ENVIRONMENTAL IMPACT STATEMENT

SPACEX STARSHIP-SUPER HEAVY LAUNCH VEHICLE AT LAUNCH COMPLEX 39A

at the Kennedy Space Center, Merritt Island, Florida

Final, Volume II, Appendix B.6, Part 4

January 2026

Federal Aviation Administration

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Appendix B Regulatory Consultations

This appendix provides regulatory consultation documentation for Endangered Species Act Section 7 consultation with the United States (U.S.) Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), Magnuson-Stevenson Fishery Conservation and Management Act consultation with the NMFS, National Historic Preservation Act (NHPA) Section 106 consultation with the Florida State Historic Preservation Officer (SHPO), U.S. Department of Transportation Act Section 4(f) consultation with officials with jurisdiction over affected properties, Coastal Zone Management Act consultation with the Florida Department of Environmental Protection, and Marine Mammal Protection Act Incidental Harassment Authorization with NMFS.

B.6 Endangered Species Act Section 7 Consultation (NMFS)

A Biological Assessment (BA) was submitted to NMFS on May 24, 2024.

On January 17, 2025, NMFS provided a Conference and Biological Opinion (CBO) on the effects of Starship-Super Heavy operations on endangered and threatened species under NMFS' jurisdiction, as well as critical habitat for those species, in the North Atlantic Ocean, Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean. The Federal Aviation Administration provided addendums to NMFS describing proposed modifications to Starship-Super Heavy operations at Launch Complex (LC)-39A, among other locations, on March 10, 2025, March 28, 2025, and April 1, 2025. The addendum submitted on April 1, 2025, supersedes the previous addendums and is included in the EIS appendix. On April 18, 2025, based on the addendum requests, NMFS provided a revised CBO on the effects of Starship-Super Heavy operations in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean. On September 16, 2025, based on the addition of Cape Canaveral Space Force Station as a launch site and new information on vehicle specifications and debris fields, NMFS provided a reinitiation of the CBO on the effects of Starship-Super Heavy operations in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean. This reinitiated CBO replaced the previous CBOs submitted on January 17, 2025, and April 18, 2025; thus, only the revised CBO is included in the EIS appendix.

incubated in the sand and after approximately 1.5–2 months of embryonic development, hatchlings emerge and swim offshore into deep, open ocean water where they feed and grow, until they migrate to the neritic zone (nearshore) as juveniles. Males generally arrive at breeding grounds before females and return to foraging grounds months before females (Hays et al. 2022). When individuals reach sexual maturity, adult turtles generally return to their natal beaches where they mate in nearshore waters and nest. North Atlantic DPS green, Kemp's ridley, and Northwest Atlantic Ocean DPS loggerhead turtles generally nest from late spring to late summer/early fall.

Sea turtles generally can hear low-frequency sounds, with a typical hearing range of 30 Hertz (Hz) to 2 kiloHertz (kHz) and a maximum sensitivity between 100–800 Hz (Bartol and Ketten 2006; Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Ridgway et al. 1969).

4.2.2 Threats Common to Green, Kemp's Ridley, and Loggerhead Turtles

ESA-listed sea turtles in the Gulf and Atlantic Ocean portions of the action area face numerous natural and human-induced threats that shape their status and affect their ability to recover. Many of these threats are either the same or similar in nature among the North Atlantic DPS of green, Kemp's ridley, and Northwest Atlantic Ocean DPS of loggerhead turtle. The threats identified in this section apply to all three species. Information on threats specific to a particular species is discussed in the corresponding Status of the Species sections where appropriate.

ESA-listed sea turtles in the Gulf and Atlantic Ocean portions of the action area were threatened by overharvesting and poaching. Although intentional take of sea turtles and their eggs does not occur extensively within these portions of the action area currently, sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. Other major threats to ESA-listed sea turtles are habitat degradation and habitat loss (e.g., human-induced and coastal erosion, storm events, light pollution, coastal development or stabilization, plastic pollution, oil pollution), fisheries interactions and bycatch, changing environmental trends, oceanic events such as cold-stunning, natural predation, and disease.

4.2.3 Green Turtle – North Atlantic DPS

The green turtle was first listed as endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened for all other areas under the ESA in 1978 (43 Fed. Reg. 32800). On April 6, 2016, the NMFS listed 11 DPSs of green turtles, with the North Atlantic DPS listed as threatened (81 Fed. Reg. 20057).

Life History

Adult females in the North Atlantic DPS nest from May–September. Female age at first reproduction is 20–40 years. Green turtles lay an average of three nests per season with an average of 100 eggs per nest (Seminoff et al. 2015). The remigration interval (i.e., return to natal beaches) is two to five years. Nesting is geographically widespread within the action area, and occurs along the southeastern Atlantic coast of the U.S. and the northwestern Gulf coast. Nesting primarily occurs along the central and southeast Atlantic coast of Florida. Four regions support nesting concentrations of particular interest in the North Atlantic DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), U.S. (Florida), and Cuba. The largest nesting site occurs in Tortuguero, Costa Rica (Seminoff et al. 2015).

Green turtle juveniles are capable of hearing underwater sounds at frequencies of 50–1,600 Hz and experience maximum sensitivity at 200–400 Hz, although sensitivity is still possible outside of this range (Piniak et al. 2016; Lenhardt 1994; Bartol and Ketten 2006; Ridgway et al. 1969).

Population Dynamics

Accurate population estimates for sea turtles do not exist because of the difficulty in sampling turtles over their large geographic ranges and within their marine environments. Nonetheless, researchers have used nesting data to study trends in reproducing sea turtles over time. A summary of nesting trends and nester abundance is provided in the most recent status review for the species (Seminoff et al. 2015). The North Atlantic DPS is the largest of the 11 green turtle DPSs, with an estimated nester abundance of over 167,000 adult females from 73 nesting sites.

Florida accounts for approximately 5% of nesting for this DPS (Seminoff et al. 2015). According to data collected from Florida's index nesting beach survey from 1989–2024, green turtle nest counts across Florida have increased from a low of 267 in the early 1990s to a high of 40,911 in 2019. Nesting decreased by half from 2019–2020, although it increased to a new record high in 2023 before dropping substantially in 2024. Green turtles generally follow a two-year reproductive cycle, which may explain fluctuating nest counts. Tortuguero, Costa Rica is the predominant nesting site, accounting for an estimated 79% of nesting for the DPS (Seminoff et al. 2015). A recent long-term study spanning over 50 years of nesting at Tortuguero found that while nest numbers increased steadily over 37 years from 1971–2008, the rate of increase slowed gradually from 2000–2008. After 2008, nesting trends decreased, with current nesting levels having reverted to that of the mid-1990s and the overall long-term trend has now become negative (Restrepo et al. 2023). While nesting in Florida has shown increases over the past decade, individuals across North Atlantic DPS nesting sites intermix and share developmental and foraging habitat. Therefore, threats that have affected nesting in the Tortuguero region may ultimately influence the trajectories of nesting in the Florida region.

DiMatteo et al. (2024a) modeled survey data to estimate a mean annual in-water abundance of juvenile and adult green turtles along the U.S. Atlantic Coast of 63,674 individuals (90% Confidence Interval [CI] = 23,381–117,610 individuals).

Threats

In addition to general threats common to all three sea turtle species considered, green turtles are especially susceptible to natural mortality from fibropapillomatosis (FP) disease (Blackburn et al. 2021; Foley et al. 2005; Manes et al. 2022; Shaver et al. 2019; Tristan et al. 2010). The prevalence of FP has reached epidemic proportions in some parts of the North Atlantic DPS of green turtle, including Florida, although the long-term impacts to North Atlantic DPS green turtles is unknown (Seminoff et al. 2015). FP results in the growth of tumors on soft external tissues (flippers, neck, tail, etc.), the carapace, the eyes, the mouth, and internal organs (gastrointestinal tract, heart, lungs, etc.) of turtles (Aguirre et al. 2002; Herbst 1994; Jacobson et al. 1989). When these tumors are particularly large or numerous, they can debilitate turtles, affecting swimming, vision, feeding, and organ function (Aguirre et al. 2002; Herbst 1994; Jacobson et al. 1989), and can even result in mortality. Perrault et al. (2021b) observed reduced immune function in green turtles with FP. Although the exact cause of FP is unknown, it is believed to be related to an infectious agent, such as a virus, and/or environmental conditions such as habitat degradation and pollution (Foley et al. 2005).

Critical Habitat

Green turtle designated and proposed critical habitat was found to be NLAA (Section 4.1.3) and is not considered further in the opinion.

Recovery Planning

In response to the current threats facing the species, NMFS and U.S. Fish and Wildlife Service (USWFS) identified actions needed to recover the U.S. Atlantic population of green turtles. These threats are discussed in further detail in the environmental baseline of this consultation. See the NMFS and USFWS 1991 recovery plan for the U.S. Atlantic population of green turtles for complete down-listing/delisting criteria for each of the following major actions (NMFS and USFWS 1991). The following items were identified as priorities to recover U.S. Atlantic green turtles:

1. Provide long-term protection to important nesting beaches.
2. Ensure at least 60% hatch success on major nesting beaches.
3. Implement effective lighting ordinances or lighting plans on nesting beaches.
4. Determine distribution and seasonal movements for all life stages in the marine environment.
5. Minimize mortality from commercial fisheries.
6. Reduce threat to population and foraging habitat from marine pollution.

4.2.4 Kemp's Ridley Turtle

The Kemp's ridley turtle was listed as endangered on December 2, 1970, under the Endangered Species Conservation Act of 1969, a precursor to the ESA. Internationally, the Kemp's ridley turtle is considered the most endangered sea turtles (Groombridge 1982; TEWG 2000; Zwinenberg 1977).

Life History

Adult female Kemp's ridley turtles nest from April–July. Age to sexual maturity ranges greatly from five to 16 years, though NMFS et al. (2011b) determined the best estimate of age to maturity for Kemp's ridley turtles was 12 years. The average remigration rate for Kemp's ridley turtles is approximately two years. Females lay approximately 2.5 nests per season with each nest containing approximately 100 eggs (Márquez M. 1994). Nesting is limited to the beaches of the western Gulf, primarily in Tamaulipas, Mexico but also in Veracruz, Mexico and Padre Island National Sea Shore, Texas.

Juvenile Kemp's ridley turtles can hear from 100–500 Hz, with a maximum sensitivity between 100–200 Hz at thresholds of 110 dB re 1µPa (Bartol and Ketten 2006).

Population Dynamics

Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. Nesting steadily increased through the 1990s, and then accelerated during the first decade of the 21st century. Following a significant, unexplained one-year decline in 2010, Kemp's ridley turtle nests in Mexico reached a record high of 21,797 nests in 2012 (NPS 2013). In 2013, there was a second significant decline, with 16,385 nests recorded. In 2014, there were an estimated 10,987 nests (approximately 4,395 females) and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS and USFWS 2015b).

A small nesting population has emerged in the U.S., primarily in Texas, rising from six nests in 1996 to 42 in 2004, to a record high of 353 nests in 2017 (National Park Service data). It is worth noting that nesting in Texas has somewhat paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013–2014, but with a rebound in 2015, the record high in 2017, and then a decrease back down to 190 nests in 2019, rebounding to 262 nests in 2020, and back down to 195 nests in 2021, and then rebounding again to 284 nests in 2022 (National Park Service data; NMFS and USFWS 2015b). Gallaway et al. (2013) estimated the female population size for age 2 and older in 2012 to be 188,713 (standard deviation; SD = 32,529). If females comprise 76% of the population, the total population of Kemp's ridley turtles greater than two years in age was estimated to have been 248,307 in 2012 (Gallaway et al. 2013).

Kemp's ridley turtle nesting population was exponentially increasing (NMFS et al. 2011b); however, since 2009 there has been concern over the slowing of recovery (Gallaway et al. 2016a; Gallaway et al. 2016b; Plotkin 2016). From 1980 through 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15% annually (Heppell et al. 2005a); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS and USFWS 2015b). The species' limited range as well as low global abundance makes it particularly vulnerable to new and continued threats. The significant nesting declines observed in 2010 and 2013–2014 potentially indicate a serious population-level impact, and the ongoing recovery trajectory is unclear. DiMatteo et al. (2024a) modeled survey data to estimate a mean annual in-water abundance of juvenile and adult Kemp's ridley turtles along the U.S. Atlantic Coast of 10,762 individuals (90% CI = 2,620–19,443 individuals).

Threats

In addition to general threats common to all three sea turtle species considered, fishery interactions and strandings appear to be the main threats to Kemp's ridley turtles. Since 2010, NMFS has documented (via the Sea Turtle Stranding and Salvage Network data) more Kemp's ridley turtle strandings in the Northern Gulf of America, compared to other sea turtle species. While a definitive cause for these strandings has not been identified, necropsy results indicate a significant number of stranded were forcibly submerged, which is commonly associated with fishery interactions (B. Stacy, NMFS, pers. comm. to M. Barnette, NMFS Protected Resources Division, March 2012). Given the nesting trends and habitat utilization of Kemp's ridley turtles, it is likely that fishery interactions in the Northern Gulf of America may continue to be an issue of concern for the species, and one that may potentially slow the rate of recovery for Kemp's ridley turtles. Kemp's ridley turtles are also especially vulnerable to threats that cause population-level impacts such as the Deepwater Horizon (DWH) oil spill and response, due to their already low numbers and location of nesting habitat. While the Kemp's ridley turtle population shows signs of increasing abundance, the species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness. Therefore, the species' resilience to future perturbation is considered low.

Critical Habitat

Critical habitat has not been designated for this species.

Recovery Planning

In response to current threats facing the species, NMFS developed goals to recover Kemp's ridley turtle populations. These threats will be discussed in further detail in the environmental baseline of this consultation. See the 2011 Final Bi-National (U.S. and Mexico) Revised Recovery Plan for Kemp's ridley turtles for complete down listing/delisting criteria for each of their respective recovery goals (NMFS and USFWS 2011). The following items were identified as priorities to recover Kemp's ridley turtles:

1. Protect and manage nesting and marine habitats.
2. Protect and manage populations on the nesting beaches and in the marine environment.
3. Maintain a stranding network.
4. Manage captive stocks.
5. Sustain education and partnership programs.
6. Maintain, promote awareness of and expand U.S. and Mexican laws.
7. Implement international agreements.
8. Enforce laws.

4.2.5 Loggerhead Turtle – Northwest Atlantic Ocean DPS

The loggerhead turtle was first listed as threatened under the ESA in 1978 (43 Fed. Reg. 32800). On September 22, 2011, the NMFS designated nine DPSs of loggerhead turtles, with the Northwest Atlantic Ocean DPS listed as threatened (75 Fed. Reg. 12598).

Life History

Adult female loggerhead turtles generally nest between April–September. They nest one to seven times in a season, with an internesting interval of approximately 14 days. Clutch sizes range from 95–130 eggs (NMFS and USFWS 2023b). Loggerhead turtles reach sexual maturity between 29–49 years of age, although this varies widely among populations (Chasco et al. 2020; Frazer and Ehrhart 1985; NMFS 2001). Mean age at first reproduction for female loggerhead turtles is 30 years. The average remigration interval is 2.7 years. Within the action area, Northwest Atlantic Ocean DPS loggerhead turtle nesting generally occurs along the Atlantic and Gulf coasts from North Carolina to Alabama and Florida, respectively, although additional nesting occurs along the entire north and western Gulf coast.

Bartol et al. (1999) reported effective hearing range for juvenile loggerhead turtles is from at least 250–750 Hz. Both yearling and two-year old loggerhead turtles had the lowest hearing threshold at 500 Hz (yearling: about 81 dB re 1µPa and two-year olds: about 86 dB re 1µPa), with the threshold increasing rapidly above and below that frequency (Bartol and Ketten 2006). Underwater tones elicited behavioral responses to frequencies between 50 and 800 Hz and auditory evoked potential responses between 100 Hz and 1.1 kHz in one adult loggerhead turtle, with the lowest threshold recorded at 98 dB re 1µPa at 100 Hz (Martin et al. 2012). Lavender et al. (2014) found post-hatchling loggerhead turtles responded to sounds in the range of 50–800 Hz, while juveniles responded to sounds in the range of 50 Hz to 1 kHz.

Population Dynamics

The total number of annual U.S. nest counts for the Northwest Atlantic DPS of loggerhead turtles from Texas through Virginia and Quintana Roo, Mexico, is over 110,000 (NMFS and USFWS 2023b). In-water estimates of abundance are difficult to perform on a wide scale. In the summer of 2010, NMFS's Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC) estimated the abundance of juvenile and adult loggerhead turtles along the continental shelf between Cape Canaveral, Florida and the mouth of the Gulf of St. Lawrence, Canada, based on Atlantic Marine Assessment Program for Protected Species (AMAPPS) aerial line-transect sighting survey and satellite tagged loggerheads (NMFS 2011c). They provided a preliminary regional abundance estimate of 588,000 individuals (approximate inter-quartile range of 382,000–817,000) based on positively identified loggerhead sightings (NMFS 2011c). A separate, smaller aerial survey, conducted in the southern portion of the Mid-Atlantic Bight and Chesapeake Bay in 2011 and 2012, demonstrated uncorrected loggerhead turtle abundance ranging from a spring high of 27,508 to a fall low of 3,005 loggerheads (NMFS and USFWS 2023b). Ceriani et al. (2019) estimated the total number of adult females nesting in Florida to be 51,319 individuals (95% CI = 16,639–99,739 individuals), based on nest count data from 2014–2018. Over 90% of loggerhead sea turtle nesting in the U.S. occurs in Florida (Ceriani et al. 2021). Most recently, DiMatteo et al. (2024a) modeled survey data to estimate a mean annual in-water abundance of juvenile and adult loggerheads along the U.S. Atlantic Coast of 193,423 individuals (90% CI = 159,158–227,668 individuals). Overall, the latest 5-year status review concluded that the DPS as a whole demonstrates a stable (neither increasing nor decreasing) population trend (NMFS and USFWS 2023a). We are not aware of any current range-wide in-water estimates for the DPS.

Based on genetic analysis of subpopulations, the Northwest Atlantic Ocean DPS of loggerhead turtle is further categorized into five recovery units corresponding to nesting beaches. These are Northern Recovery Unit, Peninsular Florida Recovery Unit, Dry Tortugas Recovery Unit, Northern Gulf of Mexico Recovery Unit, and the Greater Caribbean Recovery Unit (Conant et al. 2009).

The Northern Recovery Unit, from North Carolina to northeastern Florida, is the second largest nesting aggregation in the Northwest Atlantic Ocean DPS of loggerhead turtle, with an average of 5,215 nests from 1989 through 2008, and approximately 1,272 nesting females per year (NMFS and USFWS 2008b). The nesting trend from daily beach surveys showed a significant decline of 1.3% annually from 1989 through 2008. Aerial surveys of nests showed a 1.9% decline annually in nesting in South Carolina from 1980 through 2008. Overall, there is strong statistical data to suggest the Northern Recovery Unit has experienced a long-term decline over that period. Data since that analysis are showing improved nesting numbers and a departure from the declining trend. An annual increase of 1.3% nesting females was observed between 1983–2019 (Bolten et al. 2019). Nesting in Georgia has shown an increasing trend since comprehensive nesting surveys began in 1989. Nesting in North Carolina and South Carolina has begun to show a shift away from the declining trend of the past. Increases in nesting were seen from 2009 through 2012. Loggerhead nesting in Georgia, South Carolina, and North Carolina all broke records in 2015 and then topped those records again in 2016. Nesting in 2017 and 2018 declined relative to 2016, back to levels seen in 2013 to 2015, but then bounced back in 2019, breaking records for each of the three states and the overall recovery unit. Nesting in 2020 and 2021 declined from the 2019 records, but still remained high, representing the third and fourth highest total numbers for the Northern Recovery Unit since 2008. In 2022, Georgia loggerhead nesting broke the record at 4,071, while South Carolina and North Carolina nesting were both at the second-highest level recorded.

The Peninsular Florida Recovery Unit, defined as loggerheads originating from nesting beaches along the Gulf coast from the Georgia-Florida border to the northern shore of Tampa Bay, Florida, is the largest nesting aggregation in the Northwest Atlantic Ocean DPS of loggerhead turtle. An average of 64,513 nests per year were documented from 1989 through 2007, and approximately 15,735 nesting females per year (NMFS and USFWS 2008a). Following a 52% increase between 1989 through 1998, nest counts declined sharply (53%) from 1998 through 2007. However, annual nest counts showed a strong increase (65%) from 2007 through 2017 (FFWCC 2018). Index nesting beach surveys from 1989 through 2013 have identified 3 trends. From 1989 through 1998, a 30% increase was followed by a sharp decline over the subsequent decade. Large increases in nesting occurred since then. From 1989 through 2013, the decade-long decline had reversed and there was no longer a demonstrable trend. Loggerhead nesting in 2016 reached a new record on Florida's core index beaches (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). While nest

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numbers subsequently declined from the 2016 high, the 2007–2021 period represents a period of increase, with a maximum number of nests in 2023 (70,945 nests). The statewide estimated total for 2022 was 116,765 nests and 18,293 of those from Florida's Gulf coast (FWRI nesting database). Experts are concerned that there have not been significant increases in the number of nesters in over 30 years (1989–2018; less than the 1% recovery criterion), which suggests that the Peninsular Florida Recovery Unit is not recovering (Bolten et al. 2019).

The Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean recovery units are much smaller nesting assemblages, but they are still considered essential to the continued existence of loggerhead turtles.

The Dry Tortugas Recovery Unit includes loggerhead turtles originating from nesting beaches on islands west of Key West, Florida. The only available data for the nesting subpopulation on Key West comes from a census conducted from 1995 through 2004 (excluding 2002), which provided a range of 168–270 (mean of 246) nests per year, or about 60 nesting females (NMFS and USFWS 2007b). There was no detectable trend during this period (NMFS and USFWS 2008a).

The Northern Gulf of Mexico Recovery Unit, defined as loggerheads originating from nesting beaches from Texas through the Florida panhandle, has 100–999 nesting females annually, and a mean of 910 nests per year. Analysis of a dataset from 1997 through 2008 of index nesting beaches in the northern Gulf of America shows a declining trend of 4.7% annually. Index nesting beaches in the panhandle of Florida has shown a large increase in 2008, followed by a decline in 2009 through 2010 before an increase back to levels similar to 2003 through 2007 in 2011. Experts have not observed the amount of increase in the number of nests needed to meet recovery criterion (3% annual increase; Bolten et al. 2019).

The Greater Caribbean Recovery Unit encompasses nesting subpopulations in Mexico to French Guiana, the Bahamas, and the Lesser and Greater Antilles. The majority of nesting for this recovery unit occurs on the Yucatán peninsula, in Quintana Roo, Mexico, with 903–2,331 nests annually (Zurita et al. 2003a). Other significant nesting sites are found throughout the Caribbean Sea, and including Cuba, with approximately 250–300 nests annually (Ehrhart et al. 2003), and over 100 nests annually in Cay Sal in the Bahamas (NMFS and USFWS 2008a). Survey effort at nesting beaches has been inconsistent, and not trend can be determined for this subpopulation (NMFS and USFWS 2008a). Zurita et al. (2003b) found an increase in the number of nests on 7 of the beaches on Quintana Roo, Mexico from 1987 through 2001, where survey effort was consistent during the period. Nonetheless, nesting has declined since 2001, and the previously reported increasing trend appears to not have been sustained (NMFS and USFWS 2008a).

Threats

In addition to general threats common to all three species of sea turtle considered, loggerheads may be particularly affected by organochlorine contaminants; they have the highest organochlorine concentrations and metal loads (D'Ilio et al. 2011) in sampled tissues among the sea turtle species. Modeling suggests an increase of 3.6°F (2°C) in air temperature would result in a sex ratio of over 80% female offspring for loggerheads nesting near Southport, North Carolina. The same increase in air temperatures at nesting beaches in Cape Canaveral, Florida, would result in close to 100% female offspring. Such highly skewed sex ratios could undermine the reproductive capacity of the species. More ominously, an air temperature increase of 5.4°F (3°C) is likely to exceed the thermal threshold of most nests, leading to egg mortality (Hawkes et al. 2007). Warmer sea surface temperatures have also been correlated with an earlier onset of loggerhead nesting in the spring (Hawkes et al. 2007; Weishampel et al. 2004), short inter-nesting intervals (Hays et al. 2002), and shorter nesting seasons (Pike et al. 2006).

Critical Habitat

Northwest Atlantic Ocean DPS loggerhead turtle critical habitat is categorized into different habitat types, each with their own set of PBFs. Foraging habitat, constricted migratory habitat, and *Sargassum* habitat were found to be NLAA (Section 4.1.3) and are not considered further in the opinion. The remaining habitat type that is likely to be adversely affected by the proposed action is breeding habitat.

Breeding habitat is defined as concentrated breeding sites, and are "core" areas where data indicate adult males congregate to gain access to receptive females during the breeding season. Loggerhead turtle breeding season off Florida occurs between April–September. NMFS designated two units of breeding habitat: (1) within the Southern Florida migration corridor from the shore out to the 656 ft (200 m) depth contour along the stretch of the corridor between the Marquesas Keys and the Martin County/Palm Beach County line; and (2) in nearshore waters just south of Cape Canaveral, Florida.

Physical and Biological Features

The PBFs of breeding habitat include:

1. High densities of reproductive male and female loggerheads;
1. Proximity to primary Florida migratory corridor; and
2. Proximity to Florida nesting grounds.

Only the first PBF, high densities of reproductive male and female loggerheads, may be affected by the proposed action.

Status, Function, and Extent of Physical and Biological Features

Breeding critical habitat may be affected by fishing activities that disrupt the use of habitat, and, thus, affect densities of reproductive loggerheads, dredging and disposal of sediments that affect densities of reproductive loggerheads, oil spills and response activities that affect densities of reproductive loggerheads, alternative offshore energy development that affects densities of reproductive loggerheads, and changing environmental trends that can affect currents and water temperatures, and affect densities of reproductive loggerheads (note this is not an exhaustive list of activities that may affect breeding critical habitat). Because of these activities, there may be relatively small numbers of loggerhead turtle lethal or sub-lethal take. For example, the number of Northwest Atlantic Ocean DPS loggerhead turtles that may be killed from U.S. Navy training and testing activities is four; and the number that may be taken (non-lethal take) by the same activities is 138 over a five-year period. The number of Northwest Atlantic Ocean DPS

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loggerhead turtles that may be killed from renewable energy development off Virginia is 249 over a 30-year period, and the number that may be taken (non-lethal take) from those activities is 1,214 over a two-year construction period. The number of Northwest Atlantic Ocean DPS loggerhead turtles that may be killed in the Commercial Anchored Gill Net Fisheries off North Carolina is 20 over a 10-year period.

The most recent population abundance estimate, DiMatteo et al. (2024a), modeled survey data to estimate a mean annual in-water abundance of juvenile and adult loggerheads along the U.S. Atlantic Coast of 193,423 individuals (90% CI = 159,158–227,668 individuals). This is an underestimate of the Northwest Atlantic Ocean DPS's abundance due to limitations in detecting smaller (i.e., younger) turtles during surveys and geographic limitations of the model (i.e., the model does not estimate abundance across the entire range of the DPS). While there has been no indication that the DPS is increasing (NMFS and USFWS 2023a), the number of loggerhead turtles that may be killed or otherwise taken by past activities is relatively small compared to the population abundance overall. As such, the status and function of breeding critical habitat, particularly the high densities of reproductive male and female loggerheads, does not appear to be significantly affected by past activities.

Conservation Needs

Breeding critical habitat is essential to the conservation of Northwest Atlantic Ocean DPS loggerhead turtles because these areas host a high density of breeding individuals, and, thus, are important locations for breeding activities and the propagation of the species. Designation of breeding critical habitat relates directly to the recovery plan for this DPS, which includes recovery objectives that collectively describe the conditions necessary to ensure each recovery unit meets its recovery criteria alleviating threats to the species so that protections afforded under the ESA are no longer necessary.

Recovery criteria for each recovery unit includes specific measures for the number of nests and the number of nesting females (for more information, see the Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle Second Revision): (1) Northern Recovery Unit – a 2% or greater annual rate of increase over a generation time of 50 years, resulting in a total annual number of nests of 14,000 or greater; (2) Peninsular Florida Recovery Unit – a 1% annual rate of increase over a generation time of 50 years, resulting in a total annual number of nests of 106,100 or greater; (3) Dry Tortugas Recovery Unit – an annual rate of increase over a generation time of 50 years is 3% or greater, resulting in a total annual number of nests of 1,100 or greater; (4) Northern Gulf of Mexico Recovery Unit – an annual rate of increase over a generation time of 50 years is 3% or greater, resulting in a total annual number of nests of 4,000 or greater; and (5) Greater Caribbean Recovery Unit – a total annual number of nests at a minimum of three nesting assemblages, averaging greater than 100 nests annually, has increased over a generation time of 50 years.

A number of recovery objectives are directly or indirectly related to ensuring high densities of reproductive male and female loggerheads in breeding critical habitat, including, but not limited to: ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females; ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes; and manage sufficient feeding, migratory, and interesting marine habitats to ensure successful growth and reproduction (see Recovery Planning, below).

Recovery Planning

In response to the current threats facing the species, NMFS developed goals to recover loggerhead turtle populations. These threats will be discussed in further detail in the environmental baseline of this consultation. See the Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle Second Revision for complete down-listing/delisting criteria for each of the following recovery objectives (NMFS 2008b):

1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.
3. Manage sufficient nesting beach habitat to ensure successful nesting.
4. Manage sufficient feeding, migratory, and internesting marine habitats to ensure successful growth and reproduction.
5. Eliminate legal harvest.
6. Implement scientifically based nest management plans.
7. Minimize nest predation.
8. Recognize and respond to mass/unusual mortality or disease events appropriately.
9. Develop and implement local, state, Federal, and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats.
10. Minimize bycatch in domestic and international commercial and artisanal fisheries.
11. Minimize trophic changes from fishery harvest and habitat alteration.
12. Minimize marine debris ingestion and entanglement.
13. Minimize vessel strike mortality.

5. Environmental Baseline

The *environmental baseline* refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR §402.02).

In this section, we discuss the environmental baseline within the Gulf and Atlantic Ocean portions of the action area, as it applies to species that are likely to be adversely affected by the proposed action. This allows us to assess the prior experience and state (or condition) of the endangered and threatened species and designated critical habitat that will be exposed to effects from the proposed action. The environmental baseline is important to consider because in some life history stages or areas within their ranges, listed individuals or critical habitat features will commonly exhibit, or be more susceptible to, adverse responses to stressors than they would be in other life history stages or areas. These localized stress responses, or stressed baseline conditions, may increase the severity of the adverse effects expected from the proposed action.

5.1 Environmental Trends

Temperature profiles have been collected in the Gulf since the 1920s. The Gulf of America region has experienced a warming rate of approximately 0.347°F (0.193°C) per decade since 1970, and has warmed at least 1.8°F (1.0°C) in the past approximately 50 years (Wang et al. 2023). The rate at which the Gulf of America is warming is twice that for the global ocean (0.155°F or 0.086°C per decade), but only slightly higher than the warming trend in the subtropical northern Atlantic Ocean (0.329°F or 0.183°C per decade; Wang et al. 2023). Overall, the Atlantic Ocean region appears to be warming faster than all other ocean basins except the polar oceans, and is projected to continue to experience substantial warming in the upper 6,562 ft (2,000 m) of the ocean even under conservative emissions scenarios (Cheng et al. 2022). On average, the general warming trend in the North Atlantic Ocean over the last 80 years is 0.056±0.0011°F (0.031±0.0006 ºC) per decade in the upper 6,562 ft (2,000 m) of the ocean (Polyakov et al. 2009). One consequence of warming waters in the Gulf of America is exacerbation of hypoxic conditions in the “dead zone” caused by excessive nutrient pollution into and freshwater discharge from the Mississippi River basin, due to changes in oxygen solubility, water stratification, and primary productivity (Altieri and Gedan 2015; Bianchi et al. 2010; Laurent et al. 2018). Changes to the marine biophysical environment are also affecting the growth and movement dynamics of pelagic *Sargassum* in the Gulf of America; *Sargassum* is designated as critical habitat for juvenile green turtles and loggerhead turtles (Marsh et al. 2023; Sanchez-Rubio et al. 2018).

Recent peer-reviewed research has provided additional evidence that long-term warming has led to changes in ocean circulation which have altered the migration timing of marine species (Langan et al. 2021). In the Gulf of America, fish and invertebrate species shifted to regions with deeper waters, rather than exhibiting a pole-ward shift like other continental shelf species assemblages in North America (Pinsky et al. 2013). Along the Texas coast over a 35-year period, researchers observed 32 species exhibiting range shifts, either expanding or contracting their expected distribution due to changing environmental factors (Fujiwara et al. 2019). Chavez-Rosales et al. (2022) identified a northward shift of an average of 178 km when examining habitat suitability models for 16 cetacean species in the western North Atlantic Ocean. Record et al. (2019b) also documented a shift in North Atlantic right whale distribution, based on an environmentally-driven shift in their main prey source. Loggerhead turtle distributions are expected to shift northward in the North Atlantic Ocean so that animals can stay within the environmental characteristics of suitable habitat (Dudley et al. 2016; McMahon and Hays 2006; Patel et al. 2021). Bevan et al. (2019) predicted a northward shift in Kemp’s ridley nests, from Tamaulipas, Mexico, where a majority of Kemp’s ridley nesting currently occurs, to Texas, U.S. on North and South Padre Island, the largest Kemp’s ridley nesting sites in the U.S., with warming temperatures. They also predicted that Kemp’s ridley turtles would ultimately be unlikely to mitigate the effects of a rapidly warming environment such that highly skewed sex ratios or even mortality of eggs and hatchlings would occur. Key marine predators are predicted to experience a 35% change in core habitat area in the Pacific Ocean, with both losses and gains in habitat due to changing environmental conditions (Hazen et al. 2012) and we anticipate similar effects in the Atlantic, including the Gulf of America.

For sea turtle prey species such as mollusks, which form calcium carbonate shells, one of the greatest threats contributing to their extinction risk is ocean acidification driven by global changing environmental conditions. Ocean acidification occurs as carbon dioxide concentrations increase in the atmosphere, more carbon dioxide is absorbed by the oceans, causing lower pH and reduced availability of calcium carbonate. Because of the increase in carbon dioxide and other greenhouse gases in the atmosphere since the Industrial Revolution, ocean acidification has already occurred throughout the world's oceans and is predicted to increase considerably between now and 2100 (IPCC 2014; IPCC 2023b). Predicted rates of ocean acidification will have adverse impacts on species richness especially for strongly calcifying species, such as echinoderms and mollusks (Scherer et al. 2022) that provide food resources for sea turtle species. Changes in the marine ecosystem caused by changing environmental trends can also influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, and forage fish), ultimately affecting primary foraging areas of ESA-listed sea turtles. For migrating sea turtles, if either prey availability or habitat suitability is disrupted by changing ocean temperatures regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott 2009).

Sea turtles are especially sensitive to temperature-related changes in their life history and habitat. Notably, sex is determined by the ambient sand temperature (during the middle third of incubation) with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 77–95°F (25–35°C;(Ackerman 1997). Increases in global temperature could skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007aa; NMFS and USFWS 2007bb; NMFS and USFWS 2013aa; NMFS and USFWS 2013bb; NMFS and USFWS 2015b). For example, modeling suggests an increase of 3.6°F (2°C) in air temperature would result in a sex ratio of over 80% female offspring for loggerheads nesting near Southport, North Carolina. The same increase in air temperatures at nesting beaches in Cape Canaveral, Florida, would result in close to 100% female offspring. Such highly skewed sex ratios could undermine the reproductive capacity of the species. More ominously, an air temperature increase of 5.4°F (3°C) is likely to exceed the thermal threshold of most nests, leading to egg mortality (Hawkes et al. 2007). Warmer sea surface temperatures have also been correlated with an earlier onset of loggerhead nesting in the spring (Hawkes et al. 2007; Weishampel et al. 2004), short inter-nesting intervals (Hays et al. 2002), and shorter nesting seasons (Pike et al. 2006).

In addition to increased ocean warming and changes in species' distribution, changing environmental trends are linked to increased extreme weather events including, but not limited to, hurricanes, cyclones, tropical storms, heat waves, and droughts (IPCC 2023a). Research from IPCC (2023a) shows that it is likely extratropical storm tracks have shifted poleward in both the Northern and Southern Hemispheres, and heavy rainfalls and mean maximum wind speeds associated with hurricane events will increase with continued greenhouse gas warming. These extreme weather events have the potential to have adverse effects on ESA-listed sea turtles in the action area. For example, in 1999, off Florida, Hurricane Floyd washed out many loggerhead and green turtle nests, resulting in as many as 50,000–100,000 hatchling deaths (see https://conserveturtles.org/11665-2/). Rising sea levels can cause coastal erosion, inundation, and flooding, and can affect sea turtle nesting beaches (Fish et al. 2005; Fuentes et al. 2011; Fuentes et al. 2010a; Fuentes et al. 2010b). Warming ocean temperatures may also increase cold-stunning events of Kemp's ridley turtles in the northwest Atlantic (Griffin et al. 2019).

This review highlights evidence of significant changes in environmental conditions in the Gulf and Atlantic Ocean that may affect ESA-listed species and their habitats. While it is difficult to accurately predict the consequences of these changing environmental conditions to a particular species or habitat, a range of consequences are expected that are likely to change the status of the species and the condition of their habitats. This is discussed further in the Integration and Synthesis (Section 8).

5.2 Sound

The ESA-listed sea turtles that occur in the action area are regularly exposed to several sources of anthropogenic sounds. These include, but are not limited to maritime activities (vessel sound and commercial shipping), aircraft, seismic surveys (exploration and research), and marine construction (dredging and pile driving as well as the construction, operation, and decommissioning of offshore structures), and military activities, which are summarized in the subsequent environmental baseline subsections. These activities occur to varying degrees throughout the year. Anthropogenic noise is a known stressor that has the potential to affect sea turtles, although effects to sea turtles are not well understood.

NMFS has established criteria to predict varying levels of responses of marine species to anthropogenic sound, based upon the best available science (https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance-other-acoustic-tools). Responses to sound exposure may include lethal or nonlethal injury, permanent or temporary hearing impairment, behavioral harassment and stress, or no apparent response. Ambient noise consists of sound sources such as vocalizing animals, wind, and waves; however, anthropogenic activities such as vessels, geophysical exploration, and the construction, operational, and decommissioning of offshore structures, can contribute to, and increase, sound levels. Several policies on managing anthropogenic sound in the marine environment provide guidance for research permits involving sound-producing activities. For example, NOAA is working cooperatively with the ship building industry to find technologically-based solutions to reduce the amount of sound produced by commercial vessels.

Globally, commercial shipping's contribution to ambient noise in the ocean increased by as much as 12 dB between approximately the 1960s and 2005 (Hildebrand 2009a). Vessels are the greatest contributors to increases in low-frequency ambient sound in the sea (Andrew et al. 2011). It is predicted that ambient ocean sound will continue to increase at a rate of ½ dB per year (Ross 2005). Sound levels and tones produced are generally related to vessel size and speed. Larger vessels generally emit more sound than smaller vessels, and vessels underway with a full

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load, or those pushing or towing a load, are noisier than unladen vessels. Vessel operations associated with oil and gas activities, have been considered in previous ESA section 7 consultations. While commercial shipping vessels contribute a large portion of oceanic anthropogenic noise, other sources of maritime traffic can be present in large numbers and affect the marine environment particularly in nearshore and inland marine areas. These include recreational boats, whale-watching boats, research vessels, and ships associated with oil and gas activities.

The Gulf of America soundscape is being studied long-term by NOAA's Sound Reference Station Network (https://www.pmel.noaa.gov/acoustics/noaanps-ocean-noise-reference-station-network). This network uses static Passive Acoustic Monitoring (PAM) hydrophone (underwater sound recorder) units to monitor trends and changes in the ambient sound field in U.S. Federal waters. In addition to this network, there have been several other hydrophone units in the northern Gulf of America. A study by Wiggins et al. (2016) placed two high-frequency acoustic recording packages (HARPs) in 328–820 ft (100–250 m) water depths and three HARPs in approximately 3,280 ft (1,000 m) water depth to compare low-frequency sound pressure spectrum levels over three years. NOAA's Southeast Fisheries Science Center (SEFSC), University of California San Diego's Scripps Institution of Oceanography (SIO), and partners initiated the Long-term Investigations into Soundscapes, Trends, Ecology, and Noise (LISTEN) project (https://www.fisheries.noaa.gov/science-data/passive-acoustic-research-southeast-fisheries-science-center) throughout the U.S. and Gulf waters to expand upon the initial Wiggins et al. (2016) study. Through this program, scientists are collecting data to assess contributions of ambient noise sources to the Gulf soundscape. This collaborative study deploys moored HARPs, continuously recording over the 10 Hz–100 kHz band, from 2020–2025 (Figure 7). Additionally, the study leverages 10 years of historic HARP recordings at five long-term sites, collected by SIO as part of the DWH damage assessment to enhance the assessment of trends in cetacean density and noise (Rafter et al. 2022). Here, we include the preliminary results from the first year of the HARP recordings at sites collected under the LISTEN project from 2020–2021.

