 Status of Perdido Key Beach Mouse."

7.3. Effects of the Action on Perdido Key Beach Mouse

This section analyzes the direct and indirect effects of the Action on the PKBM, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

The effects of the Action that we consider in this section are limited to spill response activities conducted on the beaches and adjacent habitats of Perdido Key. The sandy beaches in this area were less heavily oiled than those to the west, but more heavily oiled than those to the east. Most of the island is within Florida, which prohibited the largest equipment used for the response in Alabama (Wetland Sciences 2014: p. 11). Three of the BMPs applicable to the operations on Perdido Key were intended to avoid and minimize impacts to beach mice (USCG BA: p. 239):

- BMP 34–Check travel corridors for evidence of beach mice before work.
- BMP 39–Avoid dunes, and establish a 10-foot work buffer around dune vegetation.
- BMP 46–No more than three workers using small hand tools may remove tarballs from dunes authorized for clean up.

7.3.1. Response Pathways

The pathways between Action-caused stressors and the responses of individual PKBM are the same as those described in section 6.3.1 for the Alabama beach mouse. Responses to: (a) physical modifications of dune habitats; and (b) human disturbance/artificial lighting; are comparable between PKBM and Alabama beach mice.

7.3.2. Estimation of Effects

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon the USCG BA and on the Wetland Sciences (2014) report that the USFWS commissioned to assess impacts to beach mouse habitats resulting from the spill response. Our previous description of the "USCG Take Score Model" (TSM) methodology in section 2.3.2 applies to the USCG estimation of effects to the PKBM.

The BA reports 3,218 segment days of spill response activity in 47 segments on Perdido Key (13 in Alabama, 34 in Florida). Operations began in August 2010 and continued intermittently until June 2013. The total operation was comprised of 82 percent manual cleanup, 16 percent patrol and monitor, and 2 percent mechanical. Responders logged 23 segment days of nighttime operations during 2010, including a single nighttime operation of mechanical cleanup in an Alabama segment on October 31, 2010, which involved 23 responders, a bulldozer, and a sand shark.

The 3,218 segment days of the total operation included 13 days in 13 separate segments involving work within the dunes or dune buffer zone established by BMP 39 (within 10 ft of dune vegetation). The USCG TSM results correspond to potentially lethal PKBM responses on 7 of these segment days, sub-lethal responses on 5 segment days, and a "high-behavioral" response on the 1-night mechanical cleanup operation described in the previous paragraph. The nature of this work within the dune buffer zone is not clear. None of the work is described as vegetation removal. The BA indicates that existing beach access points were available in all 13 segments except one, for which the BA states: "There may have been some localized damage to the dune system to allow access" (USCG BA: p. 246).

The USCG BA did not estimate numbers of PKBM affected by the spill response activities corresponding to the TSM results summarized above. Although the DWH Trustees described in general terms some impacts to dune habitats, they did not quantify an injury to beach mice specifically resulting from either the spill or spill response activities. The TSM results for potential PKBM responses supported a "likely to adversely affect" determination for the BA. However, interpreting the meaning of these results relative to PKBM numbers, reproduction, and distribution within the Action Area is difficult without additional information.

Wetland Sciences (2014) measured the pre- and post-spill response condition of dune vegetation cover at eight beach access points on Perdido Key that responders used. Three of these showed a small collective vegetation loss of 0.03 ac (1,107 ft^2; range 81–822 ft^2). This study did not identify a new access pathway through the dunes that would correspond to work within the dunes in one segment lacking beach access, which we mentioned in the previous paragraph. Wetland Sciences estimated the extent of indirect (disturbance) impacts at only one intensive-use staging area on Perdido Key, which was located at the GINS Johnson Beach main parking area. Using a 300-ft buffer around the site, they estimated the extent of indirect impacts at 22.8 acres (Wetland Sciences 2014: p. 21).

Density data for PKBM are not available. In section 6.1.3, we noted that an acre of suitable habitat can support about 10 adult Alabama beach mice, and that abundance varies by a factor of 10 between years (i.e., from 1–10 animals per acre). As a closely related subspecies occupying similar habitats, it is reasonable to apply this observation to the PKBM. Assuming that PKBM were present in all 23 acres of the direct and indirect impact areas quantified by Wetland Sciences, and assuming PKBM densities of 1–10 adult mice per acre, the Action would have affected about 23–230 adult PKBM, most likely by modifying behavior in the vicinity of the disturbance. Such behavioral modification could have created the likelihood of injury (see Response Pathways described in section 6.3.1 for the Alabama beach mouse), representing take in the form of harassment. Our 2014 status review, completed shortly after cleanup operations on Perdido Key ceased, characterized PKBM populations as "increasing." Therefore, we believe that any adverse effects of the spill response on PKBM were temporary.

7.4. Conclusion for Perdido Key Beach Mouse

In this section, we summarize and interpret the findings of the previous sections for the PKBM (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

e) jeopardize the continued existence of species listed as endangered or threatened; or
f) result in the destruction or adverse modification of designated critical habitat.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Status

In section 7.1, we described the dynamic history of local extirpation and reintroduction that began with a single population of less than 30 PKBM in the 1980s. Hurricanes and habitat loss/fragmentation drive this history of near extinction on several occasions. Coastal development has divided the species into three primary populations corresponding to the three tracts of publicly owned lands on Perdido Key. The PKBM occurs on some privately owned tracts between the three public areas. The USFWS has issued Incidental Take Permits associated with Habitat Conservation Plans on 12 privately owned parcels.

Without recent hurricanes, a slowing rate of coastal development, and active predator management throughout the island, our 2014 status review reports that PKBM numbers and distribution have increased since Hurricane Ivan. A current estimate of population size is not available, but as of 2013, the species was detected in 85–95 percent of tracking tubes set across suitable habitat in all three public land tracts on Perdido Key.

The range of the PKBM has a higher proportion of lands in public ownership (about 60 percent of the 17-mile length of the island) than the range of the Alabama beach mouse, but otherwise, the threats to, and the conservation needs of, the PKBM are comparable to those we described for the Alabama beach mouse in section 6.1.4. The species' primary need is to conserve large contiguous tracts containing both frontal dune and scrub habitat types, and to establish separate smaller populations wherever possible elsewhere as a defense against range-wide extinction caused by a hurricane or other catastrophic event.

Baseline

As we noted in section 7.2, a separate assessment of the status of the species in the Action Area, i.e., the environmental baseline, is not necessary for the PKBM, because the Action Area encompasses the species' entire range.

Effects

In our discussion of the effects of the Action in section 7.3, we describe two primary pathways by which the Action may have affected beach mice: physical modifications to dune habitat, and human disturbance.

The USCG BA reports 3,218 segment days of activity on Perdido Key, which included 13 days in 13 separate segments that involved work within the dunes or dune buffer zone. The USCG Take Score Model (TSM) results for these 13 segment days correspond to potentially lethal PKBM responses on 7 days, sub-lethal responses on 5 days, and a "high-behavioral" response on a nighttime mechanical cleanup operation in one segment. The nature of this work within the dune buffer zone is not clear. None of the work is described as vegetation removal. Interpreting the meaning of the TSM results relative to PKBM numbers, reproduction, and distribution within the action area is difficult without additional information.

We supplement the USCG effects analysis with findings from a USFWS-commissioned assessment of spill-response impacts to beach mouse habitats. This assessment examined habitat alterations and disturbance at staging areas and beach access points, from which we infer that the Action may have harassed 23–230 PKBM, depending on densities in areas exposed. Our 2014 status review, completed shortly after cleanup operations on Perdido Key ceased, characterized PKBM populations as "increasing." We believe that any adverse effects of the spill response on PKBM were temporary.

The Action did not exacerbate the primary threat to the species recovery, which is habitat loss and fragmentation. The Action caused no long-term impacts to the likelihood of recovery.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

After reviewing the current status of the species and the effects of the Action, it is the USFWS biological opinion that the Action did not jeopardize the continued existence of the Perdido Key Beach Mouse.

8. CHOCTAWHATCHEE BEACH MOUSE

8.1. Status of Choctawhatchee Beach Mouse

This section summarizes best available data about the biology and current condition of the Choctawhatchee Beach Mouse (CBM) (*Peromyscus polionotus allophrys*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the CBM as endangered on June 6, 1985 (50 FR 23872). The USFWS completed the most recent 5-year review of the species' status in September 2007, recommending that the CBM remain classified as endangered throughout its range (USFWS 2007).

8.1.1. Description of Choctawhatchee Beach Mouse

The CBM is one of five subspecies of the oldfield mouse that inhabit coastal dune communities along the northern coast of the Gulf of Mexico. Head and body length ranges from 69–89 mm, and tail length 43–63 mm. Adults weigh 10–17 g, with pregnant females reaching 22–25 g. Fur color on the back is orange-brown to yellow-brown, the abdomen is white, and the tail has a variable dorsal stripe.

8.1.2. Life History of Choctawhatchee Beach Mouse

The CBM is a nocturnal and burrowing mouse of the coastal dune and scrub habitats of northwest Florida. Burrows provide protection from predators, heat, and other harsh environmental conditions, a refuge for birthing and resting, and a cache for food items. Like other northern Gulf Coast beach mice, the CBM is almost certainly an opportunistic omnivore, feeding on a variety of seeds, acorns, and invertebrates; however, a comprehensive study of the species' life history has not been conducted.

Due to a relatively recent common ancestry, the CBM most likely shares many life history characteristics, such as age at sexual maturity, gestation duration, average litter size, monogamous pairing, average life span, etc., with the other four subspecies of norther Gulf Coast beach mice. For purposes of this BO, we rely on our description of the life history of the Alabama beach mouse in section 6.1.2, for our analysis of the Action relative to the CBM.

8.1.3. Numbers, Reproduction, and Distribution of Choctawhatchee Beach Mouse

The earliest records indicate that the CBM range spanned the 53 miles of Florida coastline between the Destin Pass outlet of Choctawhatchee Bay in Okaloosa County and the East Pass outlet of St. Andrew Bay in Bay County (50 FR 23872). Bowen (1968) noted that the CBM was abundant throughout this range in the 1950s. By 1979, only 40 percent of its dune habitats remained undeveloped, and the species was extirpated from seven of nine previous collection sites (Humphrey and Barbour 1981).

At the time of our ESA listing decision in 1985, the CBM persisted within about 10 miles of coastal habitats in two areas: Topsail Hill (Walton County) and Shell Island (Bay County). In 1987 and 1988, a cooperative interagency effort reintroduced CBM onto the central and west units of Grayton Beach State Park (Walton County), increasing the occupied coastline by another mile (Holler and Mason 1989). Sand accretion closed the East Pass outlet of St. Andrew Bay in 1999, which established a land connection between Shell Island and West Crooked Island. CBM from Shell Island colonized West Crooked Island, extending the range of the species eastward by about 4 miles (Lynn 2000b). East Pass has closed and opened again since the initial colonization.

Our 2007 status review (USFWS 2007) identifies four current CBM populations located at:

1) Topsail Hill Preserve State Park, and adjacent private lands;
2) Grayton Beach State Park, and adjacent private lands to the east;
3) Deer Lake State Park, and adjacent private lands to the east; and
4) Shell Island/West Crooked Island.

An additional site, Henderson Beach State Park (west of Topsail Hill in Okaloosa County), contains about 100 acres of suitable CBM habitat and once supported a population, but no one has surveyed the site in recent years to confirm whether the species is present or absent. The four sites listed above collectively contain about 2,400 acres of CBM habitat, of which 96 percent is under public ownership. The CBM occurs on some privately owned tracts adjacent to the publicly owned areas. The USFWS has issued Incidental Take Permits associated with Habitat Conservation Plans on two privately owned parcels.

The status review characterizes the western-most Topsail Hill and eastern-most Shell Island/West Crooked Island populations as most likely to persist, but all four are vulnerable to extirpation precipitated by a major hurricane. The area of the Shell Island/West Crooked Island population contains about three-quarters of the species' currently occupied range.

The substantial seasonal and inter-annual variability of beach mouse populations preclude a statistically robust and meaningful estimation of their numbers range-wide. Beach mice are short-lived (about 9 months) and breed year-round with several generations per year. Numbers at any given time are a function of recent survival, fecundity, and recruitment rates, which vary with food availability, predation pressure, and other factors. In section 6.1.3, we noted that an acre of suitable habitat can support about 10 adult Alabama beach mice, and that abundance varies by a factor of 10 between years (i.e., from 1–10 animals per acre). As a closely related subspecies occupying similar habitats, it is reasonable to apply this observation to the CBM. For purposes of this BO, we consider the 2,400 acres of habitat within the four sites identified above as supporting about 2,400–24,000 adult mice. Data that would indicate where CBM populations currently fall in this range are not available; however the 2007 status review indicated that CBM populations appeared to be "on the decline" at that time.

8.1.4. Conservation Needs of Choctawhatchee Beach Mouse

The most recent 5-year status review for the CBM (USFWS 2007) noted that the 1987 CBM Recovery Plan was under revision. At present, this revision is not yet completed. Both the Recovery Plan and 2007 status review identify habitat loss associated with coastal development as the primary threat to the CBM.

The range of the CBM has a higher proportion of lands in public ownership than the Alabama beach mouse, but otherwise, the threats to, and the conservation needs of, the CBM are comparable to those we described for the Alabama beach mouse in section 6.1.4. Reducing predation pressure, especially from feral and free-roaming domestic cats, is an important recovery need. The primary need is to conserve large contiguous tracts containing both frontal dune and scrub habitat types, and to establish separate smaller populations wherever possible elsewhere as a defense against range-wide extinction caused by a hurricane or other catastrophic event. Please refer to section 6.1.4 for further details.

8.2. Environmental Baseline for Choctawhatchee Beach Mouse

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the present status of a listed species, its habitat, and ecosystem within the Action Area. It is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

However, the Action Area of this consultation encompasses the entire range of the CBM; therefore, we have described the status of the species within the Action Area in the previous section, "8.1 Status of Choctawhatchee Beach Mouse."

8.3. Effects of the Action on Choctawhatchee Beach Mouse

This section analyzes the direct and indirect effects of the Action on the CBM, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

The effects of the Action that we consider in this section are limited to spill response activities conducted on the beaches and adjacent habitats in the current range of the CBM (see section 8.1.3), which is entirely within Okaloosa, Walton, and Bay Counties of the Florida Panhandle. The sandy beaches in this area received much less oil than those to the west in the Action Area. Three of the BMPs applicable to the operations in this area were intended to avoid and minimize impacts to beach mice (USCG BA: p. 239):

- BMP 34–Check travel corridors for evidence of beach mice before work.
- BMP 39–Avoid dunes, and establish a 10-foot work buffer around dune vegetation.
- BMP 46–No more than three workers using small hand tools may remove tarballs from dunes authorized for clean up.

8.3.1. Response Pathways

The pathways between Action-caused stressors and the responses of individual CBM are the same as those described in section 6.3.1 for the Alabama beach mouse. Responses to: (a) physical modifications of dune habitats; and (b) human disturbance/artificial lighting; are comparable between CBM and Alabama beach mice.

8.3.2. Estimation of Effects

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon the USCG BA and on the Wetland Sciences (2014) report that the USFWS commissioned to assess impacts to beach mouse habitats resulting from the spill response. Our previous description of the "USCG Take Score Model" (TSM) methodology in section 2.3.2 applies to the USCG estimation of effects to the CBM.

The BA reports 587 segment days of spill response activity within the dunes or dune buffer zone (within 10 ft of dune vegetation) of three of the four areas that currently support CBM (Topsail Hill, Grayton Beach, and Deer Lake State Parks, and adjacent private lands). Henderson Beach State Park received an additional 222 segment days of response activity. Henderson Beach lacks surveys that confirm CBM presence or absence in recent years, and we did not include it as a currently occupied location in our 2007 status review. No oil cleanup occurred in the area of the eastern-most CBM population, Shell Island/West Crooked Island.

In the Topsail Hill and Grayton Beach areas, 14 and 2 segment days, respectively, of spill response activity involved impacts to dune vegetation via manual cleanup methods. The BA does not describe the nature or spatial extent of these impacts. The BA indicates that the TSM results for this activity correspond to "avoidance or possible abandonment of one of the multiple burrows a beach mouse maintains" (p. 244). None of the work in the Deer Lake area involved impacts to vegetation. The BA characterizes all TSM results for CBM responses to the Action as behavioral, with no sub-lethal or lethal responses.

The USCG BA did not estimate numbers of CBM affected by the spill response activities corresponding to the TSM results summarized above. Although the DWH Trustees described in general terms some impacts to dune habitats, they did not quantify an injury to beach mice specifically resulting from either the spill or spill response activities. The TSM results for potential CBM responses supported a "likely to adversely affect" determination for the BA. However, interpreting the meaning of these results relative to CBM numbers, reproduction, and distribution within the Action Area is difficult without additional information.

Wetland Sciences (2014) measured the pre- and post-spill response condition of dune vegetation cover at nine beach access points in Walton County, Florida, in which the Topsail Hill and Grayton Beach CBM populations occur. Three of these showed a small collective vegetation loss of 702 ft^2 (0.0016 acre). This study did not identify any new access pathways through the dunes or any intensively used staging areas for indirect (disturbance) impacts assessment.

Lacking a description of the specific nature or spatial extent of the impacts to dune vegetation and other work within the dune buffer zone noted in the BA, we are unable to estimate the number of CBM individuals affected in the Action Area. The behavioral response of avoiding or abandoning burrows indicated by the TSM results could have created the likelihood of injury (see Response Pathways described in section 6.3.1 for the Alabama beach mouse), representing take in the form of harassment. However, due to the limited amount of oil stranding in the range of the CBM, and the less intensive cleanup required, we believe that the Action affected a very small fraction of the CBM population. No cleanup occurred in the area of the Shell Island/West Crooked Island population, which contains about three quarters of the species' currently occupied range.

8.4. Conclusion for Choctawhatchee Beach Mouse

In this section, we summarize and interpret the findings of the previous sections for the CBM (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

g) jeopardize the continued existence of species listed as endangered or threatened; or
h) result in the destruction or adverse modification of designated critical habitat.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Status

Before the 1950s, the CBM was described as abundant in a range that spanned 53 contiguous miles of the Florida Panhandle coastline. Four separate areas that collectively span less than 16 miles comprise the currently occupied range, primarily limited to public lands. These areas contain about 2,400 acres of suitable habitat. Recent estimates of CBM population size are not available; however our 2007 status review indicated that CBM populations appeared to be “on the decline” at that time.

The species’ primary recovery need is to conserve large contiguous tracts containing both frontal dune and scrub habitat types, and to establish separate smaller populations wherever possible elsewhere as a defense against range-wide extinction caused by a hurricane or other catastrophic event. An important additional need is reducing predation pressure, especially from feral and free-roaming domestic cats.

Baseline

As we noted in section 8.2, a separate assessment of the status of the species in the Action Area, i.e., the environmental baseline, is not necessary for the CBM, because the Action Area encompasses the species’ entire range.

