NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 BIOLOGICAL AND CONFERENCE OPINIONS

Action Agencies: Bureau of Ocean Energy Management

Activity Considered: Lease Issuance for Wind Resources Data Collection on the Outer Continental Shelf Offshore Georgia

Consultation Conducted By: Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service

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Date: MAR 11 2016

Public Consultation Tracking System (PCTS) number: FPR 2015-9128

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ACRONYMS AND ABBREVIATIONS

AF-annual nesting females

AN-annual nests

BOEM-Bureau of Ocean Energy Management

C-Celsius

CFR-Code of Federal Regulations

cm-centimeters

dB-decibel

DDE-dichlorodiphenyldichloroethylene

DDT-dichlorodiphenyltrichloroethane

DMA-dynamic management area

DPS-distinct population segment

EP-annual egg production

ESA-Endangered Species Act

FR-Federal Register

G&G-geological and geophysical

h-hours

HRG-high resolution geophysical

Hz-Hertz

ITS-Incidental take statement

kg-kilograms

kHz-kilohertz

km-kilometers

m-meters

ms-milliseconds

NAO-North Atlantic Oscillation

NMFS-National Marine Fisheries Service

NOAA-National Oceanic and Atmospheric Administration

OCS-Outer Continental Shelf

PCB-polychlorinated biphenyl

rms-root mean squared

SERDP SDSS-Strategic Environmental Research and Development Program spatial decision support system

TED-turtle excluder device

µPa-micropascals

US-United States

USFWS-United States Fish and Wildlife Service

1 INTRODUCTION

Section 7(a)(2) of the Endangered Species Act (ESA) requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. When a Federal agency's action "may affect" a protected species, that agency is required to consult formally with the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) or the United States Fish and Wildlife Service (USFWS), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 Code of Federal Regulations [CFR] §402.14(a)). Federal agencies are exempt from this general requirement if they have concluded that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS or the USFWS concurs with that conclusion (50 CFR §402.14(b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS and/or USFWS provide a biological opinion stating how the Federal agencies' actions affect ESA-listed species and their critical habitat under their jurisdiction. If