The low-frequency ambient soundscape, between 10–1,000 Hz, was dominated by sounds from anthropogenic activities, notably seismic exploration at deep sites and shipping at shallow sites. Seismic survey signals dominated the ambient soundscape below 100 Hz throughout the historic time series and at the new 2020–2021 sites, with the same surveys detected simultaneously at distant sites throughout the Gulf. Sound levels are most elevated in the airgun frequency band (10–100 Hz) at recording sites within or near active oil and gas lease blocks, and more moderately at sites further away, but with deep water where signals propagate effectively. During quieter periods between seismic surveys, moderately elevated sound levels in the 30–90 Hz frequency band are often evident, representing noise from vessel traffic.

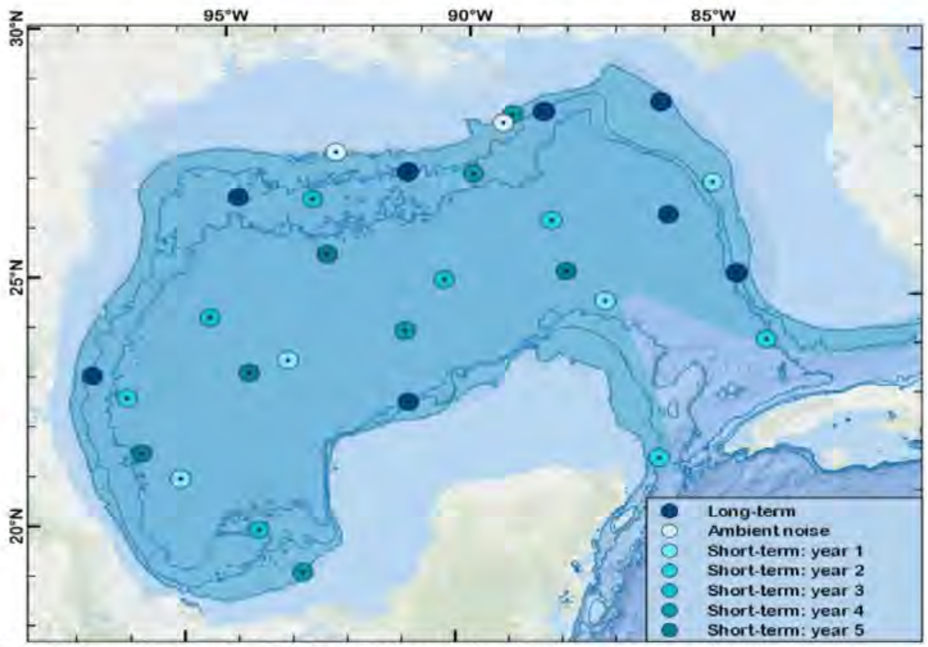

Figure 7. Location of long-term passive acoustic recording sites for the five-year LISTEN project. Figure from NMFS/Melissa Soldevilla.

The PAM data also demonstrate spatially and temporally variable patterns in noise concentration. The spatial distribution of monthly median octave bands at each site over the 2020–2021 period highlights some of the noise sources described in (Rafter et al. 2022): The 31.5 Hz octave band represents noise from shipping traffic; the 500 Hz octave band represents noise from weather; and the 31.5 Hz octave band are generally higher in the western Gulf than the eastern Gulf, which is expected given the distribution of airgun energy in the northwestern Gulf. April, May, and December have particularly high 31.5 Hz octave band levels across western sites, and in September, those levels were especially high at the central Gulf sites. These correspond with locations of seismic survey activity. Unsurprisingly, ship noise dominated the ambient soundscapes at the two shipping lane sites, where the highest number of ship detections and longest time with ship noise present occurred (Rafter et al. 2022). At the three monitoring sites with high levels of shipping traffic, daily average sound levels were consistently near, or higher than 100 dB re 1 μPa in both the 63 and 125 Hz one-third octave bands. In comparison, sound levels were approximately 20 dB lower year-round in Hawaii and approximately 10–20 dB lower in the Alaskan Arctic (depending on season).

5.3 Fisheries Bycatch and Interactions

Commercial and recreational fisheries can result in substantial detrimental impacts on populations of ESA-listed sea turtles. Although directed fishing for the species covered in this opinion is prohibited under the ESA, many listed species are still captured as "bycatch" in

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fishing operations targeting other species. Bycatch occurs when fishing operations interact with sea turtles that are not the target species for commercial harvest. Sea turtles are also susceptible to entanglement in fishing gear that is actively deployed, as well as derelict or "ghost fishing" gear that has been abandoned in the pelagic environment.

5.3.1 Federal Fisheries

Commercial and recreational fisheries managed by NMFS under the Magnuson-Stevens Act (MSA) in the Gulf and Atlantic Ocean have interacted with sea turtles throughout the past. Commercial fisheries bycatch represents a significant threat to sea turtles throughout the Gulf and Atlantic Ocean portions of the action area, as sea turtles are highly vulnerable to incidental capture in many fisheries gears including tangle nets, trawls and longlines.

Impacts to listed species and critical habitats have been evaluated via ESA section 7 consultation for all fisheries managed under a fishery management plan (FMP; 15 USC § 1853), or for which any federal action is taken to manage that fishery. Past consultations have addressed the effects of federally permitted fisheries on ESA-listed species, sought to minimize the adverse impacts of the action on ESA-listed species, and, when appropriate, have authorized the incidental taking of these species. Formal section 7 consultations have been conducted on the following federal fisheries that operate in the action area: Coastal Migratory Pelagics, Highly Migratory Species (HMS) Atlantic Shark and Smoothhound, Gulf Reef Fish, Southeastern Shrimp Trawl Fisheries, and ten fisheries in the Atlantic (including Atlantic Bluefish, Jonah Crab, Spiny Dogfish, and Summer Flounder Fisheries). NMFS has issued an ITS for the take of sea turtles in each of these fisheries (NMFS 2011a; NMFS 2012a; NMFS 2014a; NMFS 2015b). A summary of each consultation is provided below, but more detailed information can be found in the respective biological opinions (NMFS 2011a; NMFS 2011b; NMFS 2012b; NMFS 2015a; NMFS 2021a).

Coastal Migratory Pelagics Fishery

In 2015, NMFS completed a section 7 consultation on the continued authorization of the coastal migratory pelagics fishery in the Gulf and South Atlantic (NMFS 2015a). In the Gulf of America and South Atlantic, hook-and-line, gillnet, and cast net gears are used commercially, while the recreational sector uses hook-and-line gear. The biological opinion concluded that green, Kemp's ridley, and loggerhead turtles may be adversely affected by operation of the fishery. However, the proposed action was not expected to jeopardize the continued existence of any of these species. An ITS was provided for consecutive three-year periods authorizing 31 takes (nine of which could be lethal) for green turtles, 27 takes (seven of which could be lethal) for loggerhead turtles, and eight takes (two of which could be lethal) for Kemp's ridley turtles.

Highly Migratory Species Atlantic Shark and Smoothhound Fisheries

These fisheries include commercial shark bottom longline and gillnet fisheries and recreational shark fisheries under the FMP for Atlantic Tunas, Swordfish, and Sharks. NMFS has formally consulted several times on the effects of HMS shark fisheries on sea turtles (NMFS 2003; NMFS 2008a; NMFS 2012a). NMFS has also authorized a federal smoothhound fishery that will be managed as part of the HMS shark fisheries. NMFS (2012b) analyzed the potential adverse effects from the smoothhound fishery on sea turtles for the first time. Both bottom longline and gillnet are known to adversely affect sea turtles. From 2007–2011, the sandbar shark research fishery had 100% observer coverage, with 4–6% observer coverage in the remaining shark fisheries. During that period, ten sea turtle takes (all loggerheads) were observed on bottom longline gear in the sandbar shark research fishery and five were taken outside the research fishery. The five non-research fishery takes were extrapolated to the entire fishery, providing an estimate of 45.6 sea turtle takes (all loggerheads) for non-sandbar shark research fishery from 2007–2010 (Carlson and Gulak 2012; Carlson et al. 2016). No sea turtle takes were observed in the non-research fishery in 2011 (NMFS 2012a). Because the research fishery has a 100% observer coverage requirement, those observed takes were not extrapolated (Carlson and Gulak 2012; Carlson et al. 2016). Because few smoothhound trips were observed, no sea turtle captures were documented in the smoothhound fishery.

The most recent ESA section 7 consultation on the continued operation of Atlantic shark and smoothhound fisheries and Amendments 3 and 4 to the Consolidated HMS FMP was completed on December 12, 2012 (NMFS 2012b). The consultation concluded the proposed action was not likely to jeopardize the continued existence of sea turtles. An ITS was provided for consecutive three-year periods authorizing 57 takes (33 of which could be lethal) for green turtles, 126 takes (78 of which could be lethal) for loggerhead turtles, and 36 takes (21 of which could be lethal) for Kemp's ridley turtles.

Gulf Reef Fish Fishery

The Gulf reef fish fishery uses two basic types of gear: spear or powerhead, and hook-and-line gear. Hook-and-line gear used in the fishery includes both commercial bottom longline and commercial and recreational vertical line (e.g., handline, bandit gear, rod-and-reel).

Prior to 2008, the reef fish fishery was believed to have relatively moderate levels of sea turtle bycatch attributed to the hook-and-line component of the fishery (i.e., approximately 107 captures and 41 mortalities annually, all species combined, for the entire fishery; NMFS 2005a). In 2008, SEFSC observer programs and subsequent analyses indicated that the overall amount and extent of incidental take for sea turtles specified in the incidental take statement of the 2005 opinion on the reef fish fishery had been severely exceeded by the bottom longline component of the fishery with approximately 974 captures and at least 325 mortalities estimated for the period from July 2006–2007.

In response, NMFS published an Emergency Rule prohibiting the use of bottom longline gear in the reef fish fishery shoreward of a line approximating the 50-fathom depth contour in the eastern Gulf of America, essentially closing the bottom longline sector of the reef fish fishery in the eastern Gulf of America for six months pending the implementation of a long-term management strategy. The Gulf of America (formerly Gulf of Mexico) Fishery Management Council developed a long-term management strategy via a new amendment (Amendment 31 to the Reef Fish FMP). The amendment included: (1) a prohibition on the use of bottom longline gear in the Gulf reef fish fishery, shoreward of a line approximating the 35-fathom contour east of Cape San Blas, Florida, from June through August and; (2) a reduction in the number of bottom longline vessels operating in the fishery via an endorsement program and a restriction on the total number of hooks that may be possessed onboard each Gulf reef fish bottom longline vessel to 1,000, only 750 of which may be rigged for fishing.

On October 13, 2009, NMFS Southeast Regional Office completed an opinion that analyzed the expected effects of the continued operation of the Gulf reef fish fishery under the changes proposed in Amendment 31 (NMFS-SEFSC 2009). The opinion concluded that sea turtle takes would be substantially reduced compared to the fishery as it was previously prosecuted, and that operation of the fishery would not jeopardize the continued existence of any sea turtle species. Amendment 31 was implemented on May 26, 2010. In August 2011, consultation was reinitiated to address the DWH oil spill and potential changes to the environmental baseline. Reinitiation of consultation was not related to any material change in the fishery itself, violations of any terms and conditions of the 2009 opinion, or an exceedance of the ITS. The resulting September 30, 2011, opinion concluded the continued operation of the Gulf reef fish fishery is not likely to jeopardize the continued existence of any listed sea turtles (NMFS 2011a). An ITS was provided for consecutive three-year periods authorizing 116 takes (75 of which could be lethal) for green turtles, 1,044–1,065 takes (572–585 of which could be lethal) for loggerhead turtles, and 108 takes (41 of which could be lethal) for Kemp's ridley turtles.

Southeastern Shrimp Trawl Fisheries

The high activity of shrimp trawl fishing fleets in the Gulf poses risks of bycatch to listed sea turtles (NMFS 2014a). The shrimp trawl fishery FMP was amended March 9, 2020, increasing the allowable amount of fishing effort in several zones off the coasts of Mississippi, Louisiana, and Texas (Council 2019). The consultation history for this fishery is closely tied to the lengthy regulatory history governing the use of turtle excluder devices (TEDs) and a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries. The level of annual mortality described in (NRC 1990) is believed to have continued until 1992–1994, when U.S. law required all shrimp trawlers in the Atlantic and Gulf to use TEDs, allowing at least some sea turtles to escape nets before drowning (NMFS 2002).[5] TEDs approved for use have had to demonstrate 97% effectiveness in excluding sea turtles from trawls in controlled testing. These regulations have been refined over the years to ensure that TED effectiveness is maximized through proper placement and installation, configuration (e.g., width of bar spacing), flotation, and more widespread use.

Despite the apparent success of TEDs for some species of sea turtles (e.g., Kemp's ridley turtles), TEDs were later discovered to not adequately protect all species and size classes of sea turtles. Analyses by Epperly and Teas (2002) indicated that the minimum requirements for the escape opening dimension in TEDs in use at that time were too small for some sea turtles and that as many as 47% of the loggerheads stranding annually along the Atlantic and Gulf were too large to fit the existing openings. On December 2, 2002, NMFS completed an opinion on shrimp trawling in the southeastern United States (NMFS 2002) under proposed revisions to the TED regulations requiring larger escape openings (68 FR 8456 2003). This opinion determined that

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[5] TEDs were mandatory on all shrimping vessels. However, certain shrimpers (e.g., fishers using skimmer trawls or targeting bait shrimp) could operate without TEDs if they agreed to follow specific tow-time restrictions.

the shrimp trawl fishery under the revised TED regulations would not jeopardize the continued existence of any sea turtle species. The determination was based in part on the opinion's analysis that shows the revised TED regulations are expected to reduce shrimp trawl related mortality by 94% for loggerheads. In February 2003, NMFS implemented the revisions to the TED regulations.

Although mitigation measures have greatly reduced the impact on sea turtle populations, the shrimp trawl fishery is still responsible for large numbers of turtle mortalities each year. The Gulf fleet accounts for a large percentage of the sea turtle bycatch in this fishery. In 2010, the Gulf shrimp trawl fishery had an estimated bycatch mortality of 5,166 turtles (including 778 loggerhead, 486 green, and 3,884 Kemp's ridley turtles). By comparison, the southeast Atlantic fishery had an estimated bycatch mortality of 1,033 turtles (including 673 loggerhead, 28 green, and 324 Kemp's ridley turtles) in 2010 (NMFS 2014c).

On May 9, 2012, NMFS completed a biological opinion that analyzed the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast U.S. shrimp fisheries in federal waters under the MSA (NMFS 2012c). The opinion also considered a proposed amendment to the sea turtle conservation regulations to withdraw the alternative tow-time restriction at 50 CFR §223.206(d)(2)(ii)(A)(3) for skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) and instead require all of those vessels to use TEDs. The opinion concluded that the proposed action was not likely to jeopardize the continued existence of any sea turtle species. An ITS was provided that used anticipated trawl effort and fleet TED compliance (i.e., compliance resulting in overall average sea turtle catch rates in the shrimp otter trawl fleet at or below 12%) as surrogates for sea turtle takes. On November 21, 2012, NMFS determined that a Final Rule requiring TEDs in skimmer trawls, pusher-head trawls, and wing nets was not warranted and withdrew the proposal. The decision to not implement the Final Rule created a change to the proposed action analyzed in the 2012 opinion and triggered the need to reinitiate consultation. Consequently, NMFS reinitiated consultation on November 26, 2012. Consultation was completed in April 2014; the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast U.S. shrimp fisheries in federal waters under the MSA was not likely to jeopardize the continued existence of any sea turtle species. The ITS maintained the use of anticipated trawl effort and fleet TED compliance as surrogates for numerical sea turtle takes.

More recent studies demonstrate continued take from the fisheries. From 2011–2016, mandatory fisheries observer data for the southeastern shrimp trawl fishery found that otter and skimmer shrimp trawls captured 158 listed sea turtles (Scott-Denton et al. 2020). Data from 2002, 2009, 2014, and 2015 in NOAA's National Bycatch Report Database System indicated that the shrimp trawl was likely to capture 709 sea turtles annually as bycatch (Savoca et al. 2020).

On April 26, 2021, NMFS completed reinitiation on the consultation that analyzed the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast U.S. shrimp fisheries in federal waters under the MSA (NMFS-SERO 2021). Reinitiation of the 2014 consultation (NMFS 2014a) was triggered by three factors: 1) the listing of new species under the ESA (e.g., green sea turtle DPSs in 2016); 2) new bycatch information developed to better analyze the effects of the shrimp fisheries on sea turtle populations; and 3) the December 2019 Final Rule requiring TEDs for a portion of the skimmer trawl fisheries. The reinitiated biological opinion for the reinitiated consultation concluded that the proposed action was not likely to jeopardize the continued existence of any listed species, including sea turtle species. The ITS was revised for consecutive five-year periods authorizing 24,214 takes (1,700 of which could be lethal) for green turtles, 72,670 takes (2,150 of which could be lethal) for loggerhead turtles, and 84,495 takes (8,505 of which could be lethal) for Kemp's ridley turtles (NMFS SERO 2021).

Ten Fisheries in the Atlantic

In 2021, NMFS completed a section 7 consultation on the continued authorization of the American Lobster, Atlantic Bluefish, Atlantic Deep-Sea Red Crab, Mackerel/Squid/Butterfish, Monkfish, Northeast Multispecies, Northeast Skate Complex, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass Fisheries and the new authorization of the Jonah Crab Fishery (NMFS 2021b). In the Gulf of America and South Atlantic, sink gillnets, hook and line, bottom trawls, and pot/traps are the predominant gears used. The biological opinion concluded that green, Kemp's ridley, and loggerhead turtles may be adversely affected by operation of the fishery. However, the proposed action was determined not to jeopardize the continued existence of any of these species. An ITS was provided for authorizing annual takes of 8.4 North Atlantic DPS green turtles (4.8 of which could be lethal), 399 Northwest Atlantic Ocean DPS loggerhead turtles (257.8 of which could be lethal), and 58.4 Kemp's ridley turtles (42.8 of which could be lethal).

5.3.2 State Fisheries

Several coastal state fisheries are known to incidentally take listed species, and available information on these fisheries is documented through different agencies (NMFS 2014d). State commercial and recreational fisheries use gear types including trawling, pot fisheries, gillnets, pound net and weir, seines, channel nets, and vertical line, all of which are known to incidentally take sea turtles. However, most available state data are based on extremely low observer coverage, or sea turtles were not part of data collection. Thus, these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem (NMFS 2014d). The 2001 HMS biological opinion (discussed in the Federal Fisheries Section above) provides a summary of sea turtles taken in state fisheries throughout the action area.

In addition to commercial state fisheries, protected sea turtles can be incidentally captured by hook and line recreational fishers. Observations of state recreational fisheries have shown that loggerhead, Kemp's ridley, and green turtles are known to bite baited hooks. Further, observations show that loggerheads and Kemp's ridleys frequently ingest the hooks. Hooked turtles have been reported by the public fishing from boats, piers, beaches, banks, and jetties. A detailed summary of the known impacts of hook-and-line incidental captures to loggerhead turtles can be found in the Turtle Expert Working Group (TEWG) reports (TEWG 1998; TEWG 2000).

5.4 Oil and Gas

Oil and gas operations on the outer continental shelf (OCS) that have been ongoing for more than 50 years involve a variety of activities that may adversely affect ESA-listed sea turtles in the Gulf portion of the action area. As of 2022, Gulf federal offshore operations produce 1.7 million barrels (bbl) of crude oil per day, representing 15% of all U.S. crude oil production (EIA 2024). These activities and resulting impacts include vessels making supply deliveries, drilling operations, seismic surveys, fluid spills, oil spills and response, and oil platform removals. As technology has advanced over the past several decades, oil exploration and development has moved and will continue to move further offshore into deeper waters (Murawski et al. 2020).

The Bureau of Ocean and Energy Management (BOEM) administers the Outer Continental Shelf Lands Act (OCSLA) and authorizes the exploration and development of wells in Gulf leases. The sale of OCS leases in the Gulf of America and the resulting exploration and development of these leases for oil and natural gas resources has affected the status of ESA-listed species in the action area. As discussed above (Section 5.2), seismic exploration is an integral part of oil and gas discovery, development, and production in the Gulf of America. Year-round noise generated by oil and gas vessels and airguns used for seismic surveys has permanently changed the marine soundscape in the Gulf of America.