Effects

In our discussion of the effects of the Action in section 8.3, we describe two primary pathways by which the Action may have affected beach mice: physical modifications to dune habitat, and human disturbance.

The BA reports 587 segment days of spill response activity within the dunes or dune buffer zone of three of the four areas that currently support CBM. In the Topsail Hill and Grayton Beach areas, 14 and 2 segment days, respectively, of spill response activity involved impacts to dune vegetation via manual cleanup methods. The BA does not describe the nature or spatial extent of these impacts. The BA indicates that the TSM results for this activity correspond to “avoidance or possible abandonment of one of the multiple burrows a beach mouse maintains.”

Lacking a description of the specific nature or spatial extent of the impacts to dune vegetation and other work within the dune buffer zone noted in the BA, we are unable to estimate the number of CBM individuals affected in the Action Area. However, due to the limited amount of oil stranding in the range of the CBM, and the less intensive cleanup required, we believe that the Action affected a very small fraction of the CBM population. No cleanup occurred in the area of the Shell Island/West Crooked Island population, which contains about three quarters of the species’ currently occupied range.

The Action did not exacerbate the primary threat to the species recovery, which is habitat loss and fragmentation. The Action caused no long-term impacts to the likelihood of recovery.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

After reviewing the current status of the species and the effects of the Action, it is the USFWS biological opinion that the Action did not jeopardize the continued existence of the Choctawhatchee Beach Mouse.

9. ST. ANDREW BEACH MOUSE

9.1. Status of St. Andrew Beach Mouse

This section summarizes best available data about the biology and current condition of the St. Andrew Beach Mouse (SABM) (*Peromyscus polionotus peninsularis*) throughout its range that are relevant to formulating an opinion about the Action. The USFWS published its decision to list the SABM as endangered on December 18, 1998 (63 FR 70053–70062). The USFWS completed the most recent 5-year review of the species' status in March 2009, recommending that the SABM remain classified as endangered throughout its range (USFWS 2009b).

9.1.1. Description of St. Andrew Beach Mouse

The SABM is one of five subspecies of the oldfield mouse that inhabit coastal dune communities along the northern coast of the Gulf of Mexico. Fur color is pale brown color on the head and back, and pure white on underparts, sides, feet, face, and tail. Average head and body length is 75 mm); tail length 52 mm; and hind foot length 18.5 mm.

9.1.2. Life History of St. Andrew Beach Mouse

The SABM is a nocturnal and burrowing mouse of the coastal dune and scrub habitats of northwest Florida. Burrows provide protection from predators, heat, and other harsh environmental conditions, a refuge for birthing and resting, and a cache for food items. Like other northern Gulf Coast beach mice, the SABM is an opportunistic omnivore, feeding on a variety of seeds, acorns, and invertebrates.

Due to a relatively recent common ancestry, the SABM shares, with minor differences, many life history characteristics, such as age at sexual maturity, gestation duration, average litter size, monogamous pairing, average life span, etc., with the other four subspecies of norther Gulf Coast beach mice. For purposes of this BO, we rely on our description of the life history of the Alabama beach mouse in section 6.1.2, for our analysis of the Action relative to the SABM.

9.1.3. Numbers, Reproduction, and Distribution of St. Andrew Beach Mouse

Our source of information in this section is the SABM Recovery Plan (USFWS 2010b).

The range of the SABM is the eastern-most among the five subspecies of beach mice occurring along the northern Gulf of Mexico, and is entirely within the Panhandle of Florida. The currently accepted historic range extended along the Gulf coastline from the East Pass outlet of St. Andrew Bay in Bay County to Money Bayou in Gulf County. This range included the mainland coastline along St. Joseph Bay, the St. Joseph Peninsula, and about 5 miles of beaches east of Cape San Blas on the southern shoreline of Gulf County.

The currently occupied range of the SABM is limited to East Crooked Island and the St. Joseph Peninsula. The East Crooked Island population is within the boundaries of Tyndall Air Force Base. Most of the St. Joseph Peninsula population resides with the Florida State Park of the same name. A third location, the mainland beach at Palm Point, which is located across St. Joseph Bay from the northern tip of the St. Joseph Peninsula, may also support a small population, but no recent surveys are available to confirm presence or absence. The most recent survey work at East Crooked Island and the State Park cited in the Recovery Plan suggests that these populations are stable or increasing.

The USFWS has not issued any Incidental Take Permits for the SABM associated with Habitat Conservation Plans on privately owned lands.

9.1.4. Conservation Needs of St. Andrew Beach Mouse

The primary threat to the SABM is the fragmentation of its small range by coastal development. With only two known extant populations that are relatively small and isolated from each other, a primary recovery objective of the 2010 SABM Recovery Plan is to establish additional populations. Sustainable beach mouse populations require large contiguous tracts containing both frontal dune and scrub habitat types, and separate smaller populations wherever possible elsewhere, as a defense against range-wide extinction caused by a hurricane or other catastrophic event (see section 6.1.4 for further details). Managing these areas to reduce cat predation, artificial lighting, damage to dune habitats by recreational activities, and other threats is necessary to maintain resilient populations that can rebound from hurricane impacts.

9.2. Environmental Baseline for St. Andrew Beach Mouse

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the present status of a listed species, its habitat, and ecosystem within the Action Area. It is a “snapshot” of the species’ health in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

However, the Action Area of this consultation encompasses the entire range of the SABM; therefore, we have described the status of the species within the Action Area in the previous section, “9.1 Status of St. Andrew Beach Mouse.”

9.3. Effects of the Action on St. Andrew Beach Mouse

This section analyzes the direct and indirect effects of the Action on the SABM, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

The effects of the Action that we consider in this section are limited to spill response activities conducted on the beaches and adjacent habitats in the current range of the SABM (see section 9.1.3), which is entirely within Bay and Gulf Counties of the Florida Panhandle. The sandy beaches in this area received the least amount of oiling in the Action Area. Three of the BMPs applicable to the operations in this area were intended to avoid and minimize impacts to beach mice (USCG BA: p. 239):

- BMP 34–Check travel corridors for evidence of beach mice before work.
- BMP 39–Avoid dunes, and establish a 10-foot work buffer around dune vegetation.
- BMP 46–No more than three workers using small hand tools may remove tarballs from dunes authorized for clean up.

9.3.1. Response Pathways

The pathways between Action-caused stressors and the responses of individual SABM are the same as those described in section 6.3.1 for the Alabama beach mouse. Responses to: (a) physical modifications of dune habitats; and (b) human disturbance/artificial lighting; are comparable between SABM and Alabama beach mice.

9.3.2. Estimation of Effects

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon information provided in the USCG BA. Our previous description of the "USCG Take Score Model" (TSM) methodology in section 2.3.2 applies to the USCG estimation of effects to the SABM.

The BA does not report total segment days of oil cleanup activity in the range of the SABM, noting only that all TSM results were within the range of a "low-behavioral response level" corresponding to potential 'alarm' and 'startle' responses. Responders did not use any mechanical cleanup methods, which limited the possibility of collapsing burrows. Responders accomplished all work during daytime hours, which limited the possibility of disturbing nocturnal activity outside of burrows. The BA does not indicate that any of the work caused impacts to dune vegetation, as explicitly noted in the assessment for other beach mouse subspecies.

The BA does not estimate numbers of SABM affected by the spill response activities corresponding to the TSM results summarized above. Although the DWH Trustees (2016) described in general terms some impacts to dune habitats, they did not quantify an injury to beach mice specifically resulting from either the spill or spill response activities. The USGG used the TSM results to support a "likely to adversely affect" determination in the BA relative to the SABM. However, interpreting the meaning of these results relative to SABM numbers, reproduction, and distribution within the Action Area is difficult without additional information. However, based on the information summarized above, any adverse effects to SABM appear insignificant or discountable.

Wetland Sciences (2014) investigated pre- and post-spill response condition of dune vegetation cover in the Action Area. They identified no impacts to dune vegetation in the range of the SABM at beach access points used for oil cleanup. They identified no intensively used staging areas for indirect (disturbance) impacts assessment.

The limited amount of oil stranding in the range of the SABM required a much less intensive cleanup effort than elsewhere in the Action Area. Best available data suggests that Action-caused stressors were limited in severity to daytime disturbance, that individuals' exposure to such disturbance was relatively unlikely, that responses upon exposure to this disturbance, if any, were behavioral, and the sum of all such responses was not likely to measurably reduce the numbers, reproduction, or distribution of SABM in the Action Area.

9.4. Conclusion for St. Andrew Beach Mouse

In this section, we summarize and interpret the findings of the previous sections for the SABM (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

i) jeopardize the continued existence of species listed as endangered or threatened; or
j) result in the destruction or adverse modification of designated critical habitat.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

<u>Status</u>

The currently occupied range of the SABM is limited to East Crooked Island and the St. Joseph Peninsula, primarily on public lands. A primary recovery objective of the 2010 SABM Recovery Plan is to establish additional populations. Managing these areas to reduce cat predation, artificial lighting, damage to dune habitats by recreational activities, and other threats is necessary to maintain resilient populations that can rebound from hurricane impacts.

<u>Baseline</u>

As we noted in section 9.2, a separate assessment of the status of the species in the Action Area, i.e., the environmental baseline, is not necessary for the SABM, because the Action Area encompasses the species' entire range.

<u>Effects</u>

In our discussion of the effects of the Action in section 9.3, we describe two primary pathways by which the Action may have affected beach mice: physical modifications to dune habitat, and human disturbance.

The limited amount of oil stranding in the range of the SABM required a much less intensive cleanup effort than elsewhere in the Action Area. Best available data suggests that Action-caused stressors were limited in severity to daytime disturbance, that individuals' exposure to such disturbance was relatively unlikely, that responses upon exposure to this disturbance, if any, were behavioral, and the sum of all such responses was not likely to measurably reduce the numbers, reproduction, or distribution of SABM in the Action Area.

The Action did not exacerbate the primary threat to the species recovery, which is habitat loss and fragmentation. The Action caused no long-term impacts to the likelihood of recovery.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

After reviewing the current status of the species and the effects of the Action, it is the USFWS biological opinion that the Action did not jeopardize the continued existence of the St. Andrew Beach Mouse.

10. PIPING PLOVER

10.1. Status of Piping plover

This section summarizes best available data about the biology and current condition of the piping plover (*Charadrius melodus*) that are relevant to formulating an opinion about the Action. The species' range includes portions of Canada, the U.S., Mexico, and the Caribbean. In 1985, the USFWS classified the population breeding in the Great Lakes watershed as endangered, and all other breeding populations in the species' range as threatened (50 FR 50720). The migratory routes and wintering grounds of the Great Lakes breeding population overlap with those of populations breeding in the Northern Great Plains and along the Atlantic Coast. The 1985 listing rule considers piping plovers wherever found outside of the Great Lakes watershed as threatened.

Our most recent 5-year status review of the species recommended retaining the current ESA classification (USFWS 2009c). The status review also summarized data that would support classifying the piping plover for ESA purposes as two subspecies, *C. m. melodus* (Atlantic Coast breeding population), and *C. m. circumcintus.* Additional data would support classifying the latter as two discrete breeding populations: (a) the Northern Great Plains of the U.S. and Canada, and (b) the Great Lakes watershed of the U.S. and Canada. However, the review concludes that revising the classification accordingly would have little regulatory or conservation effect, because the current classification appropriately represents the status of the three breeding populations.

10.1.1. Description of Piping plover

Named for its melodic mating call, the piping plover is a pale-colored shorebird about the size of a robin. Length is 17–18 cm; weight is 43–63 g. Plumage, bill, and leg coloration are slightly different between the breeding season and winter, between juveniles and adults, and between males and females.

10.1.2. Life History of Piping plover

Our most recent 5-year status review (USFWS 2009c) of the piping plover summarized the species' biology and habitat in four geographic contexts:

1. Wintering and migration range;
2. Great Lakes breeding range;
3. Northern Great Plains breeding range; and
4. Atlantic Coast breeding range.

Of these, only information about the wintering and migration range is relevant to this BO. Please refer to the 5-year review for information about the breeding biology of the species.

Unless otherwise cited, the 5-year review (USFWS 2009c) is the source for information summarized in this section.

Migration

Piping plovers live an average of about 5 years (Wilcox 1959), with a few documented instances of banded individuals surviving to an age of 11, 15, and 17 years (Audubon Society 2017). Piping plovers migrate between breeding and wintering areas annually. Adults spend only about 2–4 months in breeding areas, and the rest of the annual cycle in wintering areas and in migration between the two areas. Plovers depart breeding areas from July through late August. During migration, piping plovers do not concentrate in large numbers at stopover sites, and most sighting reports are of single individuals.

Individuals generally return to the same wintering sites each year. During the course of winter residency, local movements between sites are common, but individuals use particular sites repeatedly. Telemetry studies in Texas estimated the mean home range size of wintering plovers at about 3,114 acres (95 percent of locations), with a core area (50 percent of locations) of 717 acres. In North Carolina, seven radio-tagged piping plovers used a 4,967-acre area at Oregon Inlet. Banded piping plovers on a Georgia barrier island were observed repeatedly throughout the winter within beach segments 0.62–2.80-mile in length.

Foraging

Piping plovers on the wintering grounds spend the majority of their time foraging (Nicholls and Baldassarre 1990a; Drake 1999a, 1999b). Feeding may occur during all hours of the day and night (Staine and Burger 1994; Zonick 1997), and during all stages in the tidal cycle (Goldin 1993; Hoopes 1993). The plover winter diet includes polycheate worms, crustaceans, fly larvae, beetles, and occasionally bivalve mollusks (Nicholls 1989; Zonick and Ryan 1995).

Piping plovers peck prey items from the surface, or slightly below the surface, of moist substrates in a great variety of settings that are near open water and without dense vegetation. Foraging sites include:

- ocean, bay, island, and inlet beaches/shorelines;
- mud, sand, and algal flats;
- shoals;

- wrack lines (seaweed, seashells, driftwood, and other materials deposited on beaches by waves and tides);
- margins of coastal ponds, lagoons, and ephemeral pools;
- salt marsh shorelines
- exposed seagrass beds and oyster reefs; and
- exposed substrates and washover passes at the mouths of rivers.

Roosting

Piping plovers roost in unvegetated or sparsely vegetated areas near open water. Debris, detritus, or micro-topographic relief may provide refuge from high winds and cold weather. Several studies identified wrack as an important component of roosting habitat for wintering piping plovers (Lott *et al.* 2009; Maddock *et al.* 2009; Smith 2007; Drake 1999a, 1999b).

10.1.3. Numbers, Reproduction, and Distribution of Piping Plover

Unless otherwise cited, the 5-year status review (USFWS 2009c) is the source for information summarized in this section.

The piping plover breeds in three regions of the U.S. and Canada: (a) the Northern Great Plains; (b) the Great Lakes watershed; and (c) the Atlantic Coast. These three populations migrate to wintering areas on the coasts of the Gulf of Mexico (most in south Texas), the Bahamas, and the Caribbean. A few individuals winter in Mexico on the northern coast of the Gulf of California.

Every fifth year since 1991, the U.S. Geological Survey (USGS) has coordinated a range wide International Piping Plover Census on both the species' wintering and breeding grounds. Results from the most recent census in 2016 are not yet published. The 2011 census detected 3,973 and 5,723 piping plovers on the wintering and breeding grounds, respectively (Elliot-Smith *et al.* 2015). The wintering area surveys always precede the breeding area surveys in a census year. Census coverage is extensive, but incomplete, and detection probability is variable in both breeding and wintering areas surveyed; therefore, 5,723 birds represents a range wide minimum population size for 2011. The Atlantic Coast, Northern Great Plains, and Great Lakes breeding area surveys accounted for 59, 39, and 2 percent of the total 2011 count, respectively.

The Atlantic Coast breeding population has gradually increased from 790 pairs in 1986 to 1,941 pairs in 2016 (USFWS 2017). The Great Lakes breeding population increased from 51 pairs in 2002 to 75 pairs in 2016. Estimating population size and discerning trends for the Northern Great Plains population is more difficult, due to the wide geographic distribution of nesting in many remote areas. The 1991 International Census of the Northern Great Plains breeding population counted about 3,500 adults, which declined to about 3,000 in 2001, followed by a dramatic increase to about 4,600 in 2006, and then a record low of about 2,200 in 2011. Additional Missouri River sandbar nesting habitat associated with multi-year drought conditions account for the increase during 2006. Absent this spike in numbers during 2006, the Census data otherwise indicate a declining trend for the Northern Great Plains breeding population.

Intensive management to reduce human disturbance and predation in the Great Lakes breeding population has contributed to improved breeding success. The average annual fledging rate for Great Lakes breeding pairs was 1.76 fledglings during the five years preceding the 2009 status review, which exceeds the recovery goal of 1.5 fledglings per pair. Breeding success in the more abundant Atlantic Coast population is variable, with higher fledging rates in eastern Canada and New England, and lower rates in the other states of the U.S. breeding range (New York to North Carolina). Fledging rates data for the Great Plains breeding population is sparse.

Expanded coverage outside of the United States in the 2011 winter International Census detected 1,066 Piping Plovers wintering in the Bahamas, representing about 27 percent of the 2011 total winter count. The count in Texas represented 54 percent of total winter numbers. The other 19 percent of the 2011 winter count was distributed in areas between Virginia and Florida on the U.S. Atlantic Coast (7 percent), between Louisiana and Florida on the U.S. Gulf Coast (11 percent), and between Mexico, Cuba, and Puerto Rico (1 percent) (Elliot-Smith *et al*. 2015).

None of the three piping plover breeding populations exclusively use a particular region in the winter range, but strong patterns of usage are evident from observations of banded birds. Atlantic Coast birds are most prevalent along the southern Atlantic Coast and Bahamas, and have been observed on the Gulf Coast only in Florida. Almost all Great Lakes birds are banded, and are observed wintering in the Carolinas, Georgia, and both coasts of Florida. Northern Great Plains birds predominate in coastal Texas, Louisiana, and Mississippi, but have been observed in every region of the wintering range. The winter range of all three breeding populations overlap most markedly on the Gulf Coast of Florida. Assessing proposed actions or potential changes that may affect piping plovers on migration or in the winter range should consider any disproportionate effects on a single breeding population, especially the small Great Lakes population, which is most vulnerable to minor changes in adult survival and fitness.

10.1.4. Conservation Needs of Piping plover

Unless otherwise cited, the 5-year status review (USFWS 2009c) is the source for information summarized in this section.

The threats to piping plover survival and recovery and corresponding conservation needs vary regionally in its broad geographic range. Conservation needs specific to the three breeding regions are not directly relevant to this BO, but in general, piping plovers are exposed to persistent threats from habitat degradation, human disturbance, and predation.

The low abundance of the Great Lakes population make it especially vulnerable to minor increases in stressors that either reduce breeding success or adult survival and fitness in winter habitats. Water management that limits riverine nesting habitat availability, and increasing oil and gas production in proximity to dispersed prairie wetlands nesting habitats, are additional stressors to the Northern Great Plains population. Although the Atlantic Coast population is gradually increasing, habitat degradation, human disturbance, and predation pressure have increased in some areas, limiting the rate of recovery. Please refer to the population-specific recovery plans for more information about conservation needs on the breeding grounds: (a)

Atlantic Coast Population (USFWS 1996); (b) Great Lakes Population (USFWS 2003); and (c) Northern Great Plains Population (USFWS 2015) (draft of first revision).