The development of wells often involves additional activities such as the installation of platforms, pipelines, and other infrastructure. Once operational, a platform will generate a variety of wastes including effluents and emissions. BOEM requires that oil and gas structures be removed from the seafloor within one year of lease termination. Many of these structures are removed by explosively severing the underwater supportive elements, which produces a shock wave that kills, injures, or disrupts marine life in the blast radius (Gitschlag et al. 1997). An underwater explosion is composed of an initial shock wave, followed by a succession of oscillating bubble pulses. A shock wave is a compression wave that expands radially out from the detonation point of an explosion. The direct shock wave results in the peak shock pressure (compression) and the reflected wave at the air-water surface produces negative pressure (expansion). Explosions are described by metrics such as amplitude, energy and time-space characteristics of the pressure wave (Popper et al. 2014a). Explosive detonations and their impacts on ESA-listed species are discussed in more detail this opinion (see Sections 2.4 and 6).

5.4.1 Oil Spills

Oil spills are accidental and unpredictable events, but are a direct consequence of oil and gas development and production from oil and gas activities in the Gulf of America. Oil releases can occur at any number of points during the exploration, development, production, and transport of oil. Any discharge of hydrocarbons into the environment is prohibited under U.S. law. Instances oil spills are generally small (less than 1,000 bbl) but there are spills that occur that are of larger size (NCCOS 2019). The summary presented here includes examples of recent events, but may not encompass all incidents. For more information, the Bureau of Safety and Environmental Enforcement (BSEE) tracks spills greater than one barrel and posts those data to their website: https://www.bsee.gov/stats-facts/offshore-incident-statistics.

Following Hurricane Ida's landfall in the Gulf of America region in September 2021, NOAA responded to 282 individual discharges of oil from wells, pipelines, and vessels caused by storm damage (NOAA 2021). On December 24, 2022, a pipeline failure at a crude oil terminal in Corpus Christi Bay, Texas, released around 14,000 gallons (gal; 52,996 liters [L]) of light crude oil, with recorded impacts to green turtles (NOAA 2024a). On November 16, 2023, a pipeline crude oil leak off the coast of Louisiana was reported to NOAA and other federal and state agencies, with an estimated 1.1 million gal (4,163,953 L) at risk of spill and an observed slick over 40 mi (64 km) in length (NOAA 2023).

When compared with the rest of the world, more than 50% of the loss of well control events come from the Federally-regulated waters of the Gulf (BSEE 2017). According to (BSEE 2017) from 2000–2015, four of the 117 loss of well control events were categorized as a total loss. The event with the highest risk is the blowout or surface flow-type incident.

In addition to accidental spills, leakage from operating and decommissioned sites can pose an ongoing threat to the ocean ecosystem and listed species by potentially introducing hydrocarbons and other pollutants such as dispersants into surrounding waters. Under OCSLA, decommissioning regulations require that within one year after lease termination, operators must permanently plug wellbores and remove all platforms (30 CFR §250). A study from 2023 estimates that, as of 2020, a total of 7,188 inactive wells or inactive leases in Federal waters of the Gulf of America have not been permanently plugged (Agerton et al. 2023). The Government Accountability Office similarly determined that around 2,700 end-of-lease wells and 500 end-of-lease platforms were overdue for decommissioning as of June 2023 (GAO 2024). Deteriorating structures from delayed decommissioning can become more vulnerable to damage and destruction from storms that are increasingly frequent due to changing environmental trends, which increases the risk of oil spills and the introduction of harmful debris into species' habitat (GAO 2024).

5.4.2 Deepwater Horizon Spill

The largest spill within the Gulf portion of the action area occurred on April 20, 2010. The semi-submersible drilling rig DWH experienced an explosion and fire while working on an exploratory well approximately 50 mi (80 km) offshore of Louisiana. The rig subsequently sank and oil and natural gas began leaking into the surrounding waters of the Gulf of America. Oil flowed for 86 days, until the well was capped on July 15, 2010. By then, 134 million bbl of oil were spilled into the Gulf. In addition, approximately 1.84 million gal (6.97 million L) of chemical dispersant were applied both subsurface and on the surface to attempt to break down the oil. The unprecedented DWH event and associated response activities (e.g., skimming, burning, and application of dispersants) resulted in adverse effects on listed species and changed the baseline for the Gulf ecosystem. Effects of the spill went beyond the footprint visually detected using satellite imagery shown in Figure 8. Berenshtein et al. (2020b) used in situ observations and oil spill transport modeling to examine the full extent of the DWH spill, beyond the satellite footprint, that was at toxic concentrations to marine organisms. Figure 8 below displays visible and toxic (brown), invisible and toxic (yellow), and non-toxic (blue) oil concentrations.

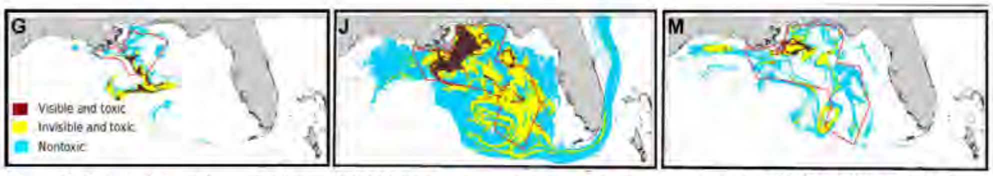
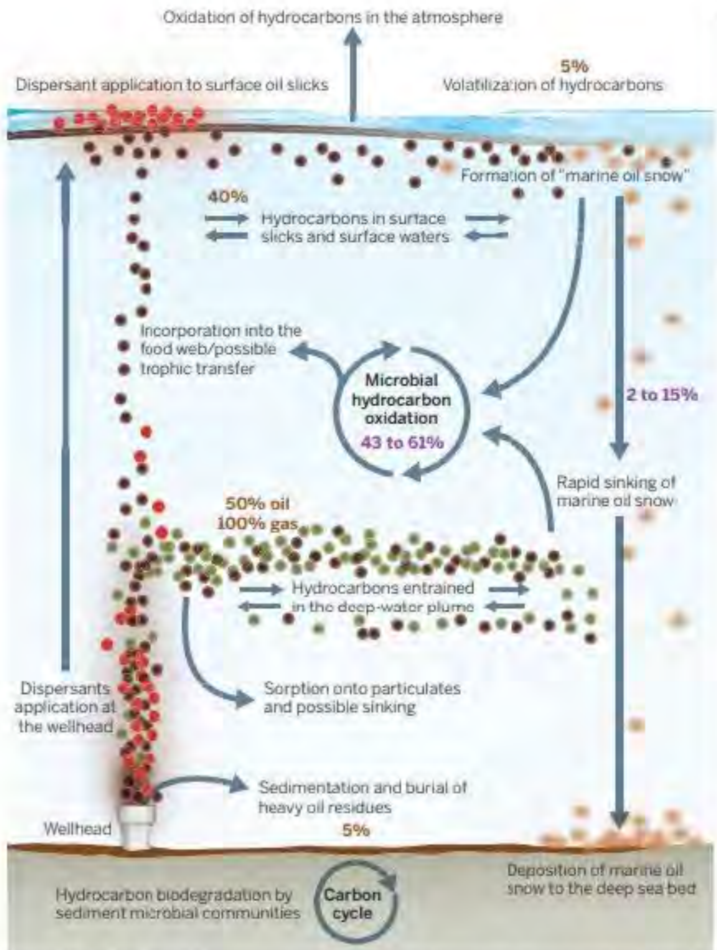


Figure 8. Figure from Berenshtein et al. (2020a) showing spatiotemporal dynamics of the DWH spill for dates showing cumulative oil concentrations in panels G (15 May 2010), J (18 June 2010), and M (2 July 2010).

The investigation conducted under the National Resource Damage Assessment regulations of the Oil Pollution Act (33 USC §2701 *et seq.*) assessed natural resource damages stemming from the DWH oil spill. The effort evaluated specific impacts to several ESA-listed species, including Kemp's ridley, green, and loggerhead sea turtles and habitats of these species (Trustees 2016b). The findings of this assessment provide details regarding impacts to the environmental baseline of listed species and critical habitats in the Gulf, summarized below, can be found at http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. The unprecedented DWH spill and associated response activities (e.g., skimming, burning, and application of dispersants) also resulted in adverse effects to listed sea turtles.

Over a decade following DWH, multiple studies demonstrate both long-term impacts of the spill to species abundance and community structure, as well as the status of ecosystem recovery from the event. Despite natural weathering processes over the years since the DWH, oil persists in some habitats where it continues to expose and impact resources in the northern Gulf of America resulting in new baseline conditions (BOEM 2016; Trustees 2016a). A review of current literature by Patterson et al. (2023) found there were clear impacts of the DWH on shelf taxa at the population level, as well as shifts in community structure (especially for reef fish and invertebrates), and the shelf ecosystem overall has proven to be remarkably resilient. The true impacts to offshore megafauna populations and their habitats may never be fully quantified, though it was necessary to characterize these impacts for response, damage assessment and restoration activities (Frasier 2020).

According to Joye (2015), offshore oil and gas from the spill had the potential to disperse across the entire water column (both pelagic and benthic environments) during DWH (Figure 9). While post-spill restoration continues, the effects of the restoration efforts and potential benefits raise uncertainty regarding overall effectiveness of restoration efforts (Wallace et al. 2019). It is unclear how these restoration efforts have changed the baseline relative to what it would be if those efforts had not happened.



Where did the oil and gas go? The percentages given in brown in the figure reflect the approximate distribution of oil (brown circles) and gas (green circles) during the Deepwater Horizon well blowout (2–4); dispersant addition is noted by red circles. Available data (purple percentages) suggest that the long-term fate is known for only 45 to 75% of the discharged hydrocarbons (7–9). Some of the unaccounted-for oil may have been deposited in coastal marshes or beaches (not shown on the figure). Vertical and horizontal aspects are not to scale.

Figure 9. Diagram showing offshore distribution of oil and gas during DWH (Joye 2015)

The DWH oil spill extensively oiled vital foraging, migratory, and breeding habitats of sea turtles throughout the northern Gulf of America. *Sargassum* habitats, benthic foraging habitats, surface and water column waters, and sea turtle nesting beaches were all affected by DWH. Sea turtles were exposed to DWH oil in contaminated habitats; breathing oil droplets, oil vapors, and smoke; ingesting oil-contaminated water and prey; and by maternal transfer of oil compounds to

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developing embryos. Translocation of eggs from the Gulf of America to the Atlantic coast of Florida resulted in the loss of sea turtle hatchlings. Other response activities, including vessel strikes and dredging, also resulted in turtle deaths.

Three hundred and nineteen live oiled turtles were rescued and showed disrupted metabolic and osmoregulatory functions, likely attributable to oil exposure, physical fouling and exhaustion, dehydration, capture and transport (Stacy et al. 2017). Accounting for turtles that were unobservable during the response efforts, high numbers of small oceanic and large sea turtles are estimated to have been exposed to oil resulting from the DWH spill due to the duration and large footprint of the spill. It was estimated that as many 7,590 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and unidentified hardshelled sea turtles), and up to 158,900 small juvenile sea turtles (Kemp's ridleys, green turtles, loggerheads, hawksbills, and hardshelled sea turtles not identified to species) were killed by the DWH oil spill. Small juveniles were affected in the greatest numbers and suffered a higher mortality rate than large sea turtles (NMFS USFWS 2013; Trustees 2016a).

Subsequent to the Programmatic Damage Assessment and Restoration Plan (PDARP) release, and as part of the DWH natural resource damage assessment, McDonald et al. (2017) estimated approximately 402,000 surface-pelagic sea turtles were exposed with 54,800 likely heavily oiled. Additionally, approximately 30% of all oceanic turtles affected by DWH and not heavily oiled were estimated to have died from ingestion of oil (Mitchelmore et al. 2017).

The DWH incident and associated response activities (e.g., nest relocation) saved animals that may have been lost to oiling, but resulted in some future fitness consequences for those individuals. Nests from loggerhead, Kemp's ridley, and green turtles were excavated prior to emergence and eggs were translocated from Florida and Alabama beaches in the northern Gulf of America between June 6 and August 19, 2010 to a protected hatchery on the Atlantic Coast of Florida. More than 28,000 eggs from 274 nests were translocated and nearly 15,000 hatchling turtles emerged and were released into the Atlantic Ocean.

Hatchlings from nesting beaches in the Gulf of America were released in the Atlantic Ocean and not the Gulf of America. Therefore, the hatchlings imprinted on the area of their release beach. Sea turtles are thought to use this imprinting information to return to the location of nesting beaches as adults. It is unknown whether these turtles will return to the Gulf of America to nest; therefore, the damage assessment determined that the 14,796 hatchlings will be lost to the Gulf of America breeding populations because of the DWH oil spill. It is estimated that nearly 35,000 hatchling sea turtles (loggerhead, Kemp's ridley, and green turtles) were injured by response activities, and thousands more Kemp's ridley and loggerhead hatchlings were lost due to unrealized reproduction of adult sea turtles that were killed by the DWH oil spill.

Kemp's ridley turtles were the most affected sea turtle species, as they accounted for 49% (239,000) of all exposed turtles (478,900) during DWH. Kemp's ridley turtles were the turtle species most impacted by the DWH event at a population level. The DWH damage assessment calculated the number of unrealized nests and hatchlings because all Kemp's ridley turtles nest in the Gulf and belong to the same population (NMFS et al. 2011a). The total population abundance of Kemp's ridley turtles could be calculated based on numbers of hatchlings because all individuals are reasonably expected to inhabit the northern Gulf of America throughout their lives. The loss of these reproductive-stage females would have contributed to the decline in total nesting abundance observed between 2011 and 2014. The estimated number of unrealized Kemp's ridley nests is between 1,300 and 2,000, which translates to approximately 65,000 and 95,000 unrealized hatchlings. This is a minimum estimate because of the overall potential DWH effect because the sub-lethal effects of DWH oil on turtles, their prey, and their habitats might have delayed or reduced reproduction in subsequent years and contributed substantially to additional nesting deficits observed following DWH. These sub-lethal effects could have slowed growth and maturation rates, increased remigration intervals, and decreased clutch frequency (number of nests per female per nesting season). The nature of the DWH effect on reduced Kemp's ridley nesting abundance and associated hatchling production after 2010 requires further evaluation.

Loggerhead turtles made up 12.7% (60,800 animals) of the total sea turtle exposures (478,900). A total of 14,300 loggerhead turtles died as a result of exposure to DWH oil. Unlike Kemp's ridley turtles, the majority of nesting for the Northwest Atlantic Ocean DPS of loggerhead turtles occurs on the Atlantic coast, and thus nesting was impacted to a lesser degree in this species. It is likely that impacts to the Northern Gulf of Mexico Recovery Unit of the Northwest Atlantic Ocean DPS of loggerhead turtle would be proportionally much greater than the impacts occurring to other recovery units, and likely included impacts to mating and nesting adults. Although the long-term effects remain unknown, the DWH impacts to the Northern Gulf of Mexico Recovery Unit may include some nesting declines in the future due to a large reduction of oceanic age classes during DWH. However, the overall impact on the population recovery of the entire Northwest Atlantic Ocean DPS of loggerhead turtle is likely small.

Green turtles made up 32.2% (154,000) of all turtles exposed to DWH oil with 57,300 juvenile mortalities out of the total exposed animals, which removed a large number of small juvenile turtles from the population. A total of four nests (580 eggs) were relocated during response efforts. While green turtles regularly use the northern Gulf of America, they have a widespread distribution throughout the entire Gulf, Caribbean, and Atlantic. Nesting is relatively rare on northern Gulf of America beaches. Although it is known that adverse impacts occurred and numbers of animals in the Gulf of America were reduced as a result of DWH, the relative proportion of the population that is expected to have been exposed to and directly impacted by the DWH event, and thus a population-level impact to green sea turtles, is not likely.

5.5 Vessel Operations

The Gulf and Atlantic Ocean are highly active regions for maritime vessel activity, including shipping, transit, fishing, and offshore operations, all of which have baseline impacts to listed species and their habitats. Propeller and collision injuries and mortalities from private and commercial vessels are a significant threat to ESA-listed sea turtles. Potential sources of adverse effects from federal vessel operations in the action area include operations of the U.S. DoD, BOEM, BSEE, Federal Energy Regulatory Commission (FERC), U.S. Coast Guard (USCG), NOAA, and U.S. Army Corps of Engineers (USACE).

Sea turtles swimming or feeding at or just beneath the surface of the water are particularly vulnerable to vessel strikes, which can result in serious injury and death (Hazel et al. 2007b). Sea turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases (Hazel et al. 2007b). Green sea turtles cannot consistently avoid being struck by vessels moving at relatively moderate speeds (i.e., greater than 4 km per hour); most vessels move much faster than this in open water (Hazel and Gyuris 2006; Hazel et al. 2007b; Work et al. 2010).

Many recovered sea turtles display injuries that appear to result from interactions with vessels and their associated propulsion systems (Work et al. 2010). This is particularly true in nearshore areas with high vessel traffic along the U.S. Atlantic and Gulf of America coasts. From 1997 to 2005, nearly 15% of all stranded loggerheads in the U.S. Atlantic and Gulf of America were documented as having sustained some type of propeller or collision injury; although it is not known what proportion of these injuries were before or after death. In one study conducted in Virginia, Barco et al. (2016) found that all 15 dead loggerhead turtles encountered with signs of acute vessel interaction were normal and healthy prior to the vessel interaction. The incidence of propeller wounds of stranded sea turtles from the U.S. Atlantic and Gulf of America doubled from about 10% in the late 1980s to about 20% in 2004. Singel et al. (2007) reported a tripling of boat strike injuries in Florida from the 1980s to 2005. Over this time period, in Florida alone, over 4,000 (approximately 500 live and 3,500 dead) sea turtle strandings were documented with propeller wounds, which represented 30% of all sea turtle strandings for the state (Singel et al. 2007). Stacy et al. (2020) analyzed Texas sea turtle stranding data for 2019, a year where sea turtle strandings were more than two times above average based on statewide stranding numbers for the previous 5 and 10 years, and analyzed causes of stranding by species and stranding zone. Vessel strike-type injuries were the most common type of trauma observed in Kemp's ridley, green, and loggerhead turtles (Stacy et al. 2020). Approximately 71% of stranded green turtles and 61% of Kemp's ridley turtles studied had documented vessel strike injuries (Stacy et al. 2020). These studies suggest that the threat of vessel strikes to sea turtles may be increasing over time as vessel traffic continues to increase in the south and southeastern U.S.

The Sea Turtle Stranding and Salvage Network reports a large number of vessel interactions (propeller injury) with sea turtles off coastal states such as New Jersey and Florida, where there are high levels of vessel traffic. The Virginia Aquarium & Marine Science Center Strandings Program reported an average of 62.3 sea turtle strandings per year in Virginia waters due to boat strikes from 2009–2014 (Barco 2015). The large majority of these (about 87%) were dead strandings. By sea turtle species, 73.3% of Virginia vessel strike strandings from 2009–2014 were loggerhead, 20.3% Kemp's ridley, and 3.5% green turtles (Barco 2015).

5.6 Dredging

Dredging involves the removal and relocation of submerged sediment in waterways, nearshore areas, and offshore, and supports activities such as maintaining coastal navigation channels, beach nourishment, levee construction, and coastal restoration. 29 of the Gulf of America lease areas that BOEM manages within the action area host blocks with significant sediment resources that may be dredged (BOEM 2024). Dredging activities can pose significant impacts to aquatic ecosystems by: (1) direct removal/burial of organisms; (2) turbidity/siltation effects; (3)

contaminant re-suspension; (4) sound/disturbance; (5) alterations to hydrodynamic regime and physical habitat; and (6) loss of riparian habitat (Chytalo 1996; Winger et al. 2000).

Marine dredging vessels are common within U.S. coastal waters. Dredging may harm sea turtle species by injuring individuals with the equipment used or degrade and modify their foraging habitat (such as soft bottom and seagrass beds), affecting available food resources. Although the underwater sounds from dredge vessels are typically continuous in duration (for periods of days or weeks at a time) and strongest at low frequencies, they are not believed to have any long-term effect on sea turtles. However, the construction and maintenance of federal navigation channels and dredging in sand mining sites ("borrow areas") have been identified as sources of sea turtle mortality. Hopper dredges can lethally harm sea turtles by entraining them in dredge drag arms and impeller pumps. Hopper dredges in the dredging mode are capable of moving relatively quickly and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge overtakes a resting or swimming organism.

To reduce take of listed species, relocation trawling may be utilized to capture and move sea turtles. In relocation trawling, a boat equipped with nets precedes the dredge to capture sea turtles and then releases the animals out of the dredge pathway, thus avoiding lethal take. Relocation trawling has been successful and routinely moves sea turtles in the Gulf of America. In 2003, NMFS completed a regional biological opinion on USACE hopper dredging in the Gulf of America that included impacts to sea turtles via maintenance dredging. NMFS determined that Gulf of America hopper dredging would adversely affect four sea turtle species (i.e., green, hawksbill, Kemp's ridley, and loggerheads) but would not jeopardize their continued existence. An ITS for those species adversely affected was issued.

Numerous other opinions have been produced that analyzed hopper dredging projects that did not fall under the scope of actions contemplated by the regional opinion, including the dredging of Ship Shoal in the Gulf Central Planning Area for coastal restoration projects in 2005, the Gulfport Harbor Navigation Project in 2007, the East Pass dredging in Destin, Florida in 2009, the Mississippi Coastal Improvements Program in 2010, and the dredging of City of Mexico beach canal inlet in 2012. Each of the above free-standing opinions had its own ITS and determined that hopper dredging during the proposed actions would not jeopardize the continued existence of any ESA-listed species, including sea turtles, or destroy or adversely modify critical habitat of any listed species.

5.7 Construction and Operation of Public Fishing Piers

The Gulf coast experienced an active hurricane season in 2020, as well as a destructive Category 4 hurricane in 2021, which required the reconstruction and repairs of several fishing piers along Mississippi, Louisiana, and Alabama. The USACE permits the building of these structures and, in many of these cases, the Federal Emergency Management Agency (FEMA) provides funding. Six FEMA funded projects along the Gulf coast were authorized in 2022 to repair piers damaged in recent storms. NMFS determined that the activities associated with the demolition/reconstruction/repair of each pier were not likely to adversely affect any ESA-listed species. However, NMFS also concluded that the fishing likely to occur following the completion of each pier project was likely to adversely affect certain species of sea turtles, but was not likely to jeopardize their continued existence. Incidental capture of sea turtles is generally nonlethal, though some captures result in severe injuries, which may later lead to death. Fishing effort is expected to continue at Gulf piers into the foreseeable future.

5.8 Research Permits

The ESA allows for the issuance of permits authorizing take of certain ESA-listed species for the purposes of scientific research (section 10(a)(1)(a)). In addition, section 6 of the ESA allows NMFS to enter into cooperative agreements with states to assist in recovery actions of listed species. The number of authorized directed and incidental takes by research permits varies widely depending on the research and species involved but may involve the taking of hundreds of sea turtles annually. Before any research permit is issued, the proposal must be reviewed under the permit regulations (i.e., must show a benefit to the species). The proposal must be reviewed for compliance with section 7 of the ESA because issuance is a Federal activity.

The primary objective of most of these field studies has generally been monitoring populations or gathering data for behavioral and ecological studies. Over time, NMFS has issued dozens of permits on an annual basis for various forms of "take" of marine mammals and sea turtles in the action area from a variety of research activities. Authorized research on ESA-listed sea turtles includes aerial and vessel surveys, close approaches, active acoustics, capture, handling, holding, restraint, and transportation, tagging, shell and chemical marking, biological sampling (i.e., biopsy, blood and tissue collection, tear, fecal and urine, and lavage), drilling, pills, imaging, ultrasound, antibiotic (tetracycline) injections, captive experiments, laparoscopy, and mortality. Most research activities involve authorized sub-lethal "takes," with some resulting mortality.

Currently, there are 24 active sea turtle research permits issued for work in the Atlantic and Gulf of America under the NMFS Sea Turtle Research and Enhancement Permitting Program and covered by the sea turtle research permit programmatic biological opinion (NMFS 2017a). The sea turtle research programmatic established mortality banks for each species, which represent the maximum total number of mortalities that could be authorized and used over a 10-year period (2018–2027). Only two sea turtle lethal takes (one Kemp's ridley and one loggerhead turtle) have been reported since 2018 when the programmatic opinion took effect.

5.9 Military Operations

Military testing and training affects listed species and their habitat through activities such as ordinance detonation, active sonar, and live munitions. The air space over the Gulf of America is used extensively by the DoD for conducting various air-to-air and air-to-surface operations. Nine military warning areas and five water test areas are located within the Gulf of America. The western Gulf of America has four warning areas used for military operations. The areas total approximately 21 million acres or 58% of the Gulf of America. In addition, six blocks in the western Gulf of America are used by the Navy for mine warfare testing and training. The central Gulf of America has five designated military warning areas that are used for military operations. The central Gulf of America has five designated military warning areas used for military operations. These areas total approximately 11.3 million acres (ac; 45,729 km^2). Portions of the Eglin Water Test Areas (EWTA) comprise an additional 0.5 million ac (2,023 km^2) in the Gulf of America. The total 11.8 million ac (47,753 km^2) is about 25% of the area of the Gulf of America.

Formal consultations on overall U.S. Navy activities in the Atlantic have been completed by NMFS, for U.S. Navy's Activities in East Coast Training Ranges (June 1, 2011); U.S. Navy Atlantic Fleet Sonar Training Activities (AFAST; January 20, 2011); Navy AFAST Letter of Authorization 2012–2014: U.S. Navy active sonar training along the Atlantic Coast and Gulf of America (December 19, 2011); Activities in the Gulf Range Complex from November 2010 to November 2015 (March 17, 2011); and Navy's East Coast Training Ranges (Virginia Capes, Cherry Point, and Jacksonville; June 2010). These opinions concluded that, although there is a potential for some U.S. Navy activities to affect sea turtles, those effects were not expected to affect any species on a population level. Therefore, the activities were determined to be not likely to jeopardize the continued existence of any ESA-listed species.

On October 22, 2018 NMFS issued a conference and biological opinion on the effects of the Navy's Atlantic Fleet Training and Testing (AFTT) Phase III activities on ESA-listed resources (NMFS 2018a). The AFTT action area includes the Gulf Range Complex, which encompasses approximately 17,000 square nautical miles (NM^2) of sea and undersea space and includes 285 NM of coastline. The four operating areas (OPAREAs) within this range complex are: Panama City OPAREA off the coast of the Florida panhandle (approximately 3,000 NM^2); Pensacola OPAREA off the coast of Florida west of the Panama City OPAREA (approximately 4,900 NM^2); New Orleans OPAREA off the coast of Louisiana (approximately 2,600 NM^2); and Corpus Christi OPAREA off the coast of Texas (approximately 6,900 NM^2). We concluded the action is not likely to jeopardize the continued existence of any ESA-listed species or result in the destruction or adverse modification of critical habitat. The AFTT Phase III opinion includes an ITS with exempted take for ESA-listed sea turtles (for details see https://repository.library.noaa.gov/view/noaa/31540). Through the section 7 consultation process with NMFS, the U.S. Navy has developed and implemented monitoring and conservation measures to reduce the potential effects of explosives, sonar, and vessel strikes on ESA-listed resources, including sea turtles, in the Atlantic Ocean and Gulf of America.

NMFS completed consultations on Eglin Air Force Base testing and training activities in the Gulf of America. These consultations concluded that adverse effects to sea turtles are likely to occur, but the action is not likely to jeopardize their continued existence or result in the destruction or adverse modification of critical habitat. These opinions included an ITS for these actions: Eglin Gulf Test and Training Range (NMFS 2004b), the Precision Strike Weapons Tests (NMFS 2005b), the Santa Rosa Island Mission Utilization Plan (NMFS 2005c), Naval Explosive Ordnance Disposal School (NMFS 2004a), Eglin Maritime Strike Operations Tactics Development and Evaluation (NMFS 2013), and Ongoing Eglin Gulf Testing and Training Activities (NMFS 2023).

5.10 Aquaculture

Marine aquaculture systems are diverse, ranging from highly controlled land-based systems to open water cages that release wastes directly to the environment. Species produced in the marine environment are also diverse, and include seaweeds, bivalve mollusks, echinoderms, crustaceans, and finfish (Langan 2004). Globally, aquaculture supplies more than 50% of all seafood produced for human consumption, and that percentage will likely continue to rise (NOAA Marine Aquaculture; https://www.fisheries.noaa.gov/topic/aquaculture). Marine aquaculture is expected to expand in the U. S. Exclusive Economic Zone (EEZ) due to increased demand for domestically grown seafood, coupled with improved technological capacity to farm in the open ocean. The National Offshore Aquaculture Act of 2005 (S. 1195) promotes offshore aquaculture development within the EEZ and established a permitting process that encourages private investment in aquaculture operations, demonstrations, and research. Although the marine aquaculture industry has been expanding in the U.S., development is highly variable among states (e.g., Virginia and Maine have productive and valuable industries, while Georgia and New York, have relatively minimal development; Lester et al. 2024).

Aquaculture is an emerging industry in the Gulf of America, though there are currently no active commercial offshore aquaculture operations. In 2020, Presidential Executive Order 13921, "Promoting American Seafood Competitiveness and Economic Growth," identified the U.S. Gulf of America as one of the first regions to be evaluated for offshore aquaculture opportunities (85 FR 28471; May 12, 2020). Farmer et al. (2022b) developed a method to identify aquaculture opportunity areas (AOA's) with the least conflict with protected species, including sea turtles. In November 2021, NOAA's National Centers for Coastal Ocean Science published a comprehensive spatial modeling study, "An Aquaculture Opportunity Atlas for the U.S. Gulf of Mexico," which identified nine potential options for AOA locations in federal waters in the Gulf of America (Figure 10). These nine locations were identified using spatial suitability modeling intended to minimize conflicts with protected/sensitive species and habitats, as well as other ocean user groups. The model included data layers relevant to administrative boundaries, national security (i.e., military), navigation and transportation, energy and industry infrastructure, commercial and recreational fishing, natural and cultural resources, and oceanography (i.e., non-living resources; Riley et al. 2021).

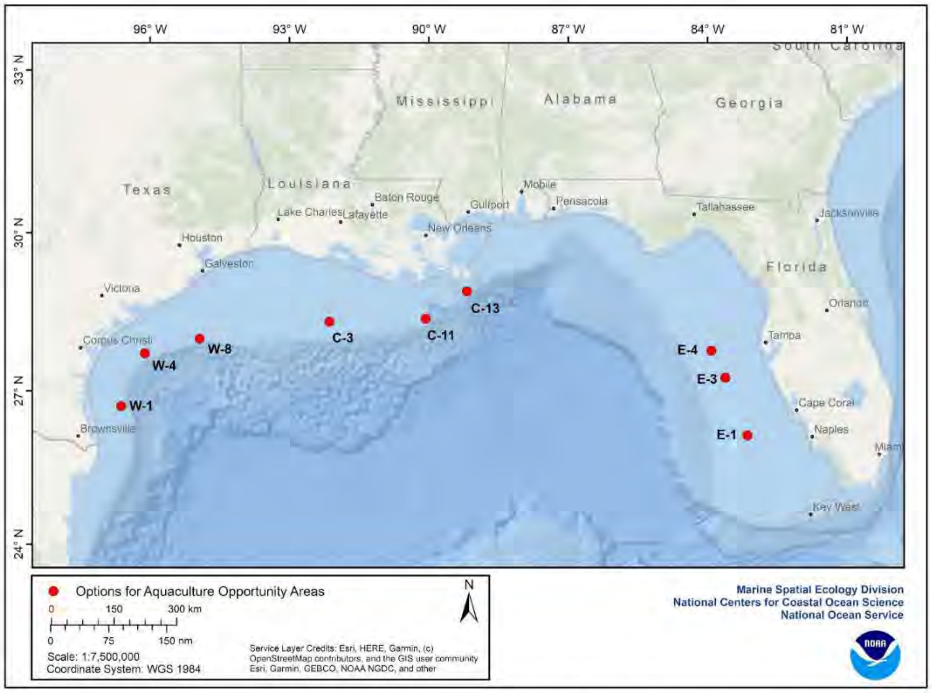

Figure 10. Nine potential locations for AOAs in federal waters of the Gulf of America (Source: NCCOS 2023)

Potential impacts to ESA-listed species can occur at all stages of aquaculture development, operation, and decommissioning, and can include attraction to farms or displacement from important habitats, resulting in changes to distribution, behaviors, or social structures (Clement 2013; Price et al. 2017). Aquaculture has the potential to affect protected species via entanglement and/or other interaction with aquaculture gear (i.e., buoys, nets, and lines), introduction or transfer of pathogens, increased vessel traffic and noise, impacts to habitat and benthic organisms, and water quality (Clement 2013; Lloyd 2003; Price et al. 2017; Price and Morris 2013). Current data suggest that interactions and entanglements of ESA-listed marine mammals and sea turtles with aquaculture gear are rare (Price et al. 2017). This may be because worldwide the number and density of aquaculture farms are low, and thus there is a low probability of interactions, or because they pose little risk to ESA-listed marine mammals or sea turtles. There are limited data on sea turtle interactions, and very few reports of marine mammal interactions with aquaculture gear. It is not always possible to determine if the gear animals become entangled in originates from aquaculture or commercial fisheries (Price et al. 2017). Some aquaculture gear has the potential for behavioral effects on marine mammals. For example, aquaculture gear may act as a "fish aggregating device" which may attract marine mammals seeking prey for food, and subsequent marine mammal depredation may occur (Callier et al. 2018). Aquaculture gear may also block migration routes (MPI 2013) or at least cause animals to have to circumnavigate the aquaculture gear.

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5.11 Invasive Species

Aquatic nuisance species are nonindigenous species that threaten the diversity or abundance of native species, the ecological stability of infested waters, or any commercial, agricultural or recreational activities dependent on such waters. Aquatic nuisance species or invasive species include nonindigenous species that may occur within inland, estuarine, or marine waters and that presently or potentially threaten ecological processes and natural resources. Invasive species have been referred to as one of the top four threats to the world's oceans (Pughiuc 2010; Raaymakers 2003; Raaymakers and Hilliard 2002; Terdalkar et al. 2005; Wambiji et al. 2007). Introduction of these species is cited as a major threat to biodiversity, second only to habitat loss (Wilcove et al. 1998). A variety of vectors are thought to have introduced non-native species including, but not limited to, aquarium and pet trades, recreation, and shipping. Shipping is the main vector of aquatic nuisance species (species hitchhiking on vessel hulls and in ballast water) in aquatic ecosystems; globally, shipping has been found to be responsible for 69% of marine invasive species (e.g., (Drake and Lodge 2007; Keller and Perrings 2011; Molnar et al. 2008). Common impacts of invasive species are alteration of habitat and nutrient availability, as well as altering species' composition and diversity within an ecosystem (Strayer 2010). Shifts in the base of food webs, a common result of the introduction of invasive species, can fundamentally alter predator-prey dynamics up and across food chains (Moncheva and Kamburska 2002; Norse et al. 2005), potentially affecting prey availability and habitat suitability for ESA-listed species. They have been implicated in the endangerment of 48% of ESA-listed species (Czech and Krausman 1997). Currently, there is little information on the level of aquatic nuisance species and the impacts of these invasive species may have on sea turtles in the action area through the duration of the project. Therefore, the level of risk and degree of impact to ESA-listed sea turtles is unknown.

Lionfish (*Pterois* sp.) have become a major invasive species in the western North Atlantic Ocean and have rapidly dispersed into the Caribbean Sea and Gulf. Since lionfish were first captured in the northern Gulf of America in 2010 and 2011, they have rapidly dispersed throughout the northern Gulf of America, with the western-most collection of lionfish off Texas (Fogg et al. 2013). Lionfish are voracious predators to native fishes having decimated native fish populations on Caribbean reefs, and have a broad habitat distribution with few natural predators in the region (Ingeman 2016; Mumby et al. 2011). It is unclear what impact lionfish will have on prey species for loggerhead and Kemp's ridley turtles in the Gulf portion of the action area. Although it is not possible to predict which aquatic nuisance species will arrive and thrive in the Gulf portion of the action area, it is reasonably certain that they will be yet another facet of change and potential stress to native biota which may affect either the health or prey base of native fauna.

5.12 Nutrient Loading and Hypoxia

Industrial and municipal activities can result in the discharge of large quantities of nutrients into coastal waters. Excessive nutrient enrichment results in eutrophication, a condition associated with degraded water quality, algal blooms (including harmful algal blooms), oxygen depletion, loss of seagrass and coral reef habitat, and in some instances the formation of hypoxic "dead zones" (USCOP 2004). Hypoxia (low dissolved oxygen concentration) occurs when waters become overloaded with nutrients such as nitrogen and phosphorus, which enter oceans from agricultural runoff, sewage treatment plants, bilge water, atmospheric deposition, and other sources. An overabundance of nutrients can stimulate algal blooms resulting in a rapid expansion of microscopic algae (phytoplankton). When excess nutrients are consumed, the algal population dies off and the remains are consumed by bacteria. Bacterial consumption decreases the dissolved oxygen level in the water which may result in mortality of fish and crustaceans, reduced benthic and demersal organism abundance, reduced biomass and species richness, and abandonment of habitat to sufficiently oxygenated areas (Craig et al. 2001; Rabalais et al. 2002). Higher trophic-level species (e.g., sea turtles) may be impacted by the reduction of available prey because of hypoxic conditions.

Nutrient loading from land-based sources, such as wastewater treatment plants and agriculture, and hypoxia remain a threat to protected species and their habitats and prey availability, which, in turn, can affect survival and reproductive fitness. In the Gulf of America, eutrophication from both point and non-point sources produces a large area with seasonally depleted oxygen levels (< 2 milligrams/liter; Rabalais et al. (2010) on the Louisiana continental shelf. The hypoxia begins in late spring, reaches a maximum in mid-summer, and disappears in the fall. Since 1993, the average extent of mid-summer, bottom-water hypoxia in the northern Gulf of America has been approximately 6,200 mi^2 (16,000 km^2), approximately twice the average size measured between 1985 and 1992. The hypoxic zone attained a maximum measured extent in 2002, when it was about 8,500 mi^2 (22,000 km^2), which is larger than the state of Massachusetts. The Mississippi River/Gulf of America Hypoxia Task Force's 2023 Report to Congress determined the midsummer extent of the hypoxic zone was 6,330 mi^2 (16,400 km^2) in 2021, and 3,270 mi^2 (8,480 km^2) in 2022 (US-HTF 2023). For 2024, NOAA measured a hypoxic zone in the Gulf of America of 6,507 mi^2 (16,853 km^2), the 12th largest zone in 38 years of measurement (NCCOS 2024; NOAA 2024b). Low-oxygen waters can induce fish kills, alter fish diets, growth, and reproduction (Rose et al. 2018), reduce habitat use by shrimp species (Craig 2012), and affect the habitat of sea turtles. Warming waters will likely exacerbate hypoxic conditions along the Gulf of America continental shelf, resulting in greater exposure to prolonged and severe hypoxic conditions (Laurent et al. 2018). Projected increases in precipitation over the next few decades in the Mississippi and Atchafalaya River Basin is anticipated to result in more water, sediment, and nutrients entering the coasts as well (US-HTF 2023).

In addition to inducing widespread hypoxia in the action area, nutrient loading and changing environmental trends can trigger the development of marine algal toxins. Marine algal toxins are produced by unicellular algae that are often present at low concentrations but may proliferate to form dense concentrations under certain environmental conditions (National Academies of Sciences and Medicine 2016). When high cell concentrations form, the toxins they produce can harm marine life, which is referred to as a harmful algal bloom (HAB). Excess nutrients from freshwater inputs enhance growth of phytoplankton that naturally occur in the ecosystem, forming "blooms" that can often produce a suite of toxins. The majority of HAB species observed in U.S. waters are present on the Gulf coast and there are frequent blooms, including, but not limited to, the dinoflagellates *Karenia brevis, Alexandrium,* and *Dinophysis*, and the diatom *Pseudo-nitzschia* in the Gulf of America (Anderson et al. 2021). Recent assessments and improved ocean monitoring capabilities have shown that the frequency, duration, and toxicity of HABs in the U.S. may be increasing overall (Anderson et al. 2021). Ocean warming has fostered the geographic expansion of new HAB species into the Gulf portion of the action area, such as Ciguatoxin-producing *Gambierdiscus* dinoflagellates into the northern Gulf of America (Anderson et al. 2021).

The various toxins produced by these species of HABs can biomagnify up the food chain, ultimately harming protected species (like sea turtles) when ingested (Perrault et al. 2021a); the toxins can affect neurological function, feeding and shelter behavior, and damage other organ systems. In the Gulf portion of the action area, researchers have determined HABs to be the cause of marine mammal unusual mortality events (Fire et al. 2020), large-scale fish kills (Overstreet and Hawkins 2017), and sea turtle deaths (NOAA 2024c). Capper et al. (2013) found that sea turtles were exposed to multiple HAB toxins (okadaic acid, brevetoxins, saxitoxins, and likely others) in Florida. Results from Vilas et al. (2023) suggest that severe red tide fisheries impacts have occurred on the West Florida Shelf, located in the eastern Gulf of America, at the ecosystem, community, and population levels in terms of biomass, catch, and productivity. Blooms of the toxic dinoflagellate *K. brevis* occur frequently on the west coast of Florida, killing fish and other marine life. The 2018 *K. brevis* harmful algal bloom experienced along the west coast of Florida was the worst red tide occurrence there since 2005 (Liu et al. 2022).