Progress towards recovery attained through increases in productivity on the breeding grounds are diminished or even reversed by small decreases in survival rates or fecundity caused by stressors experienced during the migration and wintering periods (Drake and Mehl 2004; Catlin 2009; Roche *et al*. 2010). Therefore, the plover's primary conservation need on wintering grounds is to protect and maintain a distribution of foraging and roosting habitat that maximizes individual survival and maximizes fitness for spring migration and breeding. The three breeding population Recovery Plans address this need, but the USFWS (2015) has recently compiled a conservation strategy for piping plovers in their migration and winter range that addresses it comprehensively for the entire U.S. winter range.

Piping plovers winter on wide, flat, sparsely vegetated mainland and barrier island beaches, sand spits, sandbars, and bayside flats. Waves, tides, currents, storms, terrestrial runoff, and biological communities interacting with sediments at the land/sea interface form these dynamic and ephemeral habitats. Human development at the land/sea interface tends to disrupt these processes to create areas, at least temporarily, of greater physical stability. Barrier island and beachfront development, inlet and shoreline stabilization, inlet dredging, inlet closure, beach nourishment, seawalls, and mechanical beach grooming alter habitat-forming coastal processes in much of the piping plover winter range. Jetties, groins, and other structures interrupt the movement of sediment that forms spits, shoals, flats, and barrier islands in the coastal environment. Climate-driven sea level rise will likely exacerbate the impact of shoreline stabilization features on plover habitat availability by increasing erosion rates in adjacent areas.

Constructing these shoreline stabilization features when piping plovers are present is a disturbance that disrupts foraging and roosting behaviors. The additional disturbance (human activity, pets, etc.) that accompanies coastal development is associated with reduced plover use of otherwise suitable habitats (Drake *et al*. 2001; Arvin 2008).

Sandy beaches are a major component of piping plover winter habitat. The continental U.S. wintering range of the piping plover contains about 2,119 miles of sandy beaches, of which about 40 percent are developed, and about 43 percent are reserved from further development through public or conservation organization ownership or easement (USFWS 2015). The remaining 17 percent is undeveloped, but not protected from development.

The highest priority recovery actions identified in the winter/migration conservation strategy involve protecting plovers from the direct and indirect impacts of coastal development, and from alteration of coastal morpho-dynamic processes that form and maintain plover habitats. Second-tier priority actions involve protecting plovers from human disturbance; e.g., managing pedestrian, off-road vehicle, and pet access to important plover habitats when plovers are present.

The USFWS has issued five Incidental Take Permits for the piping plover associated with Habitat Conservation Plans on privately owned lands, including one in the Action Area (Escambia County, Florida).

10.2. Environmental Baseline for Piping Plover

This section is an analysis of the effects of past and ongoing human and natural factors leading to the present status of the piping plover, its habitat, and ecosystem within the Action Area. Ordinarily, the environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation, and does not include the effects of the Action under review. However, the emergency response action of this consultation is concluded. We do not attempt to analyze the status of the species at the time the emergency and the Action began in April 2010. Instead, this section summarizes best available data about the present status of the species in the Action Area, which reflects the effects of the oil spill, response activities, and other relevant factors. We discuss the relative contribution of the Action to the species' present status in the "Effects of the Action" section, which follows this "Baseline" section.

10.2.1. Action Area Numbers, Reproduction, and Distribution of Piping Plover

The Action Area spans the geographic center of the piping plover's winter range in coastal areas of the continental U.S. between North Carolina and the Texas/Mexico border. The shorelines between Galveston County, Texas, and Apalachee Bay, Florida, contain about 600 miles of the nearly 1,800 miles designated as critical habitat for wintering piping plovers (66 FR 36038; see section 15 of this BO for our analysis of the Action relative to piping plover critical habitat).

Spill responders surveyed 4,386 miles of shoreline within the Action Area for evidence of oiling (Michel *et al.* 2013). The distribution of designated critical habitat units roughly corresponds to the distribution of the highest quality piping plover winter habitat within the Action Area, but plovers use many areas outside of critical habitat. To identify shoreline segments within which piping plovers were likely to occur during the spill response for its effects analysis, the USCG also used piping plover sightings recorded during the spill response.

The Action Area constitutes about one third of the winter range within the U.S. The Gulf Coast of Florida, Alabama, Mississippi, and Louisiana, contributed about one third of the range wide numbers counted in the winter International Census efforts of 1991, 1996, and 2001 (USFWS 2015). However, the Census results reported for the Gulf Coast include peninsular Florida, which is outside the Action Area. We do not include Texas numbers in this range wide fraction, because piping plover numbers in Texas within the Action Area (Galveston County) are a tiny fraction of the Texas numbers. The contribution by the Gulf Coast east of Texas dropped to about 17 percent in the 2006 Census, and to about 11 percent in the 2011 Census. Many areas in Louisiana, which typically contributes the largest Gulf Coast counts after Texas, were not surveyed in 2011, while spill response and damage assessment activity closed these areas to Census participants. Table 10-1 shows the Census results from 1991–2011.

Table 10-1. Results of the 1991, 1996, 2001, 2006, and 2011 International Piping Plover Census of wintering birds (taken from USFWS 2015).

Location	1991	1996	2001	2006	2011
Virginia	NS[1]	NS	NS	1	1
North Carolina	20	50	87	84	43
South Carolina	51	78	78	100	86
Georgia	37	124	111	212	63
Florida	551	375	416	454	306
Atlantic	70	31	111	133	83
Gulf	481	344	305	321	223
Alabama	12	31	30	29	38
Mississippi	59	27	18	78	88
Louisiana	750	398	511	226	86[2]
Texas	1,904	1,333	1,042	2,090	2,145
Puerto Rico	0	0	6	NS	2
U.S. Total	3,384	2,416	2,299	3,355	2,858
Mexico	27	16	NS	76	30
Bahamas	29	17	35	417	1,066
Cuba	11	66	55	89	19
Other Caribbean Islands	0	0	0	28	NS
RANGE WIDE TOTAL	**3,451**	**2,515**	**2,389**	**3,884**	**3,973**

[1] NS = not surveyed
[2] Louisiana surveys limited by DWH spill response activity.

Gratto-Trevor *et al*. (2012) studied patterns of the winter distribution of piping plovers banded in the U.S. and Canada portions of the Northern Great Plains breeding area, the Great Lakes breeding area, and the eastern Canada portion of the Atlantic Coast breeding area. The study did not include any birds banded in the U.S. portion of the Atlantic Coast breeding area. Atlantic Coast birds were not resighted within the Action Area. About 5 percent of the Great Lakes birds and 11 percent of the Northern Great Plains birds were resighted along the northern Gulf Coast in Louisiana, Mississippi, Alabama, and Florida.

10.2.2. Action Area Conservation Needs of Piping Plover

The highest priority recovery actions for piping plovers in the Action Area are the same as those identified in the range wide winter/migration Conservation Strategy (USFWS 2015): protect plovers from the direct and indirect impacts of coastal development, and from alteration of coastal morpho-dynamic processes that form and maintain plover habitats. Second-tier priority actions involve protecting plovers from human disturbance; e.g., managing pedestrian, off-road vehicle, and pet access to important plover habitats when plovers are present.

The winter/migration Conservation Strategy summarizes by state the degree of shoreline development, the number and type of structural modifications to inlets, the extent of public ownership, and other factors that characterize the current level of threats to piping plover winter habitat. In general, the Gulf coastline between Louisiana and Florida supports about one third of the winter habitat resource and accounts for about one third of the range wide development, structural alteration, and protection afforded to this resource through public ownership. For further details about threats within the Action Area, and the specific strategies to address these threats, please refer to the Conservation Strategy (USFWS 2015).

The Action of this consultation highlights an additional threat to piping plovers that other regions within the winter range do not share to the same degree: habitat degradation resulting from oil spills. The north central Gulf is the center of U.S. off-shore oil production. Spills of sufficient magnitude to strand oil on shorelines will likely include shorelines that support piping plovers.

10.3. Effects of the Action on Piping Plover

This section analyzes the direct and indirect effects of the Action on the piping plover, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

10.3.1. Response Pathways

The Action involved putting people, vehicles, and other equipment on the shorelines of the Action Area, which introduced potential stressors (biologically relevant changes to the environment) to wintering piping plovers and their foraging and roosting habitat resources. The Action also involved the physical closure of several inlets between the Gulf and protected waters to prevent the more landward movement of oil. In this section, we describe the likely responses of individual piping plovers upon exposure to Action-caused stressors.

Disturbance

The activity of cleanup crews, vehicles, and other equipment introduced movement, noise, and other changes that were likely to disturb piping plovers, if present, or to deter their use of an area.

Shorebirds are generally wary of human activity in their habitats, and will typically move away to maintain some distance. This response reduces an individual’s time spent foraging and roosting and increases its time in alert postures and movement (Burger 1991; 1994; Elliott and Teas 1996; Lafferty 2001a; 2001b; Thomas *et al*. 2002). Multiple short flights away from disturbance are a costly energy expenditure (Nudds and Bryant 2000). In surveys of piping plovers along the Atlantic and Gulf Coasts, Nicholls and Baldassarre (1990a) noted that plovers were more abundant on sites with minimal or no human disturbance. They recommended further research to determine the mechanisms and degree of disturbance that precludes the use of an area by wintering piping plovers. Recurring disturbance that precludes foraging and roosting in an area would be functionally equivalent to habitat loss. Pfister *et al.* (1992) implicate anthropogenic disturbance as a factor in the long-term decline of migrating shorebirds at staging areas.

Vehicles affect piping plover behavior. Zonick (2000) found that the density of off-road vehicles was negatively correlated with piping plover abundance on Texas beaches. Cohen *et al*. (2008) found that radio-tagged piping plovers using ocean beach habitat at Oregon Inlet in North Carolina made little use of the north side of the inlet where off-road vehicle use is permitted. The vast majority of detections (96 percent) occurred on the south side of the inlet where vehicle use is prohibited.

Prey Reduction via Wrack and Sediment Removal

Some cleanup operations involved removing oil-fouled wrack and sediments from shorelines, both by manual and mechanical means. Oil-fouled wrack and sediments represent a contamination hazard to shorebirds feeding upon the invertebrates associated with it, including piping plovers. Although removing this reservoir of contamination was prudent, wrack and sediment removal is otherwise associated with adverse shorebird responses.

Shorebird numbers are positively correlated with wrack and the biomass of invertebrates that feed on wrack (Tarr and Tarr 1987; Hubbard and Dugan 2003; Dugan *et al*. 2003). Defeo *et al*. (2009) summarized data suggesting that removing wrack via beach grooming decreases shorebird bird numbers by reducing invertebrate prey biomass. Although mechanical beach grooming equipment effectively removes human-deposited trash, these devices also remove naturally accumulated wrack, topographic depressions, emergent fore dunes and hummocks, and small clumps of vegetation that are important habitat features for shorebird roosting and foraging (Nordstrom 2000; Dugan and Hubbard 2010).

The Ixtoc oil spill in June 1979 off the Gulf Coast of Mexico stranded about 350 metric tons of oil on the barrier island beaches of South Texas. Chapman (1984) collected pre- and post-spill data on the abundance, distribution, and habitat use of shorebirds on the affected beaches, documenting declines in bird numbers and shifts in habitat usage. Shorebirds, including piping plovers, generally avoided the oiled intertidal portions the beach, and used the higher backshore portions or moved to estuarine habitats. The abundance of infaunal organisms on contaminated portions of the beach was reduced by 79 percent (Kindinger 1981; Tunnell *et al*. 1982). Chapman surmised that the decline in prey biomass most likely explained the observed shifts in shorebird habitat usage following the spill.

Inlet Closure

To prevent the movement of oil from the Gulf into adjacent sheltered waters, the Action involved the physical closure of at least 32 inlets: 29 in Louisiana, 2 in Alabama, and 1 in Florida (USFWS 2015: Appendix 1 W.b). These inlet closures are not specifically described in the BA, and were not necessarily approved by the USCG Incident Command. However, the scope of the Action includes actions taken without initial USCG authorization by the National Guard and the

States to mitigate the impacts of the spill (USCG BA; p. 9); therefore, we consider these inlet closures an Action-caused stressor.

The tidal shoals/deltas associated with inlets are a preferred foraging habitat of piping plovers (Nicholls and Baldassarre 1990b; Harrington 2008; Addison 2012). Inlet shorelines accounted for about 90 percent of the piping plover roosting locations observed at ten coastal sites in southwest Florida (Lott *et al.* 2009). Inlet closure eliminates such roosting opportunities and disrupts the processes that form and maintain the adjacent tidal deltas that support plover foraging. The expected piping plover individual response to inlet closure is an adjustment of winter home range (increased area or location shift) that included the foraging and roosting resources of the inlet.

10.3.2. Estimation of Effects

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon the USCG BA and on the DWH Trustees (2016) damage assessment as our data sources. Our previous description of the "USCG Take Score Model" (TSM) in section 2.3. also applies to the USCG estimation of effects to the piping plover.

<u>Take Score Model Results</u>

The TSM results are the best available data for estimating the amount or extent of piping plover exposure to Action-caused disturbance and wrack removal. Individual piping plovers use multiple sites during winter residency in an area (see section 10.1.2), and respond to disturbance by moving away from it (see section 10.3.1; "Disturbance"). Disturbance of extended duration and spatial scope within an individual's winter home range could impair foraging efficiency or cause home range abandonment, and thereby reduce individual survival probability or fitness for spring migration and breeding. The USCG TSM accounted for this potential impact by computing the score for a segment day of activity considering whether any activity occurred in the segment during the previous day and whether any activity occurred during the same day in adjoining segments. The TSM also accounts for reduced prey density and roosting habitat availability resulting from wrack removal, but not for the loss of habitat caused by closing inlets to prevent more landward oil movement (see "Inlet Closure" section below).

The USCG did not use the TSM to estimate piping plover effects in the Texas portion (Galveston County) of the Action Area. Spill response activity in Texas was limited to the recovery of 118 yd^3 of material, and the BA does not report the segment days associated with this work. Available plover observations data within Galveston County indicated that plover numbers and distribution were similar during 2010, 2011, and 2012, suggesting little or no effect of the limited oil cleanup work.

The majority of piping plover responses predicted by the TSM for segment days of work in Louisiana, Mississippi, Alabama, and Florida fall within the behavioral range. Piping plovers present in these segments would have most likely shifted activity away from Action-caused disturbance without biologically meaningful consequences. Figures 6.3-5, -6, -11, -14, and -17 in the BA show the locations of predicted behavioral responses, but the BA does not report the total segment days corresponding to these results.

The BA specifically identifies each segment day of work for which the TSM predicted potential sub-lethal or lethal piping plover responses (USCG BA: section 6.3.3). Table 10-1 below summarizes these TSM results by State. Table 10-1 also notes the number of piping plovers observed within segments at the time of the work or within a few weeks of the work. These bird counts are not necessarily a complete census of piping plover presence in these segments, and do not represent the actual numbers of piping plovers exposed to potentially sub-lethal and lethal stressors. However, the recorded plover sightings provide the best available data for interpreting the possible extent of such exposure.

Table 10-2. Take Score Model estimations of sub-lethal and lethal piping plover responses (segment days of work) by State, and corresponding number of piping plovers observed within these segments (Source: USCG BA: section 6.3.3).

State	Segment Days with Potential Sub-lethal Responses	# of Plovers Observed	Segment Days with Potential Lethal Responses	# of Plovers Observed
Louisiana	4	51	2	36
Mississippi	14	22		
Alabama	6	6		
Florida	16	2	1	0
Total	40	81	3	36

The spill-response work associated with the segment days reported in Table 10-2 involved large numbers of responders, excavators, bull dozers, pressure washers, sand cleaning machines, barges, etc. This work caused a scale of disturbance and habitat alteration that, according to the TSM, was sufficient to displace plovers within a substantial radius and thereby reduce individual fitness or probability of survival.

The TSM results that correspond to potentially lethal piping plover responses were limited to two segments in Louisiana (one day of work in each), where a total of 36 piping plovers were observed, and to one segment in Florida, where no piping plovers were observed within 2.4 miles of the work. The description of this work in the BA is similar to that of the work associated with the sub-lethal responses. As potentially lethal responses, one or more of the model parameters for these segment days are severe, but the BA does not deconstruct these model results. Please refer to the BA section 6.1 for more details about the TSM methodology, and to the BA section 6.3.3 for more details about the piping plover results.

In preparing the BA, the USCG found no records of piping plover deaths or injuries caused by the spill response, and found only one record of a dead piping plover recovery on 14 September 2010, with no additional information about the circumstances. The DWH Trustees (2016: Table

4.7-3) estimated that the spill itself caused the loss of 26–41 piping plovers, but did not estimate a number of individuals affected by spill response activities.

Inlet Closure

Inlets provide preferred piping plover foraging and roosting habitats (see "Inlet Closure" discussion in section 10.3.1). The tidal shoals/deltas formed near the landward and seaward approaches to an inlet are important locations for invertebrate production that is available to foraging plovers. Closing an inlet eliminates this source of prey and the roosting sites on the inlet shorelines, which most likely reduces the ability of the area to support piping plovers.

The BA did not provide an assessment of effects to piping plovers caused by the closure of 32 inlets (29 in Louisiana, 2 in Alabama, and 1 in Florida) during the spill response that we identified in the winter/migration habitat conservation strategy (USFWS 2015: Appendix 1 W.b). Of these closures, only the West Little Lagoon Pass near Gulf Shores, Alabama, was reopened by 2015. We are unaware of plans to reopen the other 31.

Lacking site-specific data on piping plover use of the closed inlets, we cannot directly estimate the number of birds this activity may have displaced to other habitat types. Except for the Chandeleur Island complex, Nicholls and Baldassarre (1990a) ranked none of the closed inlets among the most important wintering sites for piping plovers. Interpreting the effects of inlet closures in the Chandeleur Islands is complicated by the construction of about 16 miles of berm, in addition to closing existing inlets, also to reduce the landward movement of oil from the DWH spill (see section 1.2 under "*Habitat Modification*"). Sites that supported wintering piping plovers on the Gulf Coast, but that Nicholls and Baldassarre (1990a) did not rank as important sites (61 sites), had less than 40 birds per site and an average of 20. We believe it is likely that the closed inlets supported wintering piping plovers, because inlets are particularly suited to providing the species' foraging and roosting needs. It is unlikely that the closed inlets supported $20 \times 32 = 640$ plovers, as this exceeds the total number of plovers that are known to winter in the Action Area. However, this calculation illustrates the relative contribution of 32 sites of modest suitability to winter habitat carrying capacity.