5.13 Marine Debris

Marine debris is an ecological threat introduced into the marine environment through ocean dumping, littering, or hydrological transport of these materials from land-based sources or weather events (Gallo et al. 2018). Sea turtles within the action area may ingest marine debris, particularly plastics, which can cause intestinal blockage and internal injury, dietary dilution, malnutrition, and increased buoyancy. These can result in poor health, reduced fitness, growth rates, and reproduction, or even death (Nelms et al. 2016).

Plastic pollution in the marine environment is of particular concern to endangered and threatened species because plastic materials are highly persistent and can degrade into microplastics rather than fully disintegrating. Globally, between 5.3–14 million t (4.8–12.7 million MT) of plastic waste entered the ocean from 192 coastal countries in 2010 (Jambeck et al. 2015). Debris can originate from a variety of marine industries including fishing, oil and gas, and shipping. Many of the plastics discharged to the sea can withstand years of saltwater exposure without disintegrating or dissolving. Further, floating materials concentrate in ocean gyres and convergence zones, notably in regions with *Sargassum* habitat where juvenile sea turtles are known to occur, and microplastics have consistently been detected in *Sargassum* mats in coastal ecosystems (Arana et al. 2024; Law et al. 2010). Changing environmental trends are further exacerbating marine plastic fluxes; increasing storms and flooding can transport large amounts of debris into aquatic systems and microplastics, in particular, are now being transported through the atmosphere as part of biogeochemical cycles (Ford et al. 2022).

Entanglement in plastic debris (including abandoned ‘ghost’ fishing gear) is known to cause lacerations, increased drag (thereby reducing the ability to forage effectively or avoid predators), and may lead to drowning or death by starvation. In a review of global studies evaluating debris ingestion, researchers found that the probability of green and leatherback turtles ingesting debris has increased significantly between 1985– 2012, and herbivorous or jellyfish-consuming species are at greatest risk of both lethal and sublethal effects (SCHUYLER et al. 2014b). Ingested debris may block the digestive tract or remain in the stomach for extended periods, thereby reducing the feeding drive, causing ulcerations and injury to the stomach lining, or perhaps providing a source of toxic chemicals (Laist 1987; Laist 1997). Weakened animals are more susceptible to predators and disease and are less fit to migrate, breed, or, in the case of turtles, nest successfully (Katsanevakis 2008; McCauley and Bjorndal 1999). There are limited studies of debris ingestion in sea turtles within the action area; however, Plotkin et al. (1993) found that over half of the studied loggerhead turtles had anthropogenic debris, mainly pieces of plastic bags, present in digestive tract contents. Plotkin et al. (1993) attributed the deaths of three loggerhead turtles to debris ingestion, including one loggerhead turtle whose esophagus was perforated by a fishing hook, one loggerhead turtle whose stomach lining was perforated by a piece of glass, and one loggerhead turtle whose entire digestive tract was impacted by plastic trash bags. Elsewhere in the Gulf, debris such as plastic, fishing gear, rubber, aluminum foil, and tar were found in green and loggerhead turtles (Bjorndal et al. 1994). At least two turtles died as a result of debris ingestion, although the volume of debris represented less than 10% of the volume of the turtle's gut contents; therefore, even small quantities of debris can have severe health and fitness consequences (Bjorndal et al. 1994).

Sea turtles can also become entangled in marine debris, namely fishing gear, as discussed in Section 5.3.

5.14 Other Marine Pollution

Chemical-based pollution from a variety of sources may also affect listed species in the action area. These sources include atmospheric loading of pollutants such as polychlorinated biphenyls (PCBs), stormwater from coastal or river communities, and discharges from ships and industries. In addition to legacy contaminants such as PCBs, heavy metals, and pesticides, several classes of contaminants of emerging concern also introduce risks to listed species. NOAA's National Status and Trends Mussel Watch Program monitors 85 long-term sites in coastal waters in the Gulf of America, and, in 2017, detected elevated concentrations of the following contaminants of emerging concern across the coastline: brominated flame retardants, pesticides such as highly toxic organophosphates, pharmaceutical compounds, and per- and poly-fluoroalkyl substances (PFAS; Swam et al. 2023). PFAS are a class of chemicals that are highly persistent, bioaccumulative, and have been linked to liver damage, cancer, and immune suppression in humans and aquatic vertebrate study species. Sources of marine pollution are often difficult to attribute to specific federal, state, local or private actions.

Chemical pollutants (e.g., DDT, PCBs, polybrominated diphenyl ethers, perfluorinated compounds, and heavy metals) accumulate up trophic levels of the food chain, such that high trophic level species like sea turtles have higher levels of contaminants than lower trophic levels (Bucchia et al. 2015b; D'Ilio et al. 2011; Mattei et al. 2015). These pollutants can cause adverse effects, including endocrine disruption, reproductive impairment or developmental effects, and immune dysfunction or disease susceptibility (Bucchia et al. 2015a; Ley-Quiñónez et al. 2011). In sea turtles, maternal transfer of persistent organic pollutants threatens developing embryos with a pollution legacy and poses conservation concerns due to its potential adverse effects on subsequent generations (Muñoz and Vermeiren 2020). Although there is limited information on chemical pollutants in sea turtles in the action area, there are studies that have investigated heavy metals, brevetoxins, and persistent organic pollutants in some sea turtle species in other areas of the Gulf portion of the action area and adjacent waters. Two studies investigated heavy metals in Kemp's ridley, loggerhead, hawksbill, and green turtles off eastern Texas and Louisiana (Kenyon et al. 2001; Presti et al. 2000). Heavy metal (mercury, copper, lead, silver, and zinc) concentrations in blood and scute (the scales on the shell, also known as carapace) samples increased with turtle size (Kenyon et al. 2001; Presti et al. 2000). After a red tide bloom near Florida's Big Bend, Perrault et al. (2017) found brevetoxins and heavy metals in Kemp's ridley and green turtles. Perrault et al. (2017) analyzed the turtles' health relative to the presence of brevetoxins and heavy metals, and found that the presence of toxic elements was related to oxidative stress, increased tumor growth, decreased body condition, inflammation, and disease progression.

Sea turtle tissues have been found to contain organochlorines and many other persistent organic pollutants. PCB concentrations in sea turtles are reportedly equivalent to those in some marine mammals, with liver and adipose levels of at least one congener being exceptionally high (Davenport et al. 1990; Orós et al. 2009). The contaminants (organochlorines) can cause deficiencies in endocrine, developmental, and reproductive health (Storelli et al. 2007) and are known to depress immune function in loggerhead turtles (Keller et al. 2006). Females from sexual maturity through reproductive life should have lower levels of contaminants than males because contaminants are shared with progeny through egg formation. PFAS compounds have been detected in the plasma of loggerhead and Kemp's ridley turtles; adverse impacts could have endocrine and reproductive implications for turtle species (Khan et al. 2023). No information on detrimental threshold concentrations is available and little is known about the consequences of exposure of sea turtles to organochlorine compounds. More research is needed to better understand the short- and long-term health and fecundity effects of these chemical pollutants and heavy metal accumulation in sea turtles.

5.15 Other Launch and Reentry Operations

The FAA, National Aeronautics and Space Administration (commonly known as NASA), and the U.S. Space Force (USSF) are involved in space operations such as licensing and regulating U.S. commercial launch and reentry activity and launch sites, leasing launch facilities, and overseeing the preparation and launching of DoD missile launch activities, and government and commercial satellites. As part of these operations, a number of vehicles are launched from facilities across the U.S. each year, and vehicles, stages, or components such as fairings may end up in the ocean.

Space activities may affect marine protected species including sea turtles, that inhabit or transit through areas where launch and reentry operations occur. These operations often involve the deployment of weather balloons, vessel and aircraft surveillance, and expending or landing a vehicle or component of the vehicle (parachutes, fairings) in the ocean, which can affect sea turtles, their prey, and their habitat.

The programmatic letter of concurrence for launch and reentry vehicle operations in the marine environment (OPR-2021-02908) sets maximum annual limits on commercial space operations in the Gulf of America, Gulf of Mexico (non-U.S. waters), Atlantic Ocean, and Pacific Ocean. FAA, NASA, and USSF requested reinitiation on their program on July 29, 2025. NMFS is reviewing the action agencies' proposed updates to the program, including expansion of the action area, inclusion of all vehicles, launch sites, and operations, and increase of the maximum annual limits in the Atlantic and Pacific oceans. Currently, the maximum annual limits set in OPR-2021-02908 and subsequent amendments are as follows:

Table 16. Commercial space programmatic current maximum annual limits

Type of Operation	Maximum Number of Annual Operations
Atlantic Ocean	
Launches involving stages and fairings that are expended in the ocean	30
Launches involving attempted recovery of stages and fairings in the ocean	70
Spacecraft reentry and landing in the ocean	10
Launch abort test	1
Pacific Ocean	
Launches involving stages and fairings that are expended in the ocean	30
Launches involving attempted recovery of stages and fairings in the ocean	20
Spacecraft reentry and landing in the ocean	11
Gulf of America and Gulf of Mexico	
Launches involving stages and fairings that are expended in the ocean	5
Launches involving attempted recovery of stages and fairings in the ocean	5
Spacecraft reentry and landing in the ocean	10

The action agencies' proposed updates to this program include increasing maximum annual operations in the Atlantic: launches involving stages and fairings that are expended in the ocean from 30 to 270, and launches involving attempted recovery of stages and fairings in the ocean from 70 to 186; and in the Pacific: launches involving stages and fairings that are expended in the ocean from 30 to 168, and launches involving attempted recovery of stages and fairings in the ocean from 20 to 100. The action agencies also propose to set a maximum annual limit of 37 for launches involving attempted recovery of stages but the fairings are expended in the ocean.

5.16 Impact of the Baseline on ESA-Listed Species

Collectively, the environmental baseline described above has had, and likely continues to have, lasting impacts on the ESA-listed species considered in this consultation. Some of these stressors result in mortality or serious injury to individual animals (e.g., vessel strikes), whereas others result in more indirect (e.g., fishing that affects prey availability) or non-lethal (e.g., invasive species) impacts.

Assessing the aggregate impacts of these stressors on the species considered in this consultation is difficult. This difficulty is compounded by the fact that the sea turtle species in this consultation are wide-ranging and subject to stressors in locations throughout and outside the action area.

We consider the best indicator of the aggregate impact of the environmental baseline section on ESA-listed green, Kemp's ridley, and loggerhead turtles to be the status and trends of those species. As noted in Section 4.2, some of the species considered in this consultation are experiencing increases in population abundance, some are declining, and, for others, their status remains unknown. Taken together, this indicates that the environmental baseline is affecting species in different ways. The species experiencing increasing population abundances are doing so despite the potential negative impacts of the environmental baseline. Therefore, while the environmental baseline may slow their recovery, recovery is not prevented. For the species that may be declining in abundance, it is possible the suite of conditions described in the environmental baseline section is preventing their recovery. However, it is also possible their populations are at such low levels (e.g., due to historical harvesting) that, even when the species' primary threats are removed, the species may not be able to achieve recovery. At small population sizes, species may experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their limited population size to become a threat in and of itself.

5.17 Conservation and Recovery Actions

NMFS has implemented a series of regulations aimed at reducing the potential for incidental mortality of sea turtles from commercial fisheries in the action area. These include sea turtle release gear requirements for the Atlantic HMS, South Atlantic snapper-grouper, and Gulf reef fish fisheries, and TED requirements for the Southeast shrimp trawl fishery. In addition to regulations, outreach programs have been established and data on sea turtle interactions with recreational fisheries has been collected through the Marine Recreational Information Program. These measures are summarized below.

5.17.1 Federal Actions

To advance the conservation and recovery of ESA-listed sea turtles, each sea turtle recovery plan, developed jointly by NMFS and the USFWS, identifies and highlights the need to maintain an active stranding network. As a result, the Sea Turtle Stranding and Salvage Network (the Network) was formally established by NMFS in 1980 to document stranding of sea turtles along the coastal areas from Maine to Texas and in portions of the U.S. Caribbean. The Network is a cooperative effort comprised of federal, state, and permitted private partners working to inform causes of morbidity and mortality in sea turtles by responding to and documenting sea turtles, found either dead or alive (but compromised), in a manner sufficient to inform conservation management and recovery.

NMFS also formally established the Southeast Atlantic Coast Sea Turtle Disentanglement Network (STDN), an important component of the National Sea Turtle Stranding and Salvage Network. The STDN works to reduce serious injuries and mortalities caused by entanglements and is active throughout the action area responding to reports of entanglements. Where possible, sea turtles are disentangled and may be brought to rehabilitation facilities for treatment and recovery, helping to reduce death from entanglement.

Reducing Threats from Pelagic Longline and Other Hook-and-Line Fisheries

On July 6, 2004, NMFS published a Final Rule to implement management measures to reduce bycatch and bycatch mortality of Atlantic sea turtles in the Atlantic pelagic longline fishery (69 FR 40734). The management measures include mandatory circle hook and bait requirements, and mandatory possession and use of sea turtle release equipment to reduce bycatch mortality.

NMFS published the Final Rule to implement sea turtle release gear requirements and sea turtle careful release protocols in the Gulf reef fish (August 9, 2006;(71 FR 45428) and South Atlantic snapper-grouper fisheries (November 8, 2011; Lopez-Pujol and Ren 2009). These measures require owners and operators of vessels with federal commercial or charter vessel/headboat permits for Gulf reef fish and South Atlantic snapper-grouper to comply with sea turtle release protocols and have specific sea turtle release gear aboard vessels.

Revised Use of Turtle Excluder Devices in Trawl Fisheries

NMFS has also implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries. In particular, NMFS has required the use of TEDs in southeast U.S. shrimp trawls since 1989, and in summer flounder trawls in the mid-Atlantic area (south of Cape Charles, Virginia) since 1992. It is estimated that TEDs exclude 97% of the sea turtles caught in such trawls. The regulations have been refined over the years to ensure that TED effectiveness is maximized through more widespread use, and proper placement, installation, configuration (e.g., width of bar spacing), and floatation. The NMFS continues to work towards development of new, more effective gear specific to fishery needs.

Placement of Fisheries Observers to Monitor Sea Turtle Captures

On August 3, 2007, NMFS published a Final Rule that required selected fishing vessels to carry observers on board to collect data on sea turtle interactions with fishing operations, to evaluate existing measures to reduce sea turtle captures, and to determine whether additional measures to address prohibited sea turtle captures may be necessary (72 FR 43176). This Rule also extended the number of days NMFS observers could be placed aboard vessels, from 30 to 180 days, in response to a determination by the Assistant Administrator that the unauthorized take of sea turtles may be likely to jeopardize their continued existence under existing regulations.

5.17.2 State Actions

Under section 6 of the ESA, state agencies may voluntarily enter into cooperative research and conservation agreements with NMFS to assist in recovery actions of listed species. NMFS currently has an agreement with all states along the Gulf of America and Atlantic Ocean in the action area. Prior to issuance of these agreements, the proposals were reviewed for compliance with section 7 of the ESA.

5.17.3 Other Conservation Efforts

Sea Turtle Handling and Resuscitation Techniques

NMFS published a Final Rule (66 FR 67495) detailing handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Persons participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the Final Rule. These measures help to prevent mortality of hardshell turtles (such as ESA-listed sea turtles) caught in fishing or scientific research gear.

Outreach and Education, Sea Turtle Entanglement, and Rehabilitation

A Final Rule (70 FR 42508), published on July 25, 2005, allows any agent or employee of NMFS, the USFWS, the USCG, or any other federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment, if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for scientific or educational purposes. NMFS already affords the same protection to sea turtles listed as threatened under the ESA (50 CFR §223.206(b)).

NMFS has also been active in public outreach efforts to educate fishers regarding sea turtle handling and resuscitation techniques. As well as making this information widely available to all fishers, NMFS recently conducted a number of workshops with Atlantic HMS pelagic longline fishers to discuss bycatch issues including protected species, and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts and hopes to reach all fishers participating in the Atlantic HMS pelagic longline fishery.

Recovery Plans and Reviews

The Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle Second Revision was completed in 2008 (NMFS 2008b). The recovery plan for the U.S. Atlantic population of green turtles was published in 1991 (NMFS and USFWS 1991), and the Final Bi-National (U.S. and Mexico) Revised Recovery Plan for Kemp's ridley turtles was published 2011 (NMFS et al. 2011b). Recovery teams comprised of sea turtle experts that were convened and are currently working towards revising these plans based upon the latest and best available science. Five-year status reviews were completed in 2015 for green (Seminoff et al. 2015) and Kemp's ridley turtles (NMFS and USFWS 2015c). The five-year status review of the Northwest Atlantic Ocean DPS of loggerhead turtle status was conducted in 2023 (NMFS and USFWS 2023). These reviews comply with the ESA mandate for periodic status evaluation of listed species to ensure that their threatened or endangered listing status remains accurate.

6. ANALYSIS OF EFFECTS

The ESA section 7 regulations (50 CFR §402.02) define *effects of the action* as "all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.” To understand the effects of the action to listed species and critical habitats, we employ a stressor-exposure-response analysis. The stressors resulting from this action were identified in Section 2.4 and the only stressor determined to be LAA is the underwater acoustic effects from explosive events in the Gulf and Atlantic Ocean portions of the action area. The following analysis separately assesses the exposure of listed sea turtles and then critical habitat, followed by separate assessments of the responses of listed species and critical habitat to that exposure. To conclude this section, we summarize the combination of exposure and response for each species and each critical habitat.

6.1 Exposure

In this section, we consider the exposure to the various stressors that could cause an effect to ESA-listed species and designated critical habitat that are likely to co-occur with the action's modifications to the environment in space and time, and identify the nature of that co-occurrence. We describe the timing and location of the stressors to identify the populations, life stages, or sexes of each listed species likely to be exposed. We then determine to which populations those exposed individuals belong. Similarly, we describe the location, duration, and frequency of those stressors to understand the alterations to the conservation value of designated critical habitat. We also describe the duration, frequency, and intensity of stressors to quantify the number or extent of exposures that are reasonably certain to occur.

6.1.1 ESA-Listed Sea Turtle Exposure

The ESA-listed sea turtles likely to be adversely affected by underwater acoustic effects from explosive events in the Gulf and Atlantic Ocean portions of the action area are the North Atlantic DPS of green turtle, Kemp’s ridley turtle, and Northwest Atlantic Ocean DPS of loggerhead turtle. As discussed in Section 4.2, these species’ hearing ranges encompass the frequencies from an explosive event. To estimate the number of sea turtles exposed to underwater sound from the explosive events, FAA adopted SpaceX’s methodology summarized in Sections 4.1.2.1 and 4.1.2.2. Sea turtle densities were obtained from Garrison et al. (2023b) for the Gulf portion of the action area and DiMatteo et al. (2024b) for the Atlantic Ocean portion of the action area. NMFS acoustic thresholds for sea turtles corresponding to different levels of hearing threshold shifts (226 and 232 dB re 1µPa, respectively) were applied to estimate the ensonified areas, and the number of individuals of each species exposed to and potentially responding to the underwater sound from a maximum of 20 Super Heavy and 20 Starship explosions in each portion of the action area (Table 16 and Table 17). We note that the U.S. Navy has developed updated thresholds for sea turtles (U.S. Department of the Navy 2024). The U.S. Navy’s updated thresholds for sea turtles are extrapolated from Salas et al. (2023), Salas et al. (2024a), and Salas et al. (2024b), all of which observed hearing shifts in response to noise in freshwater turtles (see below). While Salas et al. (2023), Salas et al. (2024a), and Salas et al. (2024b) represent the best available information on hearing shift in freshwater turtles, at the time of this consultation, NMFS has not adopted the U.S. Navy’s sea turtle thresholds for non-Navy actions. Table 18 summarizes the total number of individuals exposed to underwater acoustic effects from

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explosive events by species. Note that estimated exposures may not match the exact product of the density and ensonified area due to rounding.

Table 17. Exposure estimates for ESA-listed sea turtles in the Gulf portion of the action area for up to 20 Super Heavy and 20 Starship explosive events

Species	Threshold (dB re 1µPa)*	Super Heavy Ensonified Area (km^2)	Starship Ensonified Area (km^2)	Maximum Monthly Mean Density (individuals per km^2)	Exposure for 20 Super Heavy Explosive Events	Exposure for 20 Starship Explosive Events
Kemp's Ridley Turtle	226	0.093	0.046	0.753	1.4067	0.6973
	232	0.024	0.012	0.753	0.3539	0.1747
Loggerhead Turtle – Northwest Atlantic Ocean DPS	226	0.093	0.046	0.8336	1.5572	0.7720
	232	0.024	0.012	0.8336	0.3918	0.1934

* Note SPL_{peak} thresholds are used
dB re 1µPa = decibels referenced to a pressure of one microPascal; km^2 = square kilometers

Table 18. Exposure estimates for ESA-listed sea turtles in the Atlantic Ocean portion of the action area for up to 20 Super Heavy and 20 Starship explosive events

Species	Threshold (dB re 1µPa)*	Super Heavy Ensonified Area (km^2)	Starship Ensonified Area (km^2)	Maximum Monthly Mean Density (individuals per km^2)	Exposure for 20 Super Heavy Explosive Events	Exposure for 20 Starship Explosive Events
Green Turtle – North Atlantic DPS	226	0.093	0.046	0.05322	0.0994	0.0493
Loggerhead Turtle – Northwest Atlantic Ocean DPS	226	0.093	0.046	0.30404	0.5680	0.2815
	232	0.024	0.012	0.30404	0.1429	0.0705

* Note SPL_{peak} thresholds are used
dB re 1µPa = decibels referenced to a pressure of one microPascal; km^2 = square kilometers

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Table 19. Total number of individuals exposed to underwater acoustic effects from explosive events in the Gulf and Atlantic Ocean portions of the action area

Species	Threshold (dB re 1μPa)*	Exposure for 20 Super Heavy Explosive Events	Exposure for 20 Starship Explosive Events	Total Estimated Individuals Exposed	Total Individuals Exposed
Green Turtle – North Atlantic DPS	226	0.0994	0.0493	0.15	1
Kemp's Ridley Turtle	226	1.4067	0.6973	2.10	3
	232	0.3539	0.1747	0.53	1
Loggerhead Turtle – Northwest Atlantic Ocean DPS	226	2.125	1.053	3.18	4
	232	0.535	0.264	0.8	1

* Note SPL_{peak} thresholds are used
dB re 1μPa = decibels referenced to a pressure of one microPascal

Green, Kemp's ridley, and loggerhead hatchlings, juveniles, and adults of either sex are likely to be exposed during the explosive events. Given that up to 40 explosive events (20 Super Heavy and 20 Starship) could occur at any time of year for the duration of the proposed action, we expect that animals will be foraging, mating, nesting, hatching, or transiting in the Gulf and Atlantic Ocean portions of the action area.

North Atlantic DPS Green Turtle – The estimated exposure is one individual in the Atlantic Ocean portion of the action area. While there are no abundance estimates for the entire population, DiMatteo et al. (2024a) modeled survey data to estimate a mean annual in-water abundance of juvenile and adult green turtles along the U.S. Atlantic Coast of 63,674 individuals (90% CI = 23,381–117,610 individuals). Given this population estimate, the estimated exposure of one individual is approximately 0.00002% of the population.

Kemp's Ridley Turtle – The estimated exposure is four individuals in the Gulf portion of the action area. While there are no abundance estimates for the entire population, DiMatteo et al. (2024a) modeled survey data to estimate a mean annual in-water abundance of juvenile and adult Kemp's ridley turtles along the U.S. Atlantic Coast of 10,762 individuals (90% CI = 2,620–19,443 individuals). Given this population estimate, the estimated exposure of four individuals is approximately 0.0004% of the population. This estimate is likely higher than the actual exposures because the population abundance estimate does not include turtles smaller than 16 in (40 cm) or turtles from the population's entire range.

Northwest Atlantic Ocean DPS Loggerhead Turtle – The estimated exposure of the population is five individuals in the Gulf and Atlantic Ocean portions of the action area. While there are no abundance estimates for the entire population, DiMatteo et al. (2024a) modeled survey data to estimate a mean annual in-water abundance of juvenile and adult loggerheads along the U.S. Atlantic Coast of 193,423 individuals (90% CI = 159,158–227,668 individuals). Based on this population estimate, the estimated exposure of five individuals is approximately 0.00003% of the population. This estimate is likely higher than the actual exposures because the population abundance estimate does not include turtles smaller than 16 in (40 cm) or turtles from the population's entire range.

6.1.2 Designated Critical Habitat Exposure

The designated critical habitat that is likely to be adversely affected by the proposed action is the breeding habitat of the Northwest Atlantic Ocean DPS of loggerhead turtle. NMFS designated two units of breeding habitat: (1) within the Southern Florida migration corridor from the shore out to the 656 ft (200 m) depth contour along the stretch of the corridor between the Marquesas Keys and the Martin County/Palm Beach County line, and (2) in nearshore waters just south of Cape Canaveral, Florida.

Only breeding habitat around Cape Canaveral, Florida overlaps with the Atlantic Ocean portion of the action area where there will be explosive events.

6.2 Response

Given the potential for exposure to stressors associated with the explosive events discussed above, in this section, we describe the range of responses ESA-listed species and the PBFs of critical habitat may display because of exposure to those stressors from explosive events. Our assessment considers the potential lethal, sub-lethal (or physiological), or behavioral responses that might reduce the fitness of individuals. We address the expected range of responses because of the types of exposure of the PBFs of critical habitat. When addressing critical habitat, we consider impairments to the function of the PBFs, the amount of time it may take for those PBFs to return to their present function, the extent of the critical habitat that is likely to be affected by the action, and whether the remaining critical habitat is sufficient to support the conservation of ESA-listed species.

6.2.1 ESA-Listed Sea Turtle Responses

For species, we discuss responses in terms of physiological, physical, or behavioral effects to the species. These responses may rise to the level of *take* under the ESA. *Take* is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 U.S.C. §1532(19)).

Super Heavy and Starship explosive events transmit acoustic energy into the water, creating a wave of pressure that can affect ESA-listed green, Kemp's ridley, and loggerhead turtles considered in this opinion. Possible sea turtle responses include hearing threshold shifts, behavioral responses, physiological stress, and masking.

Hearing Loss and Threshold Shifts

Sea turtles are susceptible to noise-induced hearing loss, or noise-induced threshold shifts (i.e., a loss of hearing sensitivity), and auditory injury when exposed to high levels of sound within their limited hearing range (most sensitive from 100– 400 Hz and limited over 1 kHz). Types of noise-induced threshold shifts include temporary threshold shift (TTS) or a permanent threshold shift (PTS). TTS is a temporary, reversible increase in hearing threshold at a specified frequency or portion of an animal's hearing range above a previously established reference level. PTS is a permanent, irreversible increase in hearing threshold at a specified frequency of portion of an animal's hearing range above a previously established reference level. Sea turtles may also be susceptible to auditory injury, which is sometimes referred to as PTS. However, the term auditory injury acknowledges that auditory injury, such as the loss of cochlear neuron synapses or auditory neuropathy, may occur even if hearing thresholds return to previously established reference levels. In other words, auditory injury includes PTS, but can occur without resulting in PTS (U.S. Department of the Navy 2024). Auditory injury has not been directly observed in sea turtles; however, it has been observed in other animals such as mice and guinea pigs (Kujawa and Liberman 2006; Kujawa and Liberman 2009; Lin et al. 2011). We note that NMFS has not adopted the U.S. Navy's updated TTS and auditory injury thresholds for sea turtles (see Section 6.1.1). The following discussion summarizes the best available information on hearing shifts in sea turtles.

Although no studies have directly measured underwater TTS or auditory injury in ESA-listed sea turtles, recent studies examined underwater TTS in freshwater turtles using broadband sound (analogous to sound from an explosion). Salas et al. (2023) exposed red-eared sliders (*Trachemys scripta elegans*) to sound exposure levels (a measure of the acoustic energy of a sound over a specified time period) between 155–193 decibels referenced to a pressure of one microPascal-squared second (dB re 1 μPa^2-s), and auditory sensitivity was measured at 400 Hz using auditory evoked potential methods. The mean predicted TTS onset was 160 dB re 1 μPa^2-s. In another study using Eastern painted turtles (*Chrysemys picta picta*), Salas et al. (2024) reported similar results, with TTS onset occurring at 154 dB re 1 μPa^2 s at 600 Hz and 158 dB re 1 μPa^2 s at 400 Hz.

Explosions create a sound that is broadband in frequency, and includes low frequencies that overlap sea turtle hearing ranges (Hildebrand 2009b). Because a greater frequency band would be affected due to explosives, there is an increased chance that the hearing impairment will affect frequencies utilized by sea turtles for acoustic cues, such as the sound of waves, coastline noise, or the presence of a vessel or predator. However, sea turtles are not known to rely heavily on sound for life functions (Nelms et al. 2016; Popper et al. 2014b) and instead may rely primarily on senses other than hearing for interacting with their environment, such as vision (Narazaki et al. 2013) and magnetic orientation (Avens and Lohmann 2003; Putman et al. 2015). As such, the likelihood that the loss of hearing in a sea turtle would affect its fitness (i.e., survival or reproduction) is low when compared to marine mammals, which rely heavily on sound for basic life functions. Sea turtles may use acoustic cues such as waves crashing, wind, vessel, and/or predator noise to perceive the environment around them. If such cues increase survivorship (e.g., aid in avoiding predators, navigation), hearing loss may affect individual sea turtle fitness.

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TTS in sea turtles is expected to last for a few hours to days, depending on the severity. TTS can significantly disrupt a turtle's normal behavior patterns for the duration over which their hearing threshold is altered. However, given TTS is temporary and sea turtles are not known to rely heavily on acoustic cues, we do not anticipate that TTS exposure would result in long-term fitness impacts to individual turtles. PTS could permanently impair a sea turtle's ability to hear environmental cues, depending on the frequency of the cue and the frequencies affected by the hearing impairment. Given this, we anticipate that at least some sea turtles that experience PTS may have a reduction in fitness either through some slight decrease in survivorship (e.g., decreased ability to hear predators or hazards such as vessels) or reproduction (e.g., minor effects to the animal's navigation that may reduce mating opportunities).

Behavioral Responses

Any acoustic stimuli within sea turtle hearing ranges in the marine environment could elicit behavioral responses in sea turtles, including noise from explosive events. Based on a limited number of studies, sea turtle behavioral responses to impulsive sounds could consist of temporary avoidance, increased swim speed, startle response, dive response, changes in depth; or there may be no observable response (McCauley et al. 2000; O'Hara and Wilcox 1990; Kastelein et al. 2024; DeRuiter and Doukara 2012). There is no evidence to suggest that sea turtle behavioral responses to acoustic stressors would persist after the sound exposure.

Exposure to a single explosive event (which applies here because, although there could be up to 40 explosive events in each portion of the action area, explosive events will not happen in succession and are extremely unlikely to occur in the same location) will likely result in a short-term startle response. Sea turtles would presumably return to normal behaviors quickly after exposure to a single explosive event, assuming the exposure did not result in TTS or PTS. Significant behavioral responses that result in disruption of important life functions, such as reproduction, would not be likely with exposure to a single explosive event. Therefore, while a large number of sea turtles may experience a behavioral response from exposure to explosive events, the anticipated impacts on fitness and survival of these individuals are minor and short-term.

Super Heavy and Starship explosive events transmit acoustic energy into the water, creating a wave of pressure that can result in TTS or PTS in ESA-listed loggerhead turtles, including potentially reproductive males and females, which may affect reproduction. There may be up to 80 explosive events within the range of Northwest Atlantic Ocean DPS loggerhead turtle (20 Super Heavy explosive events and 20 Starship explosive events, in the Gulf and the Atlantic Ocean portions of the action area), which could result in TTS or PTS to five loggerhead turtles. In the area of Cape Canaveral, Florida, Ceriani et al. (2019) estimated an annual average number of loggerhead nests between 1989–2018 at 31,144 nests (range: 19,416–43,583 nests) and 27,819 nests (range: 16,646–39,140 nests) based on data from the Florida Statewide Nesting Beach Survey program and the Florida Index Nesting Beach Survey program, respectively. Should all five expected loggerhead exposures be turtles of reproductive age, we anticipate a short-term effect to reproduction on the part of individuals exposed to the sound from an explosive event if it occurs during breeding season.

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Physiological Stress

ESA-listed sea turtles that experience either TTS, PTS, or a significant behavioral response are also expected to experience a physiological stress response. A short, low-level stress response may be adaptive and beneficial for sea turtles in that it may result in sea turtles avoiding the stressor and minimizing their exposure. Whereas stress is an adaptive response that does not normally place an animal at risk, distress involves a chronic stress response resulting in a negative biological consequence to the individual. Stress responses from underwater acoustic effects of the explosive events are expected to be short-term in nature given that, in most cases, sea turtles would not experience repeated exposure to these stressors over a long period. As such, we do not anticipate stress responses would be chronic, involve distress, or have negative long-term impacts on any individual sea turtle's fitness.

Masking

Sea turtles likely use their hearing to detect broadband low-frequency sounds in their environment, so the potential for masking would be limited to sound exposures that have similar characteristics (i.e., frequency, duration, and amplitude). Continuous and near-continuous human-generated sounds that have a significant low-frequency component, are not brief, and are of sufficient received level (e.g., proximate vessel noise and high-duty cycle or continuous active sonar), are most likely to result in masking. Explosive events, even though they have low-frequency components, would have limited potential for masking because they are of short duration. Because sea turtles may rely primarily on senses other than hearing for interacting with their environment, any effect of masking may be mediated by reliance on other environmental inputs.

6.2.2 Critical Habitat Response – Northwest Atlantic Ocean DPS Loggerhead Turtle

Super Heavy and Starship explosive events transmit acoustic energy into the water, creating a wave of pressure that can affect the PBF for breeding critical habitat. Explosive events within the unit of breeding critical habitat that may be affected by the proposed action (Cape Canaveral, Florida), would affect the PBF of concentrating reproductive individuals. The sound levels during an explosive event would impair normal functions, such as breeding, at levels causing TTS or PTS, and cause behavioral responses such as startle responses, causing individuals to leave the area. Thus, the PBF for breeding habitat would be impaired because the habitat would, at least temporarily, not concentrate reproductive individuals.

6.3 Summary of Effects

In this section, we combine the exposure analysis and response analysis to produce estimates of the amount and extent of take anticipated because of the stressors caused by this action. This summary of the anticipated effects of the action considers all consequences caused by the action and its activities. The following subsections state the anticipated effects of the action for each species and designated critical habitat that will be adversely affected by the proposed action.

6.3.1 Green Turtle – North Atlantic DPS

We expect one North Atlantic DPS green turtle to be exposed to underwater sound from Super Heavy and Starship explosive events within the 226 dB re 1µPa ensonified area in the Atlantic Ocean portion of the action area and exhibit a response in the form of TTS or behavioral and physiological stress. This may affect North Atlantic DPS green turtles' normal behavioral patterns but is not expected to result in a long-term reduction in individual fitness or have population-level effects.

6.3.2 Kemp's Ridley Turtle

We expect up to three Kemp's ridley turtles to be exposed to underwater sound from Super Heavy and Starship explosive events within the 226 dB re 1µPa ensonified area in the Gulf portion of the action area and exhibit responses in the form of TTS or behavioral and physiological stress. We also expect one Kemp's ridley turtle to be exposed to underwater sound from Super Heavy and Starship explosive events within the 232 dB re 1µPa ensonified area in the Gulf portion of the action area and exhibit responses in the form of PTS.

TTS or behavioral and physiological stress may affect Kemp's ridley turtles' normal behavioral patterns but is not expected to result in a long-term reduction in individual fitness. PTS could permanently impair a sea turtle's hearing and result in a reduction in fitness through some decrease in survivorship or reproduction, but we do not expect population-level effects.

6.3.3 Loggerhead Turtle – Northwest Atlantic Ocean DPS

We expect up to four Northwest Atlantic Ocean DPS loggerhead turtles to be exposed to underwater sound from Super Heavy and Starship explosive events within the 226 dB re 1µPa ensonified area in the Gulf and Atlantic Ocean portions of the action area and exhibit responses in the form of TTS or behavioral and physiological stress. We also expect one Northwest Atlantic Ocean DPS loggerhead turtle to be exposed to underwater sound from Super Heavy and Starship explosive events within the 232 dB re 1µPa ensonified area in the Gulf and Atlantic Ocean portions of the action area and exhibit responses in the form of PTS.

TTS or behavioral and physiological stress may affect Northwest Atlantic Ocean DPS loggerhead turtles' normal behavior patterns but is not expected to result in a long-term reduction in individual fitness. PTS could permanently impair a sea turtle's hearing and result in a reduction in fitness through some decrease in survivorship or reproduction, but we do not expect population-level effects.

6.3.4 Critical Habitat – Northwest Atlantic Ocean DPS of Loggerhead Turtle

We examined underwater acoustic effects from explosive events on the designated breeding critical habitat for Northwest Atlantic Ocean DPS of loggerhead turtle. The PBF of breeding habitat that may be adversely affected is the suitability of the habitat to allow for high densities of reproductive male and female loggerheads. In our analysis of underwater acoustic effects from explosive events to breeding habitat, we determined sound levels would temporarily alter habitat conditions such that individuals would not be concentrated within the area with sound levels above sea turtle hearing thresholds, impairing critical habitat function for the designated breeding critical habitat unit for Northwest Atlantic Ocean DPS of loggerhead turtle.

7. CUMULATIVE EFFECTS

Cumulative effects are defined in regulations as "those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR §402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7(a)(2) of the ESA.

We assessed the action area of this consultation for any non-Federal activities that are reasonably certain to occur. The past and ongoing impact of existing actions was described in the environmental baseline (Section 5). During this consultation, we searched for information on future state, tribal, local, or private (non-Federal) actions reasonably certain to occur in the action area. We did not find any information about non-Federal actions other than the activities described in the environmental baseline.

An increase in non-Federal activities described in the environmental baseline (Section 5) could increase their effect on ESA-listed resources and, for some, a future increase is considered reasonably certain to occur. Given current trends in global population growth, threats associated with changing environmental trends, pollution, fisheries, bycatch, aquaculture, vessel strikes, and sound are likely to continue to increase in the future, although any increase in effects may be somewhat countered by an increase in conservation and management, should these occur.

8. INTEGRATION AND SYNTHESIS

This opinion includes a jeopardy analysis for the ESA-listed threatened and endangered species and a destruction of adverse modification analysis for designated critical habitat that are likely to be adversely affected by the action. Section 7(a)(2) of the ESA and its implementing regulations require every federal agency, in consultation with and with the assistance of the Secretary (16 U.S.C. §1532(15)), to insure that any action it authorizes, funds, or carries out, in whole or in part, in the United States or upon the high seas, is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The jeopardy analysis, therefore, relies upon the regulatory definitions of *jeopardize the continued existence of* and *destruction or adverse modification.*

Jeopardize the continued existence of 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). *Recovery*, used in that definition, means "improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act" (50 CFR §402.02).

Destruction or adverse modification means "a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR §402.02). *Conservation*, used in that definition, means "to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary" (16 U.S.C. §1532(3)).

The Integration and Synthesis is the final step in our jeopardy analyses. In this section, we add the effects of the action (Section 6) to the environmental baseline (Section 5) and the cumulative effects (Section 7), taking into account the status of the species and critical habitat (Section 4), to formulate the agency's biological opinion as to whether the action agency can insure its proposed action is not likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated critical habitat as a whole for the conservation of the species.

8.1 Jeopardy Analysis

The jeopardy analysis assesses the proposed action's effects on ESA-listed North Atlantic DPS green, Kemp's ridley, and Northwest Atlantic Ocean DPS loggerhead turtle survival and recovery. The following sections summarize the relevant information in this opinion for each individual species considered.

8.1.1 Green Turtle – North Atlantic DPS

The North Atlantic DPS is the largest of the 11 green turtle DPSs, with an estimated nester abundance of over 167,000 adult females from 73 nesting sites (Seminoff et al. 2015). Florida accounts for approximately 5% of nesting for this DPS. According to data collected from Florida's index nesting beach survey from 1989–2024, green turtle nest counts across Florida have increased from a low of 267 in the early 1990s to a high of 40,911 in 2019. Nesting decreased by half from 2019–2020, although it increased to a new record high in 2023 before dropping substantially in 2024. Similar fluctuations were observed at Tortuguero, Costa Rica, which is the predominant nesting site, accounting for an estimated 79% of nesting for the DPS (Seminoff et al. 2015). Current nesting levels at Tortuguero, Costa Rica have reverted to that of the mid-1990s and the overall long-term trend has now become negative (Restrepo et al. 2023). Green turtles generally follow a two-year reproductive cycle, which may explain fluctuating nest counts; however, threats that have affected nesting in the Tortuguero region may ultimately influence the trajectories of nesting in the Florida region. DiMatteo et al. (2024) modeled survey data to estimate a mean annual in-water abundance of juvenile and adult green turtles along the U.S. Atlantic Coast of 63,674 individuals (90% CI = 23,381–117,610 individuals). We are not aware of any current range-wide in-water estimates for the DPS.