Our inventory of coastal inlets in the full U.S. winter range of the piping plover for the winter/migration habitat conservation strategy (USFWS 2015; Appendix 1 W.b) identified 221 inlets between North Carolina and Texas. The closure of 32 of these during the 2010 DWH spill response reduced the range wide total by 14 percent. However, the majority (29) of the DWH inlet closures were in Louisiana, where barrier islands are eroding at a rate of up to 20 meters per year, and several may disappear by the end of the century (USGS: https://pubs.usgs.gov/fs/la-wetlands/). Closing barrier island/peninsula breaches in this context may benefit piping plovers if it contributes to maintaining their barrier island habitats.

Interpretation

Extensive use of intertidal habitats places piping plovers directly on the land/sea interface that is most likely to strand oil from an ocean borne spill. In Louisiana, 90 percent of piping plovers the Department of Wildlife and Fisheries observed during winter surveys preceding the DWH spill were on shorelines that received oiling (USFWS 2015). Although most piping plovers were on breeding grounds or on migration before responders capped the Macondo well on July 15, 2010, oil was still washing onto Gulf beaches as plovers arrived thereafter.

There is no direct evidence of piping plover mortality associated with spill response activity. The most likely effect of the Action on the species was reduced individual fitness caused by the substantial disturbance of cleanup operations in their habitats. Wrack removal and other alterations of foraging substrates by cleanup operations likely reduced prey abundance, which may have also contributed to reduced plover fitness. However, the oil contamination itself would have reduced prey abundance, and this effect would likely persist longer without its removal. Reduced fitness would translate to some degree of reduced survival during spring migration or reduced productivity on the breeding grounds.

Inlets closed to prevent oil from entering protected waters may have caused impacts to the quality of piping plover winter habitat in the Action Area. However, most of the closures were in Louisiana, where filling breaches in barrier islands and peninsulas is frequently necessary to slow the nation’s highest rate of coastal erosion.

Observations of banded piping plovers (Gratto-Trevor *et al*. 2012) suggest that the northern Gulf Coast between Louisiana and the Florida Panhandle provides winter habitat for 11.2 percent of the Northern Great Plains and 4.7 percent of Great Lakes breeding populations. The 2011 International Census of the Northern Great Plains breeding population observed a record low of about 2,249 adult piping plovers, following a record high of more than 4,500 adults in 2006 (see sections 10.1.3 and 10.2.2). The small Great Lakes population was comprised of 112 adults in 2011. Using the observed winter distribution of birds banded in breeding areas cited above, 11.2 percent of the 2011 Northern Great Plains population is 253 adult birds, and 4.7 percent of the 2011 Great Lakes population is 5 birds; a total of 258.

For purposes of interpreting the relative effects of the Action on the two breeding populations, we assume that 5 out of 258 birds, or 1.9 percent are from the Great Lakes breeding population, and the remaining 98.1 percent are from the Northern Great Plains population. This indirect calculation of 258 piping plovers wintering in the Action Area is greater than the actual 2011 winter census total for Louisiana, Mississippi, and Alabama (212 birds), but less than the total including birds from the entire Gulf Coast of Florida (435 birds), most of which is outside the Action Area (see Table 10-1). The 2011 Louisiana winter census did not include many areas normally surveyed in Louisiana due to the ongoing spill response during the census period.

The BA reports that 117 piping plovers were observed during spill response activity that the TSM classified as causing potential sub-lethal and lethal responses (see Table 10-2). Applying the breeding population percentages discussed above to this number yields 114 Northern Great Plains and 3 Great Lakes birds. If we assume that all of these birds experienced a significant reduction in fitness and subsequent lower survival during spring migration or lower breeding success, the Action would have affected about 114 ÷ 2,249 = 5.1 percent of the Northern Great Plains population and 3 ÷ 112 = 2.7 percent of the Great Lakes population. However, we must temper this “worst-case” scenario with the reality that most or all piping plovers and their habitats in the Action Area were exposed to some degree of oiling during the 2010-2011 winter season, and to a progressively lesser degree during the following winters. This exposure occurred with or without the additional stressors caused by the cleanup activities. The Action removed a substantial amount of that oil from plover habitats and thereby reduced the level of substrate and prey contamination, which benefited the species.

The apparent decline of the Northern Great Plains population far exceeds the possible loss of up to 5.1 percent of its population resulting from exposure to oil and spill response activity in the Action Area, but an impact of some magnitude from these stressors is certainly not discountable. The possible loss of 2.7 percent (3 birds) of the Great Lakes population could have contributed to the observed drop in breeding pairs from 60 in 2010 to 54 in 2011, but the population had also declined by 11 pairs from 2009 to 2010, the year before the spill (Cuthbert and Saunders 2013). The Great Lakes population has since increased to 75 pairs in 2016 (Cavalieri 2016; personal communication). Results from the 2016 International Census, which will report breeding population numbers range wide, are not yet available.

10.4. Conclusion for Piping Plover

In this section, we summarize and interpret the findings of the previous sections for the piping plover (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

c) jeopardize the continued existence of species listed as endangered or threatened; or
d) result in the destruction or adverse modification of designated critical habitat.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

<u>Status</u>

The 2011 International Census detected 5,723 piping plovers on the breeding grounds. The Atlantic Coast, Northern Great Plains, and Great Lakes breeding area surveys accounted for 59, 39, and 2 percent of this total. The Atlantic Coast and Great Lakes populations are gradually increasing, and the Northern Great Plains population is likely decreasing. The two growing populations benefit from intensive management that reduces human disturbance and predation on the breeding grounds. However, decreases in survival or fecundity caused by stressors experienced during migration and winter residency (more than two thirds of the annual life cycle) may stall or reverse recovery progress on the breeding grounds. The plover's primary conservation need on the wintering grounds is to protect and maintain a distribution of foraging and roosting habitat that maximizes individual survival and maximizes fitness for spring migration and breeding success. The most serious threat to meeting this need is coastal development that alters the processes that form and maintain plover habitats. Recovery actions must also address the disturbance caused by people, off-road vehicles, and pets in important plover habitats when plovers are present.

Baseline

The Action Area constitutes about one third of the piping plover's winter range within the U.S., but supported less than one third of the species' numbers in the 2011 International Census of the wintering grounds. More precise estimates of Action Area numbers are not available to us, as the Census combines the Gulf Coast counts for Peninsular Florida with the Florida Panhandle, and Louisiana winter surveys in 2011 were disrupted by spill response activities. Analysis of banded bird observations suggests that the Action area may support about 11 percent of the Northern Great Plains population and about 5 percent of the small Great Lakes population. Birds from the Atlantic Coast breeding population are not known to use the Action Area.

Effects

Action-caused stressors relevant to piping plovers included:

- a substantial disturbance of foraging and roosting habitats;
- wrack removal and reduced prey abundance; and
- the closure of 32 inlets between the Gulf and adjacent sheltered waters.

Individual piping plovers use multiple sites during winter residency in an area, and respond to disturbance by moving away from it. The duration and spatial scope of the disturbance and impacts to prey abundance caused by cleanup operations most likely impaired foraging efficiency and altered the home range of affected individuals. The degree to which this response actually reduced individual survival probability or fitness for spring migration and breeding is not determinable.

A reasonable worst-case scenario is to attribute reduced fitness or survival to all 117 piping plovers observed on site during the most intense cleanup activity. Under this scenario, the Action affected 5.1 percent of the Northern Great Plains population and 2.7 percent of the Great Lakes population.

There is no direct evidence of piping plover mortality associated with spill response activity, and we do not believe this worst-case scenario occurred, but impacts from the spill and spill response activities may have contributed to observed declines of greater magnitude in both populations. The Northern Great Plains population declined by 52 percent from 2006 to 2011, and the Great Lakes population declined by 10 percent from 2010 to 2011. The Great Lakes population has increased beyond the level observed prior to the spill.

Most or all piping plovers and their habitats in the Action Area were exposed to some degree of oiling during the 2010-2011 winter season, and to a progressively lesser degree during the following winters. This exposure occurred with or without the additional stressors caused by the cleanup activities. The Action removed a substantial amount of that oil from plover habitats and thereby reduced the level of substrate and prey contamination, which we must recognize as a benefit to the species.

An impact of possibly long-term significance was the closure of 32 inlets in the Action Area. Inlets are particularly valuable winter habitats for plovers. However, the majority (29) of the

DWH inlet closures were in Louisiana, where barrier islands are eroding at a rate of up to 20 meters per year, and several may disappear by the end of the century. Closing barrier island breaches in this context may benefit piping plovers if it contributes to maintaining their barrier island habitat.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

After reviewing the current status of the species, the environmental baseline for the Action Area, and the effects of the Action, it is the USFWS biological opinion that the Action did not jeopardize the continued existence of the piping plover.

11. CRITICAL HABITAT FOR FOUR BEACH MOUSE SUBSPECIES

This section evaluates the Action relative to the designated critical habitat for the Alabama beach mouse (ABM) (*Peromyscus polionotus ammobates*), Perdido Key Beach Mouse (PKBM) (*Peromyscus polionotus trissyllepsis*), Choctawhatchee Beach Mouse (CBM) (*Peromyscus polionotus allophrys*), and St. Andrew Beach Mouse (SABM) (*Peromyscus polionotus peninsularis*). We combine the analyses for all four subspecies' critical habitat in one section, because the four designations identify a common suite of physical and biological features (PBFs) that are essential to the conservation of each subspecies. Sharing the same PBFs allows us to formulate a common analytical framework for evaluating potential PBF responses to the Action. Under this framework, our analyses identify designation-specific findings to support independent conclusions about the effects of the Action on the critical habitat for each subspecies.

11.1. Status of Beach Mouse Critical Habitat

This section summarizes best available data about the current condition of all designated units of critical habitat for each of the four subspecies that are relevant to formulating an opinion about the Action. The USFWS published its decision to designate critical habitat for the ABM on 30 January 2007 (72 FR 4330–4369), and for the PKBM, CBM, and SABM on 12 October 2006 (71 FR 60328–60370).

11.1.1. Description of Beach Mouse Critical Habitat

Critical habitat for the four beach mouse subspecies is designated in multiple discrete units located between the Ft. Morgan Peninsula of Alabama, and the St. Joseph Peninsula of Florida. Table 11-1 lists these units for each subspecies and identifies the acreage of each that is under Federal, State, or local government and private ownership. These units include habitats that support one or more life-history functions of beach mice.

Table 11-1. Acreage of designated critical habitat units for ABM, PKBM, CBM, and SABM ownership (Federal, State, local goverment/private) (source: 72 FR 4330–4369 for ABM, and 71 FR 60328–60370 for the other three subspecies).

Unit	State	Site Name	Federal	State	Local & Private	Total
ABM-1	AL	Fort Morgan	44	337	66	447
ABM-2	AL	Little Point Clear	16	82	170	268
ABM-3	AL	Gulf Highlands	11	44	218	273
ABM-4	AL	Pine Beach	11	-	19	30
ABM-5	AL	Gulf State Park	-	192	-	192
		Total	82	655	473	1,210
		Percent	6.8%	54.1%	39.1%	
PKBM-1	AL	Gulf State Park	-	115	-	115
PKBM-2	FL	West Perdido Key	-	-	147	147
PKBM-3	FL	Perdido Key State Park	-	238	-	238
PKBM-4	FL	Gulf Beach	-	-	162	162
PKBM-5	FL	Gulf Islands National Seashore	638	-	-	638
		Total	638	353	309	1,300
		Percent	49.1%	27.2%	23.8%	
CBM-1	FL	Henderson Beach	-	96	-	96
CBM-2	FL	Topsail Hill	-	277	32	309
CBM-3	FL	Grayton Beach	-	162	17	179
CBM-4	FL	Deer Lake	-	40	9	49
CBM-5	FL	West Crooked Island/Shell Island	1,333	408	30	1,771
		Total	1,333	983	88	2,404
		Percent	55.4%	40.9%	3.7%	
SABM–1	FL	East Crooked Island	649	-	177	826
SABM–1	FL	Palm Point	-	-	162	162
SABM–1	FL	St. Joseph Peninsula	-	1,280	222	1,502
		Total	649	1,280	561	2,490
		Percent	26.1%	51.4%	22.5%	

Critical habitat designation for the beach mouse subspecies used the term "primary constituent elements" (PCEs) to identify the key components of critical habitat that are essential to their conservation and may require special management considerations or protection. Revisions to the critical habitat regulations in 2016 (81 FR 7214, 50 CFR §4.24) discontinued use of the term PCEs, and we since rely exclusively on the term “physical and biological features” (PBFs) to refer to these key components, because the latter term is the one used in the statute. This shift in terminology does not change how the USFWS conducts a “destruction or adverse modification” analysis. In this BO, we use the term PBFs to label the key components of critical habitat that provide for the conservation of beach mice that we identified in the 2006 (PKBM, CBM, and SABM) critical habitat designation rule and the 2007 ABM rule.

The PBFs of beach mouse critical habitat are (71 FR 60328–60370 and 72 FR 4330–4369):

1. A contiguous mosaic of primary, secondary, and scrub vegetation and dune structure, with a balanced level of competition and predation and few or no competitive or predaceous nonnative species present, that collectively provide foraging opportunities, cover, and burrow sites.
2. Primary and secondary dunes, generally dominated by sea oats (*Uniola paniculata*), that, despite occasional temporary impacts and reconfiguration from tropical storms and hurricanes, provide abundant food resources, burrow sites, and protection from predators.
3. Scrub dunes, generally dominated by scrub oaks (*Quercus* spp.), that provide food resources and burrow sites, and provide elevated refugia during and after intense flooding due to rainfall and/or hurricane-induced storm surge.
4. Unobstructed habitat connections that facilitate genetic exchange, dispersal, natural exploratory movements, and recolonization of locally extirpated areas.
5. A natural light regime within the coastal dune ecosystem, compatible with the nocturnal activity of beach mice, necessary for normal behavior, growth, and viability of all life stages.

Each of the critical habitat units occupied at the time of the designation contained sufficient PBFs to provide for one or more of the life history functions of the beach mouse subspecies. Developed areas located within the mapped unit boundaries, such as buildings, paved areas, gravel driveways, ponds, swimming pools, lawns, and other structures that lack all PBFs are not considered critical habitat.

The two critical habitat designation rules each determined that the PBFs described above may require special management considerations or protections due to threats to the subspecies or its habitat. Such management considerations and protections include: management of nonnative predators and competitors, management of nonnative plants, and protection of ABM and their habitat from threats by road construction, urban and commercial development, heavy machinery, and recreational activities.

11.1.2. Conservation Value of Beach Mouse Critical Habitat

The most recent assessments of the conditions within beach mouse critical habitats are:

- ABM 5-year status review (USFWS 2009a);
- PKBM 5-year status review (USFWS 2014);
- CBM 5-year status review (USFWS 2007); and
- SABM recovery plan (USFWS 2010b).

These documents identify the primary threat to the PBFs of beach mouse critical habitat as habitat loss and fragmentation associated with coastal development. This threat is greater for the critical habitat designations that include a higher percentage of lands under private ownership, because the Federal and State lands are generally managed for conservation purposes, public recreation, and in the case of Units CBM-5 and SABM-1, for national defense (undeveloped portions of military bases) (Table 11-1). Private land ownership percentages for ABM, PKBM, CBM, and SABM critical habitat are 39.1, 23.8, 3.7, and 22.5 percent, respectively. These documents also identify the need to manage beach mouse habitats to reduce cat predation, artificial lighting, and damage to dune habitats by recreational activities.

The three status reviews cited above and the SABM recovery plan describe critical habitat conditions in general terms, and do not provide specific data on the relative conservation value of the PBFs supported. All units were designated primarily by identifying areas that contain the vegetative communities identified in the PBFs in sufficient quantity and arrangement to provide for one or more beach mouse life history functions. Habitat modification that has occurred since critical habitat designation, most likely due to development on private lands or increased recreational use of public lands, may have reduced the conservation value of these lands.

11.1.3. Conservation Needs for Beach Mouse Critical Habitat

Maintaining contiguous tracts of sufficient size that contain both frontal dune and scrub habitat types is primary need to preserve the conservation value of beach mouse critical habitat. Tracts under public ownership should manage recreational use to avoid damage to these habitats as much as possible. Controlling non-native predators, especially feral and free-roaming domestic cats, and limiting artificial lighting, is important in all critical habitat areas.

11.2. Environmental Baseline for Beach Mouse Critical Habitat

This section is an analysis of the effects of past and ongoing human and natural factors leading to the present status of designated critical habitat within the Action Area. The environmental baseline is a "snapshot" of critical habitat conditions in the Action Area at the time of the consultation, and does not include the effects of the Action under review.

However, the Action Area of this consultation encompasses the entire extent of designated critical habitat for the ABM, PKBM, CBM, and SABM; therefore, we have described the status of critical habitat within the Action Area in the previous section, "11.1 Status of Critical Habitat for Four Beach Mouse Subspecies."

11.3. Effects of the Action on Beach Mouse Critical Habitat

This section analyzes the direct and indirect effects of the Action on critical habitat for the four beach mouse subspecies, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

11.3.1. Response Pathways for Critical Habitat Features

The Action involved putting people, vehicles, and other equipment on various units of designated beach mouse critical habitat within the Action Area, which introduced potential stressors (biologically relevant changes to the environment) to the PBFs of critical habitat. We discussed in section 6.3.1 (effects analysis for ABM) two pathways by which Action-caused stressors could have caused individual beach mouse responses: (a) physical modifications of dune habitats; and (b) human disturbance/artificial lighting. These stressors affect individual plovers through modifications of the following PBFs:

- PBF #2 **–** Primary and secondary dunes, generally dominated by sea oats, that provide abundant food resources, burrow sites, and protection from predators.
- PBF #3 **–** Scrub dunes, generally dominated by scrub oaks, that provide food resources and burrow sites, and provide elevated refugia during and after intense flooding due to rainfall and/or hurricane-induced storm surge.
- PBF #5 **–** A natural light regime within the coastal dune ecosystem, compatible with the nocturnal activity of beach mice, necessary for normal behavior, growth, and viability of all life stages.

Clearing or widening beach access paths through dunes, or removing oil/tar bars from within the dunes, may damage or kill dune vegetation. While in use, artificial lighting disrupts natural light regimes.

11.3.2. Estimation of Effects to Critical Habitat Features

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon the USCG BA as our data source. Critical habitat subsections for each subspecies within section 6.5 of the BA address spill response activity within critical habitat units. Direct measures of effects to PBFs are not reported, and we rely on segment days of activity as the best available surrogate measure of the magnitude of stressors. We summarize this data by subspecies below.

ABM

The BA reports 13 segment days of daytime mechanical cleanup work in dune habitats divided between units ABM-1, 2, and 3. The BA does not report segment days of manual cleanup effort in critical habitat units; however, the total work effort in the dune zone of Baldwin County, Alabama, was 2,097 segment days (see section 6.3.2 for additional details). Manual cleanup was 86 percent of this total, and mechanical cleanup was 12 percent. Some fraction of the total manual cleanup activity likely occurred in critical habitat units.

PKBM

The BA reports 12 segment days of daytime mechanical cleanup work in dune habitats divided between units PKBM-2, 4, and 5, and one segment day of nightime mechnical work in PKBM-1. The BA does not report segment days of manual cleanup effort in critical habitat units.

CBM

No mechanical cleanup work occurred within the dunes of CBM critical habitat. The BA reports 810 segment days of daytime manual cleanup work in dune habitats divided between units CBM-1–4. No work occurred in CBM-5 (West Crooked Island/Shell Island).

SABM

The BA does not report segment days of oil cleanup activity within the dunes of SABM critical habitat. The limited work that occurred involved only daytime manual methods. The BA does not indicate that any of the work caused impacts to dune vegetation, as explicitly noted in the assessment for other beach mouse subspecies.

We supplemented our evaluation of the USCG effects analysis for beach mouse subspecies in sections 6–9 with the findings of Wetland Sciences (2014), a study that the USFWS commissioned to assess impacts to beach mouse habitats resulting from the spill response. This study evaluated the direct impacts to dune vegetation at beach access points used by spill response personnel and equipment. The total vegetation loss associated with 56 access points surveyed throughout the range of all four subspecies was 0.58 acre. This study also examined the disturbance of beach mouse habitats associated with spill response staging areas, including artificial lighting. The total spatial extent of disturbance associated with seven intensive-use staging areas was 98.98 acres. The total area designated as critical habitat for each subspecies is 1,210–2,490 acres.

Although we lack direct measures of PBFs affected by the spill response activity that the USCG quantified in terms of segment days, we are unaware of substantial modifications of beach mouse PBFs the Action may have caused. It seems unlikely that significant oil stranding and tar ball accumulation would have occurred on the higher elevations of dune habitats and required intensive and damaging cleanup methods. A tiny percentage of the segment days reported consisted of mechanical cleanup within beach mouse critical habitat: 13 segment days for ABM and 13 segment days for PKBM out of 189,566 for the Action Area. Artificial lighting for staging areas and nighttime operations would have modified the light regime PBF, but this modification ceased when operations ceased. The disturbance of noise and activity on the intertidal zone of beaches, which may have caused stress to beach mouse individuals in the adjacent dunes, is not relevant to the PBFs of critical habitat.

11.4. Conclusion for Beach Mouse Critical Habitat

In this section, we summarize and interpret the findings of the previous sections for Beach Mouse critical habitat (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

"*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR §402.02).

Status

Critical habitat for the four beach mouse subspecies is designated in multiple discrete units located between the Ft. Morgan Peninsula of Alabama, and the St. Joseph Peninsula of Florida. The total critical habitat acreage for each subspecies ranges from 1,210 acres for ABM to 2,490 acres for SABM. The four designations use a common description of PBFs essential to the conservation of each subspecies.

The primary threat to the PBFs of beach mouse critical habitat is habitat loss and fragmentation associated with coastal development. This threat is greater for the critical habitat designations that include a higher percentage of lands under private ownership. Private land ownership percentages for ABM, PKBM, CBM, and SABM critical habitat are 39.1, 23.8, 3.7, and 22.5 percent, respectively. Managing all critical habitats to reduce cat predation, artificial lighting, and damage to dune habitats by recreational activities is necessary to protect the PBFs for the conservation of each subspecies.

Baseline

As we noted in section 11.2, a separate assessment of the status of critical habitat in the Action Area, i.e., the environmental baseline, is not necessary for the four beach mouse subspecies, because the Action Area encompasses the entire extent of designated critical habitat for each subspecies.

Effects

The Action could have altered beach mouse PBFs through physical modifications of dune habitats and artificial lighting. Most of the spill cleanup work involved manual methods during daytime hours. The BA reports 13 segment days of mechanical cleanup work in ABM critical habitat and another 13 segment days in PKBM critical habitat. No mechanical cleanup work occurred in CBM and SABM critical habitat.

Wetland Sciences (2014) evaluated the direct impacts to dune vegetation at beach access points used by spill response personnel and equipment. The total vegetation loss associated with 56 access points surveyed throughout the range of all four subspecies was 0.58 acre. This study also examined the disturbance of beach mouse habitats associated with spill response staging areas, including artificial lighting. The total spatial extent of disturbance associated with seven intensive-use staging areas was 98.98 acres.

Although we lack direct measures of PBFs affected by the spill response activity that the USCG quantified in terms of segment days, we are unaware of substantial alterations of beach mouse PBFs the Action may have caused. It seems unlikely that significant oil stranding and tar ball accumulation would have occurred on the higher elevations of dune habitats, which would have required intensive and damaging cleanup methods. The spatial and temporal scope of mechanical cleanup methods was limited to 13 segment days in ABM and in PKBM habitats. Artificial lighting for staging areas and nighttime operations would have modified the light regime PBF, but this alteration ceased when operations ceased. We have no evidence that the Action caused any changes to the PBFs of beach mouse critical habitat that were not temporary.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

After reviewing the current status of the critical habitat for each subspecies and the effects of the Action on each subspecies, it is the USFWS biological opinion that the Action did not destroy or adversely modify designated critical habitat for the ABM, PKBM, CBM, and SABM.

12. CRITICAL HABITAT FOR PIPING PLOVER

12.1. Status of Piping Plover Critical Habitat

This section summarizes best available data about the current condition of all designated units of critical habitat for the piping plover (*Charadrius melodus*) that are relevant to formulating an opinion about the Action. The USFWS published its decision to designate critical habitat for the piping plover in its U.S. wintering range on 10 July 2001 (66 FR 36038–36143). The Action does not affect designated critical habitat for the piping plover in its breeding range, and we do not address it in this BO.

The USFWS evaluates critical habitat for piping plover breeding populations and for wintering populations as separate resources under the definition of "destruction or adverse modification" in ESA consultations, due to the endangered status of the Great Lakes breeding population and the threatened status of populations elsewhere (see introduction to section 10.1, "Status of Piping Plover"). Wintering range critical habitat is designated to serve a conservation purpose for all piping plover breeding populations, whereas breeding range critical habitat, where designated (U.S. portions of Great Lakes and Northern Great Plains breeding range), serves a conservation purpose for the identified breeding population.

The USFWS revised the wintering critical habitat for units in North Carolina on 21 October 2008 (73 FR 62816–62841), and for units in Texas on 19 May 2009 (74 FR 23476–23600). Our description of the status of all designated wintering critical habitat for the piping plover reflects these revisions.

12.1.1. Description of Piping Plover Critical Habitat

Critical habitat for wintering piping plovers is comprised of 256,513 acres in 141 separate units spanning a collective length of about 1,800 miles along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. The designated units include habitats that support roosting, foraging, and sheltering activities of piping plovers.

Critical habitat designation for the piping plover used the term "primary constituent elements" (PCEs) to identify the key components of critical habitat that are essential to its conservation and may require special management considerations or protection. Revisions to the critical habitat regulations in 2016 (81 FR 7214, 50 CFR §4.24) discontinued use of the term PCEs, and we since rely exclusively on the term "physical and biological features" (PBFs) to refer to these key components, because the latter term is the one used in the statute. This shift in terminology does not change how the USFWS conducts a "destruction or adverse modification" analysis. In this BO, we use the term PBFs to label the key components of critical habitat that provide for the conservation of the piping plover that we identified in the 2001 critical habitat designation rule and subsequent revisions as PCEs.

The PBFs of piping plover wintering critical habitat are (73 FR 62816–62841):

1. Intertidal sand beaches (including sand flats) or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation for feeding. In some cases, these flats may be covered or partially covered by a mat of blue-green algae.
2. Unvegetated or sparsely vegetated sand, mud, or algal flats above annual high tide for roosting. Such sites may have debris or detritus and may have micro-topographic relief (less than 20 in (50 cm) above substrate surface) offering refuge from high winds and cold weather.
3. Surf-cast algae for feeding.
4. Sparsely vegetated backbeach, which is the beach area above mean high tide seaward of the dune line, or in cases where no dunes exist, seaward of a delineating feature such as a vegetation line, structure, or road. Backbeach is used by plovers for roosting and refuge during storms.
5. Spits, especially sand, running into water for foraging and roosting.
6. Salterns, or bare sand flats in the center of mangrove ecosystems that are found above mean high water and are only irregularly flushed with sea water.
7. Unvegetated washover areas with little or no topographic relief for feeding and roosting. Washover areas are formed and maintained by the action of hurricanes, storm surges, or other extreme wave actions.
8. Natural conditions of sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites).

A designated unit contains one or more of these PBFs. The seaward edge of each unit is the contour of the mean lower low water (MLLW) elevation of each tidal day, as observed over the National Tidal Datum Epoch. The breadth of each unit extends landward from the seaward edge to where PBFs no longer occur, generally to the toe of stable, densely-vegetated dunes. The seaward and landward edges may shift over time with the movement of coastal landforms. Unit boundaries generally exclude developed areas, because these areas do not contain the PBFs. Buildings, marinas, paved areas, boat ramps, exposed oil and gas pipelines, and similar structures that may occur within unit boundaries do not contain the PBFs and are not considered critical habitat.

12.1.2. Conservation Value of Piping Plover Critical Habitat

The most recent comprehensive reviews of plover winter habitat conditions are the 2009 5-year status review (USFWS 2009c) and the 2015 winter/migration conservation strategy (USFWS

2015). We summarize in this section key points from these documents that are relevant to this BO. Please refer to these documents for further details.

Characterizing the current conservation value of piping plover critical habitat is difficult, due to the multi-state scale of the designation and to the dynamic or ephemeral nature of its PBFs. Waves, tides, currents, storms, terrestrial runoff, and biological communities interacting with sediments at the land/sea interface form and maintain piping plover winter habitats. Various human activities at the land/sea interface (construction, dredging, sand mining, sand placement, inlet stabilization/relocation/closure, seawalls, revetments, beach cleaning) disrupt these processes and reduce or degrade the PBFs. Therefore, a common and practical approach to describing the status of plover critical habitat is to quantify the extent of human alteration of features or PBF surrogates that are easily measured at large scales. Beaches and inlets encompass multiple PBFs.

Beaches

The majority of the designated units are sandy beaches that contain PBF #1 (intertidal sand beach) and #4 (sparsely vegetated backbeach). Other PBFs that are often associated with beaches are less amenable to measurement on a large scale. The total length of all designated units is about 1,800 miles. Our winter habitat conservation strategy (USFWS 2015) reports a total length of 2,119 miles of sandy beaches from Texas through North Carolina. This inventory determined that 856 miles (40 percent) of the total length are developed, and that 910 miles (43 percent) are preserved to some degree under public ownership, private ownership for conservation purposes, or conservation easement. We have not specifically analyzed the overlap between the designated units and the broader scope of this inventory, but it is substantial, as the total lengths differ only by about 300 miles. About half the designated units are within the 43 percent of sandy beaches that are preserved, and the other half are undeveloped, but not under public or other conservation ownership.

Texas appears to support piping plover habitat that is least modified, i.e., areas that retain the greatest extent of the critical habitat PBFs. Designated units in Texas span about 800 miles. Long stretches of undeveloped barrier islands and peninsulas, with overwash passes and flats, discontinuous dunes, and sparse vegetation are common on portions of the Texas coastline. The Gulf Islands National Seashore (Mississippi and Florida Panhandle), and Eglin and Tyndall Air Force Bases (Florida Panhandle), provide similar expanses of habitat within designated units. The beaches and islands of Cape Lookout National Seashore and Cape Romain National Wildlife Refuge (North Carolina) contain the only long stretches of plover beach habitat on the Atlantic Coast that is comparable to those on the Gulf Coast. However, designated units covering the undeveloped and preserved islands of Georgia (about 83 miles within designated units) provide a uniquely contiguous suite of inlets and sandy beach habitats that provide multiple PBFs in relatively close proximity.

Inlets

An inlet is an opening between barrier islands, spits, or peninsulas through which the ocean and a bay exchange water. The shorelines of the inlet throat (the main channel) provide a preferred roosting habitat (PBFs #2 and 5), and the shoals/tidal deltas that form landward and seaward of the main channel provide a preferred foraging habitat (PBFs #1, 3, 5, and 7). In an evaluation of 361 International Shorebird Survey sites from North Carolina to Florida (Harrington 2008), piping plovers were among seven shorebird species found significantly more often than expected at inlet versus non-inlet locations. Wintering plovers on the Atlantic Coast prefer wide beaches in the vicinity of inlets (Nicholls and Baldassarre 1990b; Wilkinson and Spinks 1994). Plovers forage in the intertidal flats, algal flats, and ephemeral pools associated with inlets (Nicholls and Baldassarre 1990a; Wilkinson and Spinks 1994; Dinsmore *et al*. 1998).

Our winter habitat conservation strategy (USFWS 2015) identified 221 existing inlets in the U.S. winter range of the piping plover. More than half of these have been relocated or modified by structures, dredging, or mining. These existing inlets include 11 that were opened artificially, i.e., not by natural coastal processes. This inventory of inlets also identified 64 natural inlets that were artificially closed; half of these (32) during 2010 in response to the DWH oil spill. Table 12-1 summarizes the results of the inventory by state and by the type of inlet modification.

Table 12-1. The number of open tidal inlets, inlet modifications, and artificially closed inlets in each state within the U.S. winter range of the piping plover as of December 2011 (source: USFWS 2015; App. 1 W.b)

State	Existing Inlets							Artificially Closed
	Number of Inlets	Total Number of Modified Inlets	Habitat Modification Type					
			Structures[a]	Dredged	Relocated	Mined	Artificially Opened	
NC	20	17 (85%)	7	16	3	4	2	11
SC	47	21 (45%)	17	11	2	3	0	1
GA	23	6 (26%)	5	3	0	1	0	0
FL – *Atlantic*	21	19 (90%)	19	16	0	3	10	0
FL – *Gulf*	48	24 (50%)	20	22	0	6	7	1
AL	4	4 (100%)	4	3	0	0	0	2
MS	6	4 (67%)	0	4	0	0	0	0
LA	34	10 (29%)	7	9	1	2	0	46
TX	18	14 (78%)	10	13	2	1	11	3
TOTAL	221	119 (54%)	89 (40%)	97 (44%)	8 (4%)	20 (9%)	30 (14%)	64 (n/a)

[a] Jetties, terminal groins, groin fields, rock or sandbag revetments, seawalls, or offshore breakwaters.

12.1.3. Conservation Needs for Piping Plover Critical Habitat

The highest priority recovery actions identified in the winter/migration habitat conservation strategy (USFWS 2015) involve protecting piping plover habitat from the direct and indirect impacts of coastal development. Within critical habitat, such protection involves avoiding and minimizing alterations of the coastal morpho-dynamic processes that form and maintain the PBFs. Appendix 1.W.a of the conservation strategy describes Best Management Practices applicable to human activity on or near dunes, beaches, the nearshore littoral/surf zone, inlets, and estuarine shorelines.

The PBFs of plover critical habitat are associated with intertidal ocean-facing beaches and flats; bay shoreline beaches and flats; dune systems and flats above the annual high tide; and seasonally emergent sand bars, mud flats, and oyster reefs. Sea levels define the spatial distribution of these features, which will necessarily change as sea levels rise. The winter/migration habitat conservation strategy recommends allowing natural processes to shape the contours of plover habitat rather than attempting to stabilize certain features by structural or other artificial means. Past attempts to stabilize the dynamic coastal environment for other purposes has generally reduced habitat quantity and quality for wintering piping plovers.

12.2. Environmental Baseline for Piping Plover Critical Habitat

This section is an analysis of the effects of past and ongoing human and natural factors leading to the present status of designated critical habitat for the piping plover within the Action Area. Ordinarily, the environmental baseline is a “snapshot” of critical habitat conditions in the Action Area at the time of the consultation, and does not include the effects of the Action under review. However, the emergency response action of this consultation is concluded. We do not attempt to analyze the status of the critical habitat at the time the emergency and the Action began in April 2010. Instead, this section summarizes best available data about the present status of the critical habitat in the Action Area, which reflects the effects of the oil spill, response activities, and other relevant factors. We discuss the relative contribution of the Action to the present status in the “Effects of the Action” section, which follows this “Baseline” section.

12.2.1. Action Area Conservation Value of Piping Plover Critical Habitat

The Action Area includes the northern Gulf of Mexico and its adjoining shorelines between Galveston County, Texas, and Apalachee Bay of the Florida Panhandle (see section 1.1). Along these shorelines, the USFWS has designated 39 units of piping plover critical habitat (66 FR 36038–36143):

- Texas Units 34–37;
- Louisiana Units 1–7;
- Mississippi Units 1–6, 10–15 (proposed Units 7–9 were not designated);
- Alabama Units 1–3; and
- Florida Units 1–13.

The USCG BA reports and analyzes the effects of spill response activity within only 18 of these units:

- Louisiana Units 1–7;
- Mississippi Units 1–6, 12, 14, and 15; and
- Alabama Units 2 and 3.

Therefore, we limit our description and assessment of piping plover critical habitat to these 18 units. The total size of the 18 units is 36,752 acres, of which 22,076 acres (60 percent) are within the three largest units: MS-14, LA-7, and LA-1. These 18 units contain 14.3 percent of the total acreage of designated critical habitat in the U.S. winter range of the piping plover. About two thirds of the acreage of the 18 units is under public or other conservation ownership.

The two largest units, MS-14 and LA-7, are a complex of barrier islands. MS-14 includes the privately owned Cat Island, and the four Mississippi islands of the multi-state Gulf Islands National Seashore. LA-7 is comprised of the entire island chain between the Breton and Chandeleur Islands. Breton National Wildlife Refuge is within LA-7, and other portions are state owned. LA-1, the third-largest unit receiving spill response activity, is comprised of 3 segments of the western-most LA coastline, including both state and privately owned lands.

In the remainder of this section, we summarize information from the winter/migration conservation strategy (USFWS 2015) that pertains to alterations of piping plover critical habitat units that received spill response activity.

Louisiana Units

Louisiana has lost about 40 mi^2 of coastal marsh per year for several decades, constituting about 80 percent of the nation's annual coastal wetland loss (Louisiana Office of Coastal Protection and Restoration https://www.lacoast.gov/new/About/). The barrier islands fronting the Mississippi River delta plain, including those designated as piping plover critical habitat, buffer the effects of ocean waves and currents on the estuaries and wetlands behind them. However, Louisiana's barrier islands are eroding at a rate of up to 20 meters per year, and several may disappear by the end of the century (USGS: https://pubs.usgs.gov/fs/la-wetlands/). The coastal morpho-dynamic processes that form the PBFs of piping plover critical habitat are not in dynamic equilibrium in Louisiana.

Hurricane Katrina cut 44 new inlets through islands of the Chandeleur chain (Unit LA-7) in 2005, many of which closed naturally as material migrated back into the inlets in the years following the storm event. The State closed several breaches cut by Hurricane Andrew (1992) on Raccoon Island (Unit LA-4) prior to the DWH spill.

The State of Louisiana closed 11 inlets in the Chandeleur chain (Unit LA-7) during the DWH oil spill response, and constructed 7.4 miles of sand berm along the seaward edge of the chain to reduce landward oil movement (see section 1.2). Also in response to the DWH spill, the State closed two inlets on Elmer's Island (Unit LA-5).

In 2011-2012, Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) project TE-52 closed breaches in Belle Pass West (the 3-mile-long peninsula west of Bell Pass) within Unit LA-5 to facilitate wetland restoration (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2013). Similar CWPPRA projects closed several breaches on:

- East Timbalier Island (Unit LA-5) in 1999-2000 (CWPPRA Projects TE-25 and TE-30);
- Trinity Island (Unit LA-4) in 1998 (CWPPRA Project TE-24); and
- Whiskey Island (Unit LA-4) in 1998 (CWPPRA Project TE-27) (Louisiana Office of Coastal Protection and Restoration, http://www.lacoast.gov).

Much of the placed material for those projects has since migrated to the ends of the islands, creating prime foraging habitat for plovers in the form of large sand spits and flats.

Mississippi Units

Storms have opened at least 7 inlets on Mississippi shorelines in recent decades. In 1969, Hurricane Camille opened Camille Cut on Ship Island, dividing the island into West and East Ship Islands, which are within Unit MS-14. At least 7 breaches or inlets have closed naturally since 1952. The Mississippi Coastal Improvements Program (MsCIP) proposes to use dredged material from the Horn Island ship channel to provide beach fill for a portion of West Ship Island, and to close Camille Cut with sediment mined from Sand Island (USACE 2009). No inlet shoal complexes have been mined to supply sediment for beach nourishment projects in Mississippi.

Alabama Units

Hurricanes have cut several inlets cut across Dauphin Island (Unit AL-2), including a 5-mile-wide shallow inlet cut early in the 20th century that had closed by 1942, and Katrina Cut, opened on the western end of the island by Hurricane Katrina in 2005. The State of Alabama closed Katrina cut with a temporary rock berm in 2010 to block oil from the DWH spill from reaching Mississippi Sound; however, the State later requested USACE to authorize the berm as a permanent structure (USACE 2011).

12.2.2. Action Area Conservation Needs for Piping Plover Critical Habitat

About one third of piping plover critical habitat acreage in the Action Area is under private ownership that may support new coastal development. Such development would likely eliminate or degrade the PBFs essential to piping plover conservation in the affected units. Avoiding and minimizing alterations of the coastal morpho-dynamic processes that form and maintain the PBFs is the primary critical habitat conservation need in the Action Area. The Best Management Practices described in Appendix 1.W.a of the winter/migration conservation strategy (USFWS 2015) apply to critical habitat units in the Action Area.

The winter/migration habitat conservation strategy recommends allowing natural processes to shape the contours of plover habitat rather than attempting to stabilize certain features by structural or other artificial means. Alarming erosion rates for various Louisiana barrier islands and peninsulas have prompted authorities to pursue a more active approach in some Louisiana Units (see section 12.2.1 under “Louisiana Units”). Several CWPPRA projects have closed breaches in various critical habitat units. Designing such projects to provide a net benefit to piping plovers while also protecting and restoring wetlands located landward of eroding islands and peninsulas is an important conservation need for the species in Louisiana.

12.3. Effects of the Action on Piping Plover Critical Habitat

This section analyzes the direct and indirect effects of the Action on critical habitat for piping plover, which includes the direct and indirect effects of interrelated and interdependent actions.

Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur.

12.3.1. Response Pathways for Critical Habitat Features

The Action involved putting people, vehicles, and other equipment on 18 units of designated piping plover critical habitat within the Action Area, which introduced potential stressors (biologically relevant changes to the environment) to the PBFs of critical habitat. The Action also involved the physical closure of several inlets between the Gulf and protected waters to prevent the more landward movement of oil.

We discussed in section 10.3.1 three pathways by which Action-caused stressors could have caused individual piping plover responses. One of these pathways, disturbance, is not relevant to the PBFs. The other two pathways: (a) prey reduction via wrack and sediment removal; and (b) inlet closure; affect individual plovers through modifications of their foraging, roosting, and sheltering habitat.

The studies referenced in section 10.3.1 about bird responses to wrack/sediment removal and inlet closure are applicable to our evaluation of effects to piping plover critical habitat. Removing wrack (e.g., PBF #3, surf-cast algae) removes plover prey organisms. Excavating sand or mud also removes prey organisms, and may alter the micro-topography that provides shelter from winds and cold (PBF #2). Inlet closure eliminates a preferred roosting habitat (PBFs #2 and 5) along inlet shorelines, and eliminates the foraging shoals/tidal deltas that form landward and seaward of the inlet channel (PBFs #1, 3, 5, and 7).

12.3.2. Estimation of Effects to Critical Habitat Features

In this section, we estimate the likely amount or extent of the types of responses identified in the previous section. Unless otherwise cited, we rely upon the USCG BA as our data source. Direct measures of effects to PBFs are not reported, and we rely on segment days of activity as the best available surrogate. Section 6.3.4 of the BA reports the segment days of spill response activity that occurred within plover critical habitat units, repeated in Table 12-2 below, and provides a general description of how activity affected the habitat.

The 2,776 total segment days of cleanup in plover critical habitat, while substantial, was less than 2 percent of the entire shoreline spill response of 189,566 segment days (see Table 1-1). More than half of this work was accomplished during 2010. Three of the designated units received about 80 percent of the spill response effort: LA-5, MS-14, and AL-2. Work in these three units spanned 3–5 calendar years.

Table 12-2. Segment days of spill response activity by piping plover critical habitat unit and calendar year (source: USCG BA; Table 6.3.7).

Unit	2010	2011	2012	2013	2014	All Years Total	Location
LA-1	1	-	-	-	-	1	Texas / Louisiana border to Cheniere au Tigre
LA-2	8	-	-	-	-	8	Atchafalaya River Delta
LA-3	4	-	-	-	-	4	Point au Fer Island
LA-4	169	9	2	-	-	180	Isles Dernieres
LA-5	261	93	275	489	16	1,134	Timbalier Islands to East Grand Terre Island
LA-6	39	6	1	-	-	46	Mississippi River Delta
LA-7	4	-	-	-	-	4	Breton Islands and Chandeleur Island Chain
MS-1	137	-	-	-	-	137	Lakeshore through Bay St. Louis
MS-2	98	-	-	-	-	98	Henderson
MS-3	8	1	-	-	-	9	Pass Christian
MS-4	1	6	-	-	-	7	Long Beach
MS-5	1	8	-	-	-	9	Gulfport
MS-6	13	9	-	-	-	22	Mississippi City
MS-12	6	-	-	-	-	6	Deer Island
MS-14	551	179	25	-	-	755	Mississippi Barrier Islands
MS-15	-	3	-	-	-	3	North and South Rigolets
AL-2	181	112	19	38	-	350	Dauphin / Little Dauphin and Pelican Islands
AL-3	2	1	-	-	-	3	Fort Morgan
Total	1,484	427	322	527	16	2,776	

The heavy oiling in Units LA-5, MS-14, and AL-2 received the full range of both manual and mechanical methods of surface oil removal, vegetation (wrack) removal, and sediment relocation. Work in MS-14 involved the excavation of a layer of oil up to 12–14 inches beneath the surface. In AL-2, responders dug 1,239 pits or trenches 11–24 inches deep. The 15 other units received mostly manual cleanup methods to remove surface oil and oil-fouled wrack.

The DWH spill stranded oil within piping plover critical habitat, exposing the PBFs to contamination. This exposure occurred with or without the additional stressors caused by the cleanup activities. The Action removed a substantial amount of that oil from critical habitat and thereby reduced the level of substrate and prey contamination, which should speed the recovery of PBFs.

Inlet Closure

Of the 32 inlets closed as part of the DWH spill response (see section 10.3.2), 17 were within piping plover critical habitat units: 11 in LA-7 (Chandeleur Islands), 5 in LA-4 (Isles Dernieres), and 1 in AL-2 (Dauphin Island). Although the areas around inlets support multiple PBFs, in Louisiana, barrier islands and peninsulas are eroding at an alarming rate (see section 12.2.1 under "Louisiana Units"). Closing barrier island/peninsula breaches in a landscape with an ongoing net loss of PBFs may benefit piping plovers if it slows the rate of such loss.

In coastal areas where erosion and accretion processes are roughly balanced, piping plover critical habitat PBFs move as tidal deltas, beaches, mud flats, and other coastal land forms move.

Plovers exploit these dynamic and ephemeral habitats where they occur. However, erosion and accretion processes are not balanced in coastal Louisiana, where open water is replacing land at a rate of about 40 mi^2 per year. The USCG BA did not analyze the effects of the inlet closures.

Lacking specific data on PBFs at the inlet closures, the net effect of the inlet closures on piping plover critical habitat PBFs is difficult to judge. Inlets are relatively important components of critical habitat elsewhere in the critical habitat designation (see section 12.1.2). Effects of inlet closure will likely persist well beyond the period of the spill response. We believe the inlet closures may have caused a minor reduction in the conservation value of piping plover critical habitat; however, we are unable to evaluate the significance of this reduction in this rapidly eroding landscape context.

12.4. Conclusion for Piping Plover Critical Habitat

In this section, we summarize and interpret the findings of the previous sections for piping plover critical habitat (status, baseline, and effects) relative to the purpose of a BO under section 7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

c) jeopardize the continued existence of species listed as endangered or threatened; or
d) result in the destruction or adverse modification of designated critical habitat.

"*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR §402.02).

Status

Critical habitat for wintering piping plovers is comprised of 256,513 acres in 141 separate units spanning a collective length of about 1,800 miles along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. The designated units include habitats that support roosting, foraging, and sheltering activities of piping plovers. Characterizing the current conservation value of piping plover critical habitat is difficult, due to the multi-state scale of the designation and to the dynamic or ephemeral nature of its physical and biological features (PBFs) identified as essential to piping plover conservation. All of the units were undeveloped at the time of the 2001 designation, and as of 2015, about half of the units are preserved under public or other conservation ownership. The USFWS (2015) winter/migration habitat conservation strategy identifies protecting piping plover habitat from the direct and indirect impacts of coastal development as the highest recovery priority. Within critical habitat, such protection involves avoiding and minimizing alterations of the coastal morpho-dynamic processes that form and maintain the PBFs.

Baseline

The Action affected 18 units of piping plover critical habitat. The total size of the 18 units is 36,752 acres, of which 22,076 acres (60 percent) are within the three largest units: MS-14, LA-7, and LA-1. These 18 units contain 14.3 percent of the total acreage of designated critical habitat in the U.S. winter range of the piping plover. About two thirds of the acreage of the 18 units is under public or other conservation ownership.

Effects

The Action logged 2,776 segment days of cleanup activity in piping plover critical habitat. More than half of this work was accomplished during 2010. Three of the designated units received about 80 percent of the spill response effort: LA-5, MS-14, and AL-2. Work in these three units spanned 3–5 calendar years. The heavy oiling in these three units received the full range of both manual and mechanical methods of surface oil removal, vegetation (wrack) removal, and sediment relocation. The other 15 units received mostly manual cleanup methods to remove surface oil and oil-fouled wrack.

The DWH spill stranded oil within piping plover critical habitat, exposing the PBFs to contamination. This exposure occurred with or without the additional stressors caused by the cleanup activities. The Action removed a substantial amount of that oil from critical habitat and thereby reduced the level of substrate and prey contamination, which should speed the recovery of PBFs. Of the 32 inlets closed as part of the DWH spill response, 17 were within piping plover critical habitat units: 11 in LA-7 (Chandeleur Islands), 5 in LA-4 (Isles Dernieres), and 1 in AL-2 (Dauphin Island).

We must interpret the significance of the PBF alterations caused by activities intended to reduce oil contamination, and the longer-term effects of the inlet closures, at the scale of the full critical habitat designation. The 18 units affected by the Action constitute 14.3 percent of the total acreage of designated critical habitat. The most extensive alterations of critical habitat via cleanup operations occurred in three units that contain 43 percent of the affected acreage, or about 6 percent of the full winter range designation. These alterations were temporary, and should speed PBF recovery from oil contamination. The alterations via inlet closures were more limited in scale, affecting 17 locations within three units, but may persist for years to come. We believe the inlet closures may have caused a minor reduction in the conservation value of piping plover critical habitat; however, we are unable to evaluate the significance of this reduction in the rapidly eroding landscape context of the barrier islands in this portion of the Action Area.

As we discussed on page 2 of the introduction to this BO, the effects of *future* non-federal actions in the Action Area, i.e., **cumulative effects**, are not relevant to our evaluation of the *completed* Action, as is the case for our evaluation of proposed actions. This BO determines after-the-fact whether the completed Action jeopardized species or destroyed/adversely modified critical habitat.

After reviewing the current status of the critical habitat, the environmental baseline for the Action Area, and the effects of the Action, it is the USFWS biological opinion that the Action did not destroy or adversely modify designated critical habitat for the piping plover.

13. INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term “take” in the ESA means “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” (ESA §3). In regulations at 50 CFR §17.3, the USFWS further defines:

- “harass” as “an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering;”
- “harm” as “an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering;” and
- “incidental take” as “any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.”

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to and not intended as part of the agency action is not prohibited, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

An emergency response action that may affect listed species and designated critical habitat is the sole circumstance under which Federal agencies may initiate ESA consultation *after* implementing the action. However, the Services have no authority to exempt the taking of listed species from the ESA take prohibitions after-the-fact. Therefore, the ITS of an emergency consultation BO does not include reasonable and prudent measures or terms and conditions to minimize take, unless the agency has an ongoing action related to the emergency. The Action evaluated in this BO is concluded.

During the DWH emergency response, the USCG coordinated with the Services to obtain recommendations for avoiding and minimizing adverse effects of response activities to listed species and critical habitats. The agencies formalized these recommendations as a set of 52 Best Management Practices (BMPs) (Appendix E of the USCG BA) applicable to particular response activities, listed species, and their habitats. The USCG BA described the effects of the Action considering the record of BMP application, including authorized deviations from particular BMPs at particular times and locations. Likewise, the “Effects of the Action” sections of this BO account for the BMPs in describing species’ responses to the Action, and in estimating the amount or extent of such responses that are consistent with the definition of take, quoted above. The USFWS will use the findings of these sections as necessary to update the species’ status and environmental baseline in future consultations.

14. CONSERVATION RECOMMENDATIONS

§7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The USFWS offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the USCG.

1. Emergency response to the Deepwater Horizon (DWH) event covered a large area over a long period of time. We recommend that the USCG continue to work cooperatively with the USFWS, NOAA-NMFS, and EPA to incorporate into the responses to future oil spills the lessons learned from DWH about the effectiveness of various conservation measures for avoiding and minimizing impacts to listed species and designated critical habitats.

2. We recommend that the USCG continue to work through the National Response Team to develop and maintain over time programmatic consultations that address the effects of spill response activities on listed species and designated critical habitats. Programmatic consultations would compile conservation measures applicable to various circumstances, which would facilitate rapid implementation during spill responses. Programmatic consultations would also facilitate USCG effect determinations early during a spill response action. Early effect determinations would narrow the scope of actions that must conclude consultation with a biological opinion after an action is concluded by defining in advance for particular areas and habitat types the circumstances for not-likely-to-adversely affect determinations relative to species and critical habitats that may occur in an action area.

3. The DWH event highlighted the need for up-to-date, real-time baseline information on the locations and status of protected resources. NOAA's Emergency Response management System (ERMA) (https://response.restoration.noaa.gov/maps-and-spatial-data/environmental-response-management-application-erma/) proved very useful during the course of the DWH response. We encourage continued use and support of this system, including updates of the Environmental Sensitivity Indices, as new information becomes available. When possible, data collection using aircraft or unmanned aerial vehicles (i.e., drones) could assist in providing real-time information through this system about resources in current and projected areas of spill impacts.

4. Finally, we look forward to working collaboratively with the USCG to enhance the USFWS Information for Planning and Consultation (IPaC) website (https://ecos.fws.gov/ipac/) for use during future events. We envision developing simple, species- and habitat-specific conservation recommendations for rapid implementation following spills to avoid and minimize the adverse effects of spill response activities.

15. REINITIATION NOTICE

Formal consultation for the Action (USCG emergency response to the DWH oil spill) considered in this BO is concluded. Reinitiating consultation is required under certain circumstances if the action agency retains discretionary involvement or control over the Action. However, the Action is also concluded. Therefore, reinitiating this consultation will not be necessary.

16. LITERATURE CITED

Ackerman, R.A. 1980. Physiological and ecological aspects of gas exchange by sea turtle eggs. American Zoologist 20:575-583.

Addison, L. 2012. Use of southeastern North Carolina inlets by migrating and wintering piping plovers (*Charadrius melodus*). Audubon North Carolina, Wilmington, North Carolina. Poster presentation at January 2012 Atlantic Coast piping plover and least tern workshop in Shepherdstown, West Virginia.

Arvin, J. 2008. A survey of upper Texas coast critical habitats for migratory and wintering piping plover and associated resident "sand plovers." Gulf Coast Bird Observatory's interim report to Texas Parks and Wildlife Department. Grant No. TX E-95-R.

Audubon Society. 2017. Meet Old Man Plover, the Pride of the Great Lakes. <http://www.audubon.org/news/meet-old-man-plover-pride-great-lakes>.

Bird, B.L. 2002. Effects of predator risk, vegetation structure, and artificial lighting on the foraging behavior of beach mice. Master's thesis. University of Florida, Gainesville.

Bird, B.L, L.C. Branch, and D.L. Miller. 2004. Effects of coastal lighting on foraging behavior of beach mice. Conservation Biology 18: 1435-1439.

Blair, K. 2005. Determination of sex ratios and their relationship to nest temperature of loggerhead sea turtle (*Caretta caretta*, L.) hatchlings produced along the southeastern Atlantic coast of the United States. Unpublished Master of Science thesis. Florida Atlantic University, Boca Raton, Florida.

Brillhart, D.B. and D.W. Kaufman. 1991. Influence of illumination and surface structure on space use by prairie deer mice (*Peromyscus maniculatus bairdii*). J. Mammalogy 72:502-512.

Burchfield, P.M. and J.L Peña. 2011. Final report on the Mexico/United Stated of America population for the Kemp's Ridley sea turtle, *Lepidochelys kempii*, on the coasts of Tamaupilas, Mexico. 2011. Annual report to Fish and Wildlife Service. 43 pp.

Burger, J. 1991. Foraging behavior and the effect of human disturbance on the piping plover (*Charadrius melodus*). J. Coastal Research 7:39-52.

Burger, J. 1994. The effect of human disturbance on foraging behavior and habitat use in piping plover (*Charadrius melodus*). Estuaries 17:695-701.

Caillouet, C.W. 2011. Guest Editorial: Did the BP-Deepwater Horizon-Macondo oil spill change the age structure of the Kemp's ridley population? Marine Turtle Newsletter 130: 1-2.

Carr, A. 1963. Panspecific reproductive convergence in *Lepidochelys kempii*. Ergebnisse der Biologie 26:298-303.

Carr, A. and L. Ogren. 1960. The ecology and migrations of sea turtles, 4. The green turtle in the Caribbean Sea. Bulletin of the American Museum of Natural History 121(1):1-48.

Catlin, D.H. 2009. Population dynamics of piping plovers (*Charadrius melodus*) on the Missouri River. PhD Dissertation. Virginia Polytechnic Institute and State University. Blacksburg. 106 pp.

Cavalieri, V. 2016. Personal Communication. August 1, 2016, email to Kathryn Matthews, USFWS, Raleigh, NC. FEIS for Figure Eight Island Terminal Groin Project. Number of

Great Lakes breeding pairs for 2016. Fish and Wildlife Biologist, USFWS, East Lansing, Michigan.

Chaloupka, M. 2001. Historical trends, seasonality and spatial synchrony in green sea turtle egg production. Biological Conservation 101:263-279.

Chapman, B.R. 1984. Seasonal abundance and habitat-use patterns of coastal bird populations on Padre and Mustang Island barrier beaches (following the Ixtoc I Oil Spill). Report prepared for U.S. Fish and Wildlife Service under Contract No. 14-16-0009-80-062.

Christens, E. 1990. Nest emergence lag in loggerhead sea turtles. J. Herpetology 24(4):400-402.

Cohen, J.B., S.M. Karpanty, D.H. Catlin, J.D. Fraser, and R.A. Fischer. 2008. Winter ecology of piping plovers at Oregon Inlet, North Carolina. Waterbirds 31:472-479.

Collard, S.B. and L.H. Ogren. 1990. Dispersal scenarios for pelagic post-hatchling sea turtles. Bulletin of Marine Science 47(1):233-243.

Congdon, J.D., A.E. Dunham, and R.C. van Loben Sels. 1993. Delayed sexual maturity and demographics of Blanding's turtles (*Emydoidea blandingii*): implications for conservation and management of long-lived organisms. Conservation Biology 7(4):826-833.

Cuthbert, F.J. and S. Saunders. 2013. Piping plover breeding biology and management in the Great Lakes, 2013. Report submitted to the US Fish and Wildlife Service, East Lansing, MI. 34 pp.

Danielson, B. J. 2005. Importance of multiple independent populations of Alabama beach mice. Issue paper and presentation to Alabama beach mouse recovery team. May 16, 2005.

Deepwater Horizon Natural Resource Damage Assessment Trustees. 2016. Deepwater Horizon oil spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement. Retrieved from http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan

Defeo, O., A. McLachlan, D. S. Schoeman, T. A. Schlacher, J. Dugan, A. Jones, M. Lastra, and F. Scapini. 2009. Threats to sandy beach ecosystems: a review. Estuarine, Coastal and Shelf Science 81:1-12.

Dickerson, D.D. and D.A. Nelson. 1989. Recent results on hatchling orientation responses to light wavelengths and intensities. Pages 41-43 *in* Eckert, S.A., K.L. Eckert, and T.H. Richardson (compilers). Proceedings of the 9th Annual Workshop on Sea Turtle Conservation and Biology. NOAA Technical Memorandum NMFS-SEFC-232.

Dodd, C.K., Jr. 1988. Synopsis of the biological data on the loggerhead sea turtle Caretta caretta (Linnaeus 1758). U.S. Fish and Wildlife Service, Biological Report 88(14).

Douglass, S.L., T.A. Sanchez, and S. Jenkins. 1999. Mapping erosion hazard areas in Baldwin County, Alabama and the use of confidence intervals in shoreline change analysis. J. Coastal Research, SI(28), pp. 95-105.

Drake, K. L. 1999a. Time allocation and roosting habitat in sympatrically wintering piping and snowy plovers. M. S. Thesis. Texas A&M University-Kingsville, Kingsville, Texas. 59pp.

Drake, K. R. 1999b. Movements, habitat use, and survival of wintering piping plovers. M.S. Thesis. Texas A&M University-Kingsville, Kingsville, Texas. 82 pp.

Drake, K. R., J. E. Thompson, K. L. Drake, and C. Zonick. 2001. Movements, habitat use and survival of non-breeding piping plovers. Condor 103:259-267.

Drake, K.L. and K.R. Mehl. 2004. Hypothesis II: Is survival limiting piping plover population growth? Pages 26–29 *in* Westworth, S.M., D. Martens, C.L. Gratto-Trevor, J.P. Goossen and S. Davis. 2004. Northern Great Plains Piping Plover Science Workshop: 20–23 November 2003, Regina Saskatchewan. Unpublished Canadian Wildlife Service Report, Edmonton, Alberta. 58 pp.

Dugan, J. E. and D. M. Hubbard. 2010. Loss of coastal strand habitat in southern California: the role of beach grooming. Estuaries and Coasts (2010) 33:67–77.

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

Eckert, K.L., B.P. Wallace, J.G. Frazier, S.A. Eckert, and P.C.H. Pritchard. 2012. Synopsis of the biological data on the leatherback sea turtle (Dermochelys coriacea). U.S. Department of Interior, Fish and Wildlife Service, Biological Technical Publication BTP-R4015-2012, Washington, D.C.

Ehrhart, L.M. 1989. Status report of the loggerhead turtle. Pages 122-139 in Ogren, L., F. Berry, K. Bjorndal, H. Kumpf, R. Mast, G. Medina, H. Reichart, and R. Witham (editors). Proceedings of the 2nd Western Atlantic Turtle Symposium. NOAA Technical Memorandum NMFS-SEFC-226.

Ehrhart, L.M., D.A. Bagley, and W.E. Redfoot. 2003. Loggerhead turtles in the Atlantic Ocean: geographic distribution, abundance, and population status. Pages 157-174 *in* Bolten, A.B. and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Books, Washington D.C.

Elliott, L.F. and T. Teas. 1996. Effects of human disturbance on threatened wintering shorebirds. In fulfillment of Texas Grant number E-1-8. Project 53. 10 pp.

Elliott-Smith, E., M. Bidwell, A.E Holland, and S.M. Haig. 2015. Data from the 2011 International Piping Plover Census: U.S. Geological Survey Data Series 922. 296 p. http://dx.doi.org/10.3133/ds922.

Encalada, S.E., K.A. Bjorndal, A.B. Bolten, J.C. Zurita, B. Schroeder, E. Possardt, C.J. Sears, and B.W. Bowen. 1998. Population structure of loggerhead turtle (*Caretta caretta*) nesting colonies in the Atlantic and Mediterranean as inferred from mitochondrial DNA control region sequences. Marine Biology 130:567-575.

Ernest, R.G. and R.E. Martin. 1993. Sea turtle protection program performed in support of velocity cap repairs, Florida Power & Light Company St. Lucie Plant. Applied Biology, Inc., Jensen Beach, Florida. 51 pages.

Fleming, K.L. and N.R. Holler. 1990. Reproduction in captive Santa Rosa beach mice (*Peromyscus polionotus leucocephalus*) and Choctawhatchee beach mice (*P.p. allophrys*). J. the Alabama Academy of Science 61:143.

Frair, W., R.G. Ackerman, and N. Mrosovsky. 1972. Body temperature of *Dermochelys coriacea:* warm water turtle from cold water. Science 177:791-793.

Gallaway, B.J., W.J. Gazey, C.W. Caillouet, Jr., P.T. Plotkin, F. A. Abreu Grobois, A.F. Amos, P.M. Burchfield, R.R. Carthy, M.A. Castro Mart´Inez, J.G. Cole, A.T. Coleman, M.Cook, S.Dimarco, S.P. Epperly, M.Fujiwara, D.Gomez Gamez, G.L. Graham, W.L. Griffin, F.Illescas Mart´Inez, M.M. Lamont, R.L. Lewison, K.J. Lohmann, J.M. Nance, J. Pitchford, N.F. Putman, S.W. Raborn, J.K. Rester, J.J. Rudloe, L. Sarti Martinez, M.

Schexnayder, J.R. Schmid, D.J. Shaver, C.Slay, A.D. Tucker, M. Tumlin, T. Wibbels, and B.M. Zapata Najera. 2016. Development of a Kemp's ridley sea turtle stock assessment model. Gulf of Mexico Science 2016(2), pp. 138–157.

Gerrodette, T. and J. Brandon. 2000. Designing a monitoring program to detect trends. Pages 36-39 *in* Bjorndal, K.A. and A.B. Bolten (editors). Proceedings of a Workshop on Assessing Abundance and Trends for In-water Sea Turtle Populations. NOAA Technical Memorandum NMFS-SEFSC-445.

Godfrey, M.H. and N. Mrosovsky. 1997. Estimating the time between hatching of sea turtles and their emergence from the nest. Chelonian Conservation and Biology 2(4):581-585.

Godfrey, P.J., S.P. Leatherman, and P.A. Buckley. 1978. Impact of off-road vehicles on coastal ecosystems. Pages 581-599 *in* Coastal Zone 1978 Symposium on Technical, Environmental Socioeconomic and Regulatory Aspects of Coastal Zone Management, Vol. II. San Francisco, California.

Goldin, M.R. 1993. Piping Plover (Charadrius melodus) management, reproductive ecology, and chick behavior at Goosewing and Briggs Beaches, Little Compton, Rhode Island, 1993. The Nature Conservancy, Providence, Rhode Island.

Gratto-Trevor, C, D. Amirault-Langlais, D. Catlin, F. Cuthbert, J. Fraser, S. Maddock, E. Roche, and F. Shaffer. 2012. Connectivity in piping plovers: do breeding populations have distinct winter distributions? J. Wildlife Management 76(2):348–355.

Greer, A.E., J.D. Lazell, Jr., and R.M. Wright. 1973. Anatomical evidence for counter-current heat exchanger in the leatherback turtle (*Dermochelys coriacea*). Nature 244:181.

Hailman, J.P. and A.M. Elowson. 1992. Ethogram of the nesting female loggerhead (*Caretta caretta*). Herpetologica 48:1-30.

Hanson, J., T. Wibbels, and R.E. Martin. 1998. Predicted female bias in sex ratios of hatchling loggerhead sea turtles from a Florida nesting beach. Canadian J. Zoology 76(10):1850-1861.

Harrington, B.A. 2008. Coastal inlets as strategic habitat for shorebirds in the southeastern United States. DOER technical notes collection. ERDC TN-DOERE25. U.S. Army Engineer Research and Development Center, Vicksburg, MS. http://el.erdc.usace.army.mil/elpubs/pdf/doere25.pdf.

Hays, G.C. 2000. The implications of variable remigration intervals for the assessment of population size in marine turtles. J. Theoretical Biology 206:221-227.

Hendrickson, J.R. 1958. The green sea turtle *Chelonia mydas* (Linn.) in Malaya and Sarawak. Proceedings of the Zoological Society of London 130:455-535.

Heppell, S.S. 1998. Application of life-history theory and population model analysis to turtle conservation. Copeia 1998(2):367-375.

Heppell, S.S., D.T. Crouse, L.B. Crowder, S.P. Epperly, W. Gabriel, T. Henwood, R. Marquez, and N.B. Thompson. 2005. A population model to estimate recovery time, population size, and management impacts on Kemp's ridley sea turtles. Chelonian Conservation and Biology 4(4):767-773.

Heppell, S.S., L.B. Crowder, D.T. Crouse, S.P. Epperly, and N.B. Frazer. 2003. Population models for Atlantic loggerheads: past, present, and future. Pages 225-273 in Bolten, A.B.

and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Books, Washington, D.C.

Hildebrand, H.H. 1963. Hallazgo del área de anidación de la tortuga marina “lora” *Lepidochelys kempi* (Garman), en la coasta occidental del Golfo de México. Sobretiro de Ciencia, México 22:105-112.

Hirth, H.F. 1997. Synopsis of the biological data on the green turtle *Chelonia mydas* (Linnaeus 1758). U.S. Fish and Wildlife Service, Biological Report 97(1).

Holler, N. R, and R. M. Mason. 1989. Gulf Coast beach mouse recovery–reestablishment of Choctawhatchee and Perdido Key beach mice to areas of formerly occupied habitat. Final Performance Report. 45 pp.

Holler, N. R., M. C. Wooten, and C. L. Hawcroft. 1997. Population biology of endangered Gulf coast beach mice (*Peromyscus polionotus*): conservation implications. Technical Report. Alabama Cooperative Fish and Wildlife Research Unit.

Holliman, D. C. 1983. Status and habitat of Gulf Coast Alabama beach mice (*Peromyscus polionotus ammobates* and *P. p. trissyllepsis*). Northeast Gulf Science. 6(2): 121-129.

Hoopes, E.M. 1993. Relationships between human recreation and piping plover foraging ecology and chick survival. M.S. Thesis. University of Massachusetts, Amherst, Massachusetts.

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. and G.C. Hays. 2001. Asynchronous emergence by loggerhead turtle (*Caretta caretta*) hatchlings. Naturwissenschaften 88:133-136.

Hubbard, D. M. and J. E. Dugan. 2003. Shorebird use of an exposed sandy beach in southern California. Estuarine Coastal Shelf Science 58: 41-54.

Hughes, A.L. and E.A. Caine. 1994. The effects of beach features on hatchling loggerhead sea turtles. Pages 237 *in* Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Eliazar (compilers). Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351.

Jimenez, M.C., A. Filonov, I. Tereshchenko, and R.M. Marquez. 2005. Time-series analyses of the relationship between nesting frequency of the Kemp’s ridley sea turtle and meteorological conditions. Chelonian Conservation and Biology 4(4):774-780.

Kindinger, M. E. 1981. Impacts of the Ixtoc I oil spill on the community structure of the intertidal and subtidal infauna along South Texas beaches. M.S. Thesis. Division of Biology, Corpus Christi State University, Corpus Christi, Texas, viii + 91 pp.

Lafferty, K.D. 2001a. Birds at a Southern California beach: Seasonality, habitat use and disturbance by human activity. Biodiversity and Conservation 10:1949-1962.

Lafferty, K.D. 2001b. Disturbance to wintering western snowy plovers. Biological Conservation 101:315-325.

Limpus, C.J. 1971. Sea turtle ocean finding behaviour. Search 2(10):385-387.

Lohmann, K.J. and C.M.F. Lohmann. 2003. Orientation mechanisms of hatchling loggerheads. Pages 44-62 *in* Bolten, A.B. and B.E. Witherington (editors). Loggerhead Sea Turtles. Smithsonian Books, Washington D.C.

Lott, C.A., C.S. Ewell Jr., and K.L. Volanky. 2009. Habitat associations of shoreline-dependent birds in barrier island ecosystems during fall migration in Lee County, Florida. Prepared for U.S. Army Corps of Engineers, Engineer Research and Development Center, Technical Report. 103 pp.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2013. http://mississippiriverdelta.org/files/2017/03/CWPPRA-West-Belle-Pass-barrier-headland-restoration-factsheet.pdf

Lynn, W. J. 2000a. Social organization and burrow-site selection of the Alabama Beach Mouse (*Peromyscus polionotus ammobates*). Master's thesis, Auburn University, Alabama.

Lynn, W. J. 2000b. Memorandum dated September 18, 2000, on East Pass beach mouse trapping results. Alabama Cooperative Fish and Wildlife Research Unit. Auburn, Alabama.

Maddock, S., M. Bimbi, and W. Golder. 2009. South Carolina shorebird project, draft 2006–2008 piping plover summary report. Audubon North Carolina and U.S. Fish and Wildlife Service, Charleston, South Carolina. 135 pp.

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, Florida.

Marquez-Millan, R. 1994. Synopsis of biological data on the Kemp's ridley sea turtle, *Lepidochelys kempi* (Garman, 1880). NOAA Technical Memorandum NMFS-SEFC-343.

Meylan, A. 1982. Estimation of population size in sea turtles. Pages 135-138 *in* Bjorndal, K.A. (editor). Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington, D.C.

Meylan, A.B., B.E. Witherington, B. Brost, R. Rivero, And P.S. Kulilis. 2006. Sea turtle nesting in Florida, USA: assessments of abundance and trends for regionally significant populations of *Caretta, Chelonia,* and *Dermochelys*. Pages 306-307 *in* Frick, M., A. Panagopoulou, A.F. Rees, and K. Williams (compilers). Book of Abstracts. Twenty-sixth Annual Symposium on Sea Turtle Biology and Conservation. International Sea Turtle Society, Athens, Greece.

Michel, J., E.H. Owens, S. Zengel, A. Graham, Z. Nixon, T. Allard, W. Holton, P.D. Reimer, A. Lamarche, M. White, N. Rutherford, C. Childs, G. Mauseth, G. Challenger, and E. Taylor. 2013. Extent and degree of shoreline oiling: Deepwater Horizon oil spill, Gulf of Mexico, USA. PLoS ONE 8(6):e65087. doi:10.1371/journal.pone.0065087

Moran, K.L., K.A. Bjorndal, and A.B. Bolten. 1999. Effects of the thermal environment on the temporal pattern of emergence of hatchling loggerhead turtles *Caretta caretta*. Marine Ecology Progress Series 189:251-261.

Morreale, S. J., P. M. Plotkin, D. J. Shaver, and H. J. Kalb. 2007. Adult migration and habitat utilization: ridley turtles in their element, p. 213–229. In: Biology and conservation of ridley sea turtles. P. T. Plotkin (ed.). The John Hopkins University Press, Baltimore, MD.

Moyers, J. 1996. Food habitats of Gulf coast subspecies of beach mice *Peromyscus polionotus*. Master's thesis. Auburn University, Alabama.

Moyers, J.E., N.R. Holler, and M.C. Wooten. 1999. Species status report, current distribution and status of the Perdido Key, Choctawhatchee and St. Andrew Beach Mouse. U.S. Fish and Wildlife Service Grant Agreement No. 1448-0004-94-9174.

Mrosovsky, N. 1968. Nocturnal emergence of hatchling sea turtles: control by thermal inhibition of activity. Nature 220(5174):1338-1339.

Mrosovsky, N. and A. Carr. 1967. Preference for light of short wavelengths in hatchling green sea turtles (*Chelonia mydas*), tested on their natural nesting beaches. Behavior 28:217-231.

Mrosovsky, N. and C.L. Yntema. 1980. Temperature dependence of sexual differentiation in sea turtles: implications for conservation practices. Biological Conservation 18:271-280.

Mrosovsky, N. and J. Provancha. 1989. Sex ratio of hatchling loggerhead sea turtles: data and estimates from a five year study. Canadian J. Zoology 70:530-538.

Mrosovsky, N. and S.J. Shettleworth. 1968. Wavelength preferences and brightness cues in water finding behavior of sea turtles. Behavior 32:211-257.

Murphy, T.M. and S.R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the southeast region. Unpublished report prepared for the National Marine Fisheries Service.

Musick, J.A. 1999. Ecology and conservation of long-lived marine mammals. Pages 1-10 *in* Musick, J.A. (editor). Life in the Slow Lane: Ecology and Conservation of Long-lived Marine Animals. American Fisheries Society Symposium 23, Bethesda, Maryland.

National Marine Fisheries Service. 2001. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-455.

National Marine Fisheries Service. 2014. Biological opinion: continued implementation of the sea turtle conservation regulations under the ESA and the continued authorization of the southeast U.S. shrimp fisheries in federal waters under the Magnuson-Stevens Fishery Management and Conservation Act. Consultation SER-2013-12255. Southeast Regional Office, St. Petersburg, Florida. 346 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1991. Recovery plan for U.S. population of Atlantic green turtle (*Chelonia mydas*). National Marine Fisheries Service, Washington, D.C. 59 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2007. Green sea turtle (*Chelonia mydas*) 5-year review: summary and evaluation. NMFS, Silver Spring, Maryland, and USFWS Southeast Region, Jacksonville Ecological Services Field Office, Florida. August 2007. 102 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2008. Recovery plan for the Northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*), second revision. National Marine Fisheries Service, Silver Spring, Maryland. 325 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2013. Leatherback sea turtle (*Dermochelys coriacea*) 5-year review: summary and evaluation. NMFS, Silver Spring, Maryland, and USFWS Southeast Region, Jacksonville Ecological Services Field Office, Florida. November 2013. 91 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2015. Kemp’s ridley sea turtle (*Lepidochelys kempii*) 5-year review: summary and evaluation. NMFS, Silver Spring, Maryland, and USFWS Southwest Region, Albuquerque, New Mexico. July 2015. 62 pp.

National Marine Fisheries Service, U.S. Fish and Wildlife Service, and SEMARNAT. 2011. Bi-national recovery plan for the Kemp's ridley sea turtle (*Lepidochelys kempii*), second Revision. NMFS, Silver Spring, Maryland. 156 pp. + app.

Nelson, D.A. 1988. Life history and environmental requirements of loggerhead turtles. U.S. Fish and Wildlife Service Biological Report 88(23). U.S. Army Corps of Engineers TR EL-86-2 (Rev.).

Nelson, D.A. and D.D. Dickerson. 1987. Correlation of loggerhead turtle nest digging times with beach sand consistency. Abstract of the 7th Annual Workshop on Sea Turtle Conservation and Biology.

Nicholls, J.L. 1989. Distribution and other ecological aspects of piping plovers (*Charadrius melodus*) wintering along the Atlantic and Gulf Coasts. M.S. Thesis. Auburn University, Auburn, Alabama.

Nicholls, J.L. and G.A. Baldassarre. 1990a. Winter distribution of piping plovers along the Atlantic and Gulf Coasts of the United States. Wilson Bulletin 102:400-412.

Nicholls, J.L. and G.A. Baldassarre. 1990b. Habitat associations of piping plover wintering in the United States. Wilson Bulletin 102(4):581-590.

Nordstrom, K.F. 2000. Beaches and dunes on developed coasts. Cambridge University Press, Cambridge, Massachusetts. 338 pp.

Novak, J.A. 1997. Home range and habitat use of Choctawhatchee beach mice. M.S. thesis, Auburn University, Alabama.

Nudds, R.L. and D.M. Bryant. 2000. The energetic cost of short flight in birds. J. Experimental Biology 203:1561-1572.

Ogren, L.H. 1989. Distribution of juvenile and subadult Kemp's ridley turtles: preliminary results from the 1984-1987 surveys. Pages 116-123 *in* Caillouet, C.W., Jr., and A.M. Landry, Jr. (eds.). Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management. Texas A&M University Sea Grant College Program TAMU-SG-89-105.

Oli, M.K., N.R. Holler, M.C. Wooten. 2001. Viability analysis of endangered Gulf Coast beach mice (*Peromyscus polionotus*) populations. Biological Conservation 97:107-118.

Orreck, J., B. Danielson, and R. Brinkerhoff. 2004. Rodent foraging is affected by indirect, but not by direct, cues of predation risk. Behavioral Ecology 15(3): 433-437.

Pearce, A.F. 2001. Contrasting population structure of the loggerhead turtle (*Caretta caretta*) using mitochondrial and nuclear DNA markers. Unpublished Master of Science thesis. University of Florida, Gainesville, Florida. 71 pp.

Pfister, C., B.A. Harrington, and M. Lavine. 1992. The impact of human disturbance on shorebirds at a migration staging area. Biological Conservation 60:115-126.

Philibosian, R. 1976. Disorientation of hawksbill turtle hatchlings (*Eretmochelys imbricata*) by stadium lights. Copeia 1976:824.

Provancha, J.A. and L.M. Ehrhart. 1987. Sea turtle nesting trends at Kennedy Space Center and Cape Canaveral Air Force Station, Florida, and relationships with factors influencing nest site selection. Pages 33-44 *in* Witzell, W.N. (editor). Ecology of East Florida Sea Turtles: Proceedings of the Cape Canaveral, Florida Sea Turtle Workshop. NOAA Technical Report NMFS-53.

Provancha, J.A. and P. Mukherjee. 2011. Late-term nest incubation and hatchling release of northeastern Gulf sea turtle nests in response to April 2010 Deepwater Horizon oil spill. Innovative Health Applications, LLC.

Putman, N.F., T.J. Shay, and K.J. Lohmann. 2010. Is the geographic distribution of nesting in the Kemp's ridley turtle shaped by the migratory needs of offspring? Integrative and Comparative Biology, a symposium presented at the annual meeting of the Society for Integrative and Comparative Biology, Seattle, WA. 10 pp.

Rave, E.H. and N.R. Holler. 1992. Population dynamics of beach mice (*Peromyscus polionotus ammobates*) in southern Alabama. J. Mammalogy 73:347-355.

Reina, R.D., P.A. Mayor, J.R. Spotila, R. Piedra, and F.V. Paladino. 2002. Nesting ecology of the leatherback turtle, *Dermochelys coriacea*, at Parque Nacional Marino Las Baulas, Costa Rica: 1988-1989 to 1999-2000. Copeia 2002(3):653-664.

Roche, E.A., J.B. Cohen, D.H. Catlin, D.L. Amirault-Langlais, F.J. Cuthbert, C.L. Gratto-Trevor, J. Felio, and J.D. Fraser. 2010. Range-wide piping plover survival: correlated patterns and temporal declines. J. Wildlife Management 74:1784-1791.

Rostal, D.C. 2007. Reproductive physiology of the ridley sea turtle. Pages 151-165 *in* Plotkin P.T. (editor). Biology and Conservation of Ridley Sea Turtles. Johns Hopkins University Press, Baltimore, Maryland.

Routa, R.A. 1968. Sea turtle nest survey of Hutchinson Island, Florida. Quarterly J. Florida Academy Sciences 30(4):287-294.

Salmon, M., J. Wyneken, E. Fritz, and M. Lucas. 1992. Seafinding by hatchling sea turtles: role of brightness, silhouette and beach slope as orientation cues. Behaviour 122 (1-2):56-77.

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, R.S. Waples. 2015. Status review of the green turtle (*Chelonia mydas*) under the U.S. Endangered Species Act. NOAA Technical Memorandum, NOAA-NMFS-SWFSC-539. 571pp. http://www.cio.noaa.gov/services_programs/prplans/pdfs/ID232_Final_Product_Green_Turtle_Technical_Memorandum_SWFSC_No_539.pdf

Seney, E.E. and A.M. Landry. 2008. Movements of Kemp's ridley sea turtles nesting on the upper Texas coast: implications for management. Endangered Species Research 4:73-84.

Shaffer, M. and B.A. Stein. 2000. Safeguarding our Precious Heritage. Chapter 11 in Stein, B.A., L.S. Kutner, J.S. Adams (eds). Precious heritage: the status of biodiversity in the United States. Oxford University Press, New York. 399pp.

Shamblin B.M., A.B. Bolten, F.A. Abreu-Grobois, K.A. Bjorndal, L. Cardona, C. Carreras, et al. 2014. Geographic patterns of genetic variation in a broadly distributed marine vertebrate: new insights into loggerhead turtle stock structure from expanded mitochondrial DNA sequences. PLoS ONE 9(1): e85956. https://doi.org/10.1371/journal.pone.0085956

Smith, B.S. 2007. 2006–2007 Nonbreeding shorebird survey, Franklin and Wakulla Counties, Florida. Final report to the Service in fulfillment of Grant #40181-7-J008. Apalachicola Riverkeeper, Apalachicola, Florida. 32 pp.

Smith, K.E.L. 2003. Movements and habitat use of the Santa Rosa beach mouse *(Peromyscus polionotus leucocephalus)* in a successional dune mosaic. Master's thesis, University of Florida.

Sneckenberger, S. 2001. Factors influencing habitat use by the Alabama beach mouse *Peromyscus polionotus ammobates.* Master's thesis, Auburn University, Alabama.

Snover, M.L., A.A. Hohn, L.B. Crowder, and S.S. Heppell. 2007. Age and growth in Kemp's ridley sea turtles: evidence from mark-recapture and skeletochronology. Pages 89-106 *in* Plotkin P.T. (editor). Biology and Conservation of Ridley Sea Turtles. John Hopkins University Press, Baltimore, Maryland.

Solow, A.R., K.A. Bjorndal, and A.B. Bolten. 2002. Annual variation in nesting numbers of marine turtles: the effect of sea surface temperature on re-migration intervals. Ecology Letters 5:742-746.

South Alabama Regional Planning Commission. 2001. Fort Morgan Peninsula Resource Assessment. Alabama Department of Conservation & Natural Resources. Mobile, Alabama.

Staine, K.J. and J. Burger. 1994. Nocturnal foraging behavior of breeding piping plovers (*Charadrius melodus*) in New Jersey. Auk 111:579-587.

Sternberg, J. 1981. The worldwide distribution of sea turtle nesting beaches. Center for Environmental Education, Washington, D.C.

Stewart, K.R. 2007. Establishment and growth of a sea turtle rookery: the population biology of the leatherback in Florida. Ph.D. dissertation, Duke University, Durham, North Carolina.

Stewart, K.R. and C. Johnson. 2006. *Dermochelys coriacea*–leatherback sea turtle *in* P.A. Meylan, editor. Biology and conservation of Florida turtles. Chelonian Research Monographs 3:144-157.

Stewart, K.R. and J. Wyneken. 2004. Predation risk to loggerhead hatchlings at a high-density nesting beach in Southeast Florida. Bulletin of Marine Science 74(2):325-335.

Swilling, W.R. 2000. Ecological dynamics of the endangered Alabama beach mouse (*Peromyscus polionotus ammobates*). Master's thesis, Auburn University, Alabama.

Swilling, W.R. and M.C. Wooten. 2002. Subadult dispersal in a monogamous species: the Alabama beach mouse (*Peromyscus polionotus ammobates*). J. Mammalogy 83(1):252-259.

Swilling, W.R., M.C. Wooten, N.R. Holler, and W.J. Lynn. 1998. Population dynamics of Alabama beach mice (*Peromyscus polionotus ammobates*) following Hurricane Opal. American Midland Naturalist 140:287-298.

Tarr, J.G. and P.W. Tarr. 1987. Seasonal abundance and the distribution of coastal birds on the northern Skeleton Coast, South West Africa/Nimibia. Madoqua 15:63-72.

Thomas, K., R.G. Kvitek, and C. Bretz. 2002. Effects of human activity on the foraging behavior of sanderlings (*Calidris alba*). Biological Conservation 109:67-71.

Tunnell, J.W., B.R. Chapman, M.E. Kindinger, and Q.R. Dokken. 1982. Environmental impact of Ixtoc I oil spill on south Texas sandy beaches: infauna and shorebirds. Simposio Internacional Ixtoc I, Mexico City. 2-5 June 1982.

Turtle Expert Working Group. 2000. Assessment for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-444.

Turtle Expert Working Group. 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-555.

Turtle Expert Working Group. 2009. An assessment of the loggerhead turtle population in the Western North Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-575.

U.S. Army Corps of Engineers. 2009. Comprehensive plan and integrated programmatic environmental impact statement, Mississippi Coastal Improvements Program (MsCIP) Hancock, Harrison, and Jackson Counties, Mississippi. Mobile, Alabama. 417 pp. http://www.mscip.usace.army.mil/.

U.S. Army Corps of Engineers. 2011. Public notice SAM-2011-00780-SPG: request for authorization to retain and maintain and existing sand-filled rock rubble berm, west end of Dauphin Island, Gulf of Mexico/Mississippi Sound, Mobile County, Alabama. Mobile District, Mobile, Alabama. 26 pp.

U.S. Fish and Wildlife Service. 1996. Piping plover (*Charadrius melodus*), Atlantic Coast population, revised recovery plan. Hadley, Massachusetts. 258 pp.

U.S. Fish and Wildlife Service. 2003. Recovery plan for the Great Lakes piping plover (*Charadrius melodus*). U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. viii + 141 pp.

U.S. Fish and Wildlife Service. 2007. Choctawhatchee beach mouse (*Peromyscus polionotus allophrys*) 5-year review: summary and evaluation. Southeast Region, Panama City Field Office. 25 pp.

U.S. Fish and Wildlife Service. 2009a. Alabama beach mouse (*Peromyscus polionotus ammobates*) 5-year review: summary and evaluation. Southeast Region, Alabama Ecological Services Field Office. 34 pp.

U.S. Fish and Wildlife Service. 2009b. St. Andrew Beach Mouse (*Peromyscus polionotus peninsularis*) 5-year review: summary and evaluation. Southeast Region, Panama City Field Office. 28 pp.

U.S. Fish and Wildlife Service. 2009c. Piping plover (*Charadrius melodus*) 5-year review: summary and evaluation. Northeast Region. 214 pp.

U.S. Fish and Wildlife Service. 2010a. Final report on the Mexico/United States of America population restoration project for the Kemp's ridley sea turtle, *Lepidochelys kempii*, on the coasts of Tamaulipas and Veracruz, Mexico.

U.S. Fish and Wildlife Service. 2010b. Recovery Plan for the St. Andrew Beach Mouse (*Peromyscus polionotus peninsularis*). Atlanta, Georgia. 95 pp.

U.S. Fish and Wildlife Service. 2011. Biological Opinion for Gulf Highlands LLC and Beach Club West Condominiums Incidental Take Permits, Baldwin County, Alabama. July 8, 2011. AL Ecological Services Field Office. Daphne, AL. 144 pp.

U.S. Fish and Wildlife Service. 2014. Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*) 5-year review: summary and evaluation. Southeast Region, Panama City Field Office. 32 pp.

U.S. Fish and Wildlife Service. 2015. Recovery Plan for the Northern Great Plains piping plover (*Charadrius melodus*) in two volumes. Volume I: Draft breeding recovery plan for the Northern Great Plains piping plover (*Charadrius melodus*); and Volume II: Draft revised recovery plan for the wintering range of the Northern Great Plains piping plover (*Charadrius melodus*) and Comprehensive conservation strategy for the piping plover (*Charadrius melodus*) in its coastal migration and wintering range in the continental United States. Denver, Colorado. 166 pp.

U.S. Fish and Wildlife Service. 2017. Abundance and productivity estimates–2016 update: Atlantic Coast piping plover population. Hadley, Massachusetts.

Van Zant, J.L. and M.C. Wooten. 2003. Translocation of Choctawhatchee beach mice (*Peromyscus polionotus allophrys*): hard lessons learned. Biological Conservation 112(3): 405-413.

Weishampel, J.F., D.A. Bagley, and L.M. Ehrhart. 2006. Intra-annual loggerhead and green turtle spatial nesting patterns. Southeastern Naturalist 5(3):453-462.

Weston, J. 2007. Captive breeding of beach mice. Peromyscus Genetic Stock Center, University of South Carolina, Columbia.

Wetland Sciences, Inc. 2014. Assessment of Gulf coast beach mouse habitat impacts associated with oil spill clean up efforts necessitated by the Deepwater Horizon oil spill. Report to the U.S. Fish and Wildlife Service. 232 pp. https://www.fws.gov/doiddata/dwh-ar-documents/907/DWH-AR0259034.pdf

Wilcox, L. 1959. A 20-year banding study of the piping plover. Auk 76: 129-152.

Wilkinson, E., L. Branch, and D. Miller. 2010. Habitat restoration for beach mice: landscape-level population studies and dune restoration. Third Annual Report to USFWS, Contract Number 401817G016, University of Florida, Gainesville, Florida.

Williams-Walls, N., J. O'Hara, R.M. Gallagher, D.F. Worth, B.D. Peery, and J.R. Wilcox. 1983. Spatial and temporal trends of sea turtle nesting on Hutchinson Island, Florida, 1971-1979. Bulletin of Marine Science 33(1):55-66.

Witherington, B.E. 1986. Human and natural causes of marine turtle clutch and hatchling mortality and their relationship to hatching production on an important Florida nesting beach. Unpublished Master of Science thesis. University of Central Florida, Orlando, Florida.

Witherington, B.E. 1992. Behavioral responses of nesting sea turtles to artificial lighting. Herpetologica 48:31-39.

Witherington, B.E. 1997. The problem of photopollution for sea turtles and other nocturnal animals. Pages 303-328 *in* Clemmons, J.R. and R. Buchholz (editors). Behavioral Approaches to Conservation in the Wild. Cambridge University Press, Cambridge, United Kingdom.

Witherington, B.E. and K.A. Bjorndal. 1991. Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles (*Caretta caretta*). Biological Conservation 55:139-149.

Witherington, B.E. and L.M. Ehrhart. 1989. Status and reproductive characteristics of green turtles (*Chelonia mydas*) nesting in Florida. Pages 351-352 *in* Ogren, L., F. Berry, K. Bjorndal, H. Kumpf, R. Mast, G. Medina, H. Reichart, and R. Witham (editors). Proceedings of the Second Western Atlantic Turtle Symposium. NOAA Technical Memorandum NMFS-SEFC-226.

Witherington, B.E. and R.E. Martin. 1996. Understanding, assessing, and resolving light-pollution problems on sea turtle nesting beaches. Florida Marine Research Institute Technical Report TR-2. 73 pp.

Witherington, B.E., K.A. Bjorndal, and C.M. McCabe. 1990. Temporal pattern of nocturnal emergence of loggerhead turtle hatchlings from natural nests. Copeia 1990(4):1165-1168.

Wood, D.W. and K.A. Bjorndal. 2000. Relation of temperature, moisture, salinity, and slope to nest site selection in loggerhead sea turtles. Copeia 2000(1):119-128.

Wyneken, J., L.B. Crowder, and S. Epperly. 2005. Final report: evaluating multiple stressors in loggerhead sea turtles: developing a two-sex spatially explicit model. Final Report to the U.S. Environmental Protection Agency National Center for Environmental Research, Washington, DC. EPA Grant Number R829094.

Zonick, C. 1997. The use of Texas barrier island washover pass habitat by piping plovers and other coastal water birds. Report to the Texas Parks and Wildlife Department and U.S. Fish and Wildlife Service.

Zonick, C. and M. Ryan. 1995. The ecology and conservation of piping plovers (*Charadrius melodus*) wintering along the Texas Gulf Coast. Department of Fisheries and Wildlife, University of Missouri, Columbia, Missouri. 49pp.

Zonick, C.A. 2000. The winter ecology of the piping plover (*Charadrius melodus*) along the Texas Gulf Coast. Ph.D. dissertation. University of Missouri, Columbia, Missouri.