North Atlantic DPS green turtles will experience TTS or behavioral and physiological stress responses throughout the Atlantic Ocean portion of the action area from Super Heavy and Starship explosive events. We anticipate one instance of TTS or behavioral and physiological

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stress is reasonably certain to occur over 40 total explosive events in the Atlantic Ocean portion of the action area.

As discussed in Section 6.2.1, TTS and behavioral and physiological stress is temporary and sea turtles do not rely heavily on acoustic cues. As such, we do not anticipate that TTS or behavioral and physiological stress exposure would result in a reduction in numbers and will not have a measurable impact on the reproduction of the species. The anticipated effects leading to TTS or behavioral and physiological stress in one individual will not affect the distribution of this species. Therefore, one TTS or behavioral and physiological stress exposure will not have measurable impacts to the population to which that individual belongs and the effects of the stressors resulting from explosive events as part of the proposed action will not affect the survival of North Atlantic DPS green turtles in the wild.

The 1991 Recovery Plan for the U.S. Atlantic population of green turtles identified the major actions needed to recover this DPS (NMFS and USFWS 1991). Demographic criteria for delisting the species includes a level of nesting in Florida that has increased to an average of 5,000 nests per year for at least six years. There are no recovery actions that are directly relevant to the proposed action, although the recovery plan acknowledges that explosives can affect green turtles and cause negative impacts including, but not limited to, injury and mortality. While we anticipate North Atlantic DPS green turtles will be harassed by underwater sound during explosive events, this will not impede the potential for recovery of North Atlantic DPS green turtles. Therefore, the effects of the stressors resulting from explosive events as part of the proposed action will not appreciably diminish the ability of green turtles to recover in the wild.

In summary, based on the evidence available, including the status of the species, environmental baseline, analysis of effects, and cumulative effects, we determine that the proposed action would not appreciably reduce the likelihood of both survival and recovery of North Atlantic DPS green sea turtles in the wild.

8.1.2 Kemp's Ridley Turtle

The Kemp's ridley turtle has declined to the lowest population level of all sea turtle species in the world. Nesting aggregations at a single location (Rancho Nuevo, Mexico), which were estimated at 40,000 females in 1947, declined to an estimated 300 females by the mid-1980s. From 1980 through 2003, largely due to conservation efforts, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico increased 15% annually (Heppell et al. 2005b). By 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from these three primary nesting beaches. Because females lay approximately 2.5 nests each season they nest, 10,987 nests represents 4,395 females nesting in a season at these primary nesting sites. Increases in nest counts have also been documented over the past two decades at nesting beaches in Texas (NMFS and USFWS 2015a). DiMatteo et al. (2024a) modeled survey data to estimate a mean annual in-water abundance of juvenile and adult Kemp's ridley turtles along the U.S. Atlantic Coast of 10,762 individuals (90% CI = 2,620–19,443 individuals).

Kemp's ridley turtles will experience TTS, PTS, and behavioral and physiological stress responses throughout the Gulf portion of the action area from Super Heavy and Starship explosive events. We anticipate three instances of TTS or behavioral and physiological stress, and one instance of PTS are reasonably certain to occur over the 40 total anticipated explosive events in the Gulf portion of the action area.

As discussed in Section 6.2.1, PTS could decrease an individual sea turtle's ability to detect danger such as approaching vessels or predators, and may reduce foraging or breeding opportunities or increase risks of sustaining other harm. Therefore, PTS could result in mortality or injury of one individual, leading to a slight reduction in numbers. This reduction in numbers, as well as the effects of TTS or behavioral and physiological stress responses in three other individuals, will not have a measurable impact on the reproduction of the species. The anticipated effects leading to TTS or behavioral and physiological stress in three individuals and PTS in one individual will not affect the distribution of this species.

Therefore, the minor reduction in numbers and associated reduction in reproduction, along with the lack of impacts to the distribution of the species will not have measurable impacts to the populations to which these individuals belong. Thus, the effects of the stressors resulting from explosive events as part of the proposed action will not affect the survival of Kemp's ridley turtles in the wild.

The 2011 Bi-National Revised Recovery Plan for the Kemp's Ridley Sea Turtle identified the major actions needed to recover this species (NMFS et al. 2011c). Relevant to the proposed action, this includes reducing impacts from explosives. Demographic recovery criteria for downlisting the species include the following: 1) a population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico; and 2) recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches. Demographic recovery criteria for delisting the species include the following: 1) an average population of at least 40,000 nesting females per season (as measured by clutch frequency per female per season and annual nest counts) over a six-year period distributed among nesting beaches in Mexico and the U.S.; and 2) ensure average annual recruitment of hatchlings over a six-year period from *in situ* nests and beach corrals is sufficient to maintain a population of at least 40,000 nesting females per nesting season distributed among nesting beaches in Mexico and the U.S. into the future. While we anticipate Kemp's ridley turtles will be adversely affected by underwater sound from explosive events, this will not impede the recovery objectives for Kemp's ridley turtles. Therefore, the effects of the stressors resulting from explosive events as part of the proposed action will not appreciably diminish the ability of Kemp's ridley turtles to recover in the wild.

In summary, based on the evidence available, including the status of the species, environmental baseline, analysis of effects, and cumulative effects, we determine that the proposed action would not appreciably reduce the likelihood of both survival and recovery of Kemp's ridley sea turtles in the wild.

8.1.3 Loggerhead Turtle – Northwest Atlantic Ocean DPS

The total number of annual U.S. nest counts for the Northwest Atlantic DPS of loggerhead turtles from Texas through Virginia and Quintana Roo, Mexico, is over 110,000 (NMFS and USFWS 2023b). NMFS's NEFSC and SEFSC estimated the abundance of juvenile and adult loggerhead turtles along the continental shelf between Cape Canaveral, Florida and the mouth of the Gulf of St. Lawrence, Canada, at 588,000 individuals (NMFS 2011c). An aerial survey over the southern portion of the Mid-Atlantic Bight and Chesapeake Bay in 2011 and 2012, estimated an abundance ranging from 27,508–3,005 loggerheads (NMFS and USFWS 2023b). Ceriani et al. (2019) estimated the total number of adult females nesting in Florida to be 51,319, based on nest count data from 2014–2018. The annual rate of nesting females increased 1.3% from 1983–2019 for the Northern Recovery Unit (i.e., loggerheads nesting in Georgia, North Carolina, South Carolina, and Virginia; Bolten et al. 2019; NMFS and USFWS 2023a). There is no significant trend in the annual number of nesting females in either the Peninsular Florida (1989–2018) or Northern Gulf of Mexico (1997–2018) recovery units over the last several decades (NMFS and USFWS 2023a). Overall, the latest 5-year status review concluded that the Northwest Atlantic DPS is stable (NMFS and USFWS 2023a). DiMatteo et al. (2024a) modeled survey data to estimate a mean annual in-water abundance of juvenile and adult loggerheads along the U.S. Atlantic Coast of 193,423 individuals (90% CI = 159,158–227,668 individuals). We are not aware of any current range-wide in-water estimates for the DPS.

Northwest Atlantic Ocean DPS loggerhead turtles are expected to experience TTS, PTS, and behavioral and physiological stress responses throughout the Gulf and Atlantic Ocean portions of the action area from Super Heavy and Starship explosive events. We anticipate four instances of TTS or behavioral and physiological stress, and one instance of PTS are reasonably certain to occur over 80 total explosive events across the Gulf and Atlantic Ocean portions of the action area.

As discussed in Section 6.2.1, PTS could decrease an individual sea turtle's ability to detect danger such as approaching vessels or predators; and may reduce foraging or breeding opportunities or increase risks of sustaining other harm. Therefore, PTS could result in mortality or injury of one individual, leading to a slight reduction in numbers. This reduction in numbers, as well as the effects of TTS or behavioral and physiological stress responses in four other individuals, will not have a measurable impact on the reproduction of the species. The anticipated effects leading to TTS or behavioral and physiological stress in four individuals and PTS in one individual will not affect the distribution of this species.

Therefore, the minor reduction in numbers and associated reduction in reproduction, along with the lack of impacts to the distribution of the species will not have measurable impacts to the populations to which these individuals belong. Thus, the effects of the stressors resulting from explosive events as part of the proposed action will not affect the survival of Northwest Atlantic Ocean DPS loggerhead turtles in the wild.

The 2009 Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle identified the major actions needed to recover this DPS (NMFS and USFWS 2008b). There are no recovery actions that are directly relevant to the proposed action, although the recovery plan acknowledges that explosives can affect loggerheads and cause negative impacts including, but not limited to, injury and mortality. Demographic recovery criteria include the following statistically significant minimum levels of increase in the annual number of loggerhead nests over 50 years for each recovery unit: 1) Northern Recovery Unit: 2% (minimum of 14,000 nests); 2) Peninsular Florida Recovery Unit: 1% (minimum of 106,100 nests); 3) Dry Tortugas Recovery Unit: 3% (minimum of 1,100 nests); and 4) Northern Gulf of Mexico Recovery Unit: 3% (minimum of 4,000 nests). While we do anticipate Northwest Atlantic Ocean DPS loggerhead turtles will be adversely affected by exposure to underwater sound from explosive events, this will not impede recovery of Northwest Atlantic Ocean DPS loggerhead turtles. Therefore, the effects of the stressors resulting from explosive events as part of the proposed action will not appreciably diminish the ability of loggerhead turtles to recover in the wild.

In summary, based on the evidence available, including the status of the species, environmental baseline, analysis of effects, and cumulative effects, we determine that the proposed action would not appreciably reduce the likelihood of both survival and recovery of Northwest Atlantic Ocean DPS loggerhead turtles in the wild.

8.2 Destruction/Adverse Modification Analysis

Recovery of the Northwest Atlantic Ocean DPS of loggerhead turtle cannot occur without protecting the PBF that supports breeding critical habitat. Super Heavy and Starship explosive events will adversely affect Northwest Atlantic Ocean DPS loggerhead turtle critical habitat. Thus, our destruction or adverse modification analysis determines whether or not the proposed action is likely to appreciably diminish the value of critical habitat as a whole for the conservation of a listed species, in the context of the status of the critical habitat (Section 4), effects of the action (Section 6), the environmental baseline (Section 5), and cumulative effects (Section 7).

The PBF for breeding critical habitat considered in this consultation is high densities of reproductive male and female loggerhead turtles. Our effects analysis determined that explosive events are likely to adversely affect the PBF because underwater sound from explosive events will, at least temporarily, diminish habitat quality because individuals will not concentrate in areas where sound levels are sufficient to cause PTS, TTS, or behavioral and physiological stress responses. Because explosive events will not be continuous or regular in a particular portion of the breeding critical habitat unit, stressors from these explosive events will not appreciably diminish the conservation value of critical habitat as a whole. We determine that the proposed action would not result in the destruction or adverse modification of critical habitat for the Northwest Atlantic Ocean DPS of loggerhead turtle.

9. Conclusion

After reviewing and analyzing the current status of the listed species, the environmental baseline within the action area, the consequences of the proposed action and associated activities, and the cumulative effects, it is NMFS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the North Atlantic DPS of green turtle, Kemp's ridley turtle, or Northwest Atlantic Ocean DPS of loggerhead turtle, or destroy or adversely modify designated critical habitat for the Northwest Atlantic Ocean DPS of loggerhead turtle.

NMFS also determined the proposed action may affect, but is not likely to adversely affect: blue whale, false killer whale – Main Hawaiian Islands Insular DPS, fin whale, gray whale – Western North Pacific DPS, humpback whale – Mexico DPS and Central America DPS, North Atlantic right whale, North Pacific right whale, sei whale, sperm whale, Rice's whale, Guadalupe fur seal, Hawaiian monk seal; green turtle – North Atlantic DPS, South Atlantic DPS, East Pacific DPS, Central North Pacific DPS, East Indian-West Pacific DPS, North Indian DPS, and Southwest Indian DPS, hawksbill turtle, leatherback turtle, loggerhead turtle – North Pacific Ocean DPS, South Pacific Ocean DPS, North Indian Ocean DPS, Southwest Indian Ocean DPS, and Southeast Indo-Pacific Ocean DPS, and olive ridley turtle – Mexico's Pacific Coast breeding colonies and all other areas/not Mexico's Pacific Coast breeding colonies; Atlantic sturgeon – Carolina DPS, Chesapeake Bay DPS, and South Atlantic DPS, giant manta ray, Gulf sturgeon, Nassau grouper, oceanic whitetip shark, scalloped hammerhead shark – Central and Southwest Atlantic DPS, Eastern Pacific DPS, and Indo-West Pacific DPS, shortnose sturgeon, smalltooth sawfish – U.S. portion of range DPS, steelhead trout – South-Central California Coast DPS and Southern California DPS, black abalone, boulder star coral, elkhorn coral, lobed star coral, mountainous star coral, pillar coral, rough cactus coral, staghorn coral, white abalone, and proposed sunflower sea star and designated critical habitat of the Main Hawaiian Islands Insular DPS of false killer whale, Central America DPS and Mexico DPS of humpback whale, Hawaiian monk seal, North Atlantic right whale, hawksbill turtle, leatherback turtle, North Atlantic DPS of green turtle, Northwest Atlantic Ocean DPS of loggerhead turtle, Carolina DPS and South Atlantic DPS of Atlantic sturgeon, Gulf sturgeon, Nassau grouper, black abalone, boulder star coral, elkhorn coral, lobed star coral, mountainous star coral, pillar coral, rough cactus coral, staghorn coral, and proposed critical habitat of the Central North Pacific DPS, East Pacific DPS, North Atlantic DPS, and South Atlantic DPS of green turtle and Rice's whale.

10. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR §402.02). Section 7(b)(4) and section 7(o)(2) of the ESA, as well as in regulation at 50 CFR §402.14(i)(5) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

10.1 Amount or Extent of Take

In the opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

Table 20. Anticipated number and type of ESA takes of sea turtles for up to 20 Super Heavy explosive events

Species	TTS/ significant behavioral response	PTS
Green Turtle – North Atlantic DPS	1	–
Kemp's Ridley Turtle	3	1
Loggerhead Turtle – Northwest Atlantic Ocean DPS	4	1

10.2 Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the impact of incidental take on the species (50 CFR §402.02). These measures "cannot alter the basic design, location, scope, duration, or timing of the action and may involve only minor changes" (50 CFR §402.14(i)(2)). NMFS believes the following reasonable and prudent measures are necessary and appropriate:

1. The FAA shall continue to coordinate with NMFS to minimize effects to ESA-listed green, Kemp's ridley, and loggerhead turtles from explosive events.
2. The FAA shall monitor and report to NMFS's Office of Protected Resources ESA Interagency Cooperation Division on impacts to ESA-listed green, Kemp's ridley, and loggerhead turtles from explosive events at nmfs.hq.esa.consultations@noaa.gov with the subject line "OPR-2025-02468 – [Flight #] ITS Report."

10.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the FAA must comply (or must ensure that any applicant complies) with the following terms and conditions. The FAA or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR §402.14(i)(3)).

1. The following terms and conditions implement reasonable and prudent measure 1:
   a. The FAA shall continue to coordinate with NMFS to help inform future consultations on Starship-Super Heavy operations in the action area. Coordination should include provision and review of Starship-Super Heavy fate reports and annual reports, regular review of ESA section 7 reinitiation triggers (described in Section 12), and potential development of new measures to increase the effectiveness of mitigation and monitoring.

2. The following terms and conditions implement reasonable and prudent measure 2:
   a. The FAA shall monitor SpaceX and Starship-Super Heavy operations as licensed, and submit fate reports after each Starship-Super Heavy flight and annual reports to NMFS Office of Protected Resources ESA Interagency Cooperation Division.

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b. The FAA shall report any new information regarding the nature and extent of potential effects, and ranges to effects (e.g., ensonified areas), of explosive events on ESA-listed species.
c. The FAA shall report to the NMFS Office of Protected Resources ESA Interagency Cooperation Division all observed injury or mortality of any ESA-listed species resulting from the proposed action within the action area.
d. The FAA shall report to the NMFS Office of Protected Resources ESA Interagency Cooperation Division on impacts to ESA-listed green, Kemp's ridley, and loggerhead turtles from explosive events. The report should be submitted no more than 30 days after each flight prior to reusability. This may be submitted with the fate report.

11. CONSERVATION RECOMMENDATIONS

Conservation recommendations are "suggestions … regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information" (50 CFR §402.02).

The following conservation recommendations should be considered by the FAA to minimize or avoid effects to threatened and endangered species associated with this action:

1. We recommend FAA gather acoustic data (in-air and in-water) on Super Heavy and Starship landings (i.e., landing burns and impact with the ocean surface) and explosive events. Sound source verification will help to improve the accuracy of predictions of the underwater acoustic impacts of similar activities in the future.
2. During any nighttime vessel operations in any portion of the action area, we recommend vessel speeds do not exceed 10 kt to reduce the risk of lethal or injurious vessel strike. We also recommend that dedicated observers be equipped with nighttime visual equipment to identify protected species in the dark.
3. We recommend FAA monitor potential impacts to ESA-listed species and designated or proposed critical habitat from debris resulting from space launch and reentry activities. This includes immediate impacts (e.g., reentry debris fields, expended stages, launch vibration and heat/debris plumes), as well as potential long-term impacts from the accumulation of debris.
4. We recommend FAA monitor potential impacts to ESA-listed species and designated or proposed critical habitat from barge/floating platform landings (e.g., verification of overpressures, light pollution).
5. The FAA should coordinate with the NOAA Marine Debris Program (MDP) to determine how activities of the MDP may apply to space launch and reentry debris.
6. We recommend FAA utilize the Whale Alert app to report and identify where whale "safety zones" occur, so that vessel operators and observers can help reduce vessel strikes. For instance, recently, two North Atlantic right whales were observed off the Florida Gulf coast. NMFS did not declare a Dynamic Management Area because these whales were not observed off the U.S. East Coast; however, the endangered whales were reported on the Whale Alert app.
7. We recommend FAA analyze the underwater acoustic effects from vehicle landings (i.e., landing burn and impact with the ocean surface) and explosive events in shallow water,

should vehicle explosions occur there with greater frequency than is understood at the time of this consultation (see also Section 12), because sound propagates differently in shallow water compared to deep water.

8. We recommend FAA minimize the number of weather balloons released per launch and explore alternatives to the release of weather balloons, to reduce marine debris.

In order for NMFS Office of Protected Resources Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on ESA-listed species or their critical habitat, FAA should notify the Interagency Cooperation Division of any conservation recommendations implemented in the final action. Notice can be provided to nmfs.hq.esa.consultations@noaa.gov with the Environmental Consultation Organizer (ECO) number for this consultation (OPR-2025-02468) in the subject line.

12. REINITIATION OF CONSULTATION

This concludes formal consultation on FAA's proposed action to modify and issue a vehicle operator license authorizing SpaceX to conduct Starship-Super Heavy operations in the North Atlantic Ocean, Gulf of America, Gulf of Mexico (non-U.S. waters), North Pacific Ocean, South Pacific Ocean, and Indian Ocean. Consistent with 50 CFR §402.16(a), reinitiation of consultation is required and shall be requested by the Federal agency, where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and:

1. If the amount or extent of incidental taking specified in the ITS is exceeded;
2. If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
3. If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the opinion; or
4. If a new species is listed or critical habitat designated that may be affected by the identified action.

Examples of information that could change our effects analysis, or new information that will better inform our effects analysis, and may require reinitiation include, but are not limited to:

- Issuance of a new license or extension of the current license's expiration date;
- A new launch site is proposed to become operational;
- Information on trajectories (e.g., from a new launch site, or to a another landing area), which will inform where a potential mishap may occur;
- Data regarding the likelihood or the number of times a specific trajectory is/will be used, which will better inform the assumptions on where a mishap or landing may occur;
- Data regarding landing locations of each vehicle (e.g., locations and how many times a vehicle lands in the vicinity of those locations, how often a landing area will be used compared to other landing areas, the likelihood that a vehicle will land in specific areas [e.g., nearer to launch sites] more than other areas [e.g., further offshore]), which will better inform the assumption that there is an equal probability a landing occurs anywhere within a portion of the action area, and subsequently the species densities and estimated exposure;
- Information on the ports and routes used by surveillance/recovery vessels and floating platforms/ocean-going barges/drone ships;

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- Changes to the launch vehicle or flight plan that affect the performance of the launch vehicle or affect progress towards achieving a fully reusable vehicle, which will inform the likelihood of mishaps; and
- Potential impacts to listed species or critical habitat that occur after the vehicle has sunk (e.g., does propellant leak out at the seafloor or over time, how does the vehicle erode over time).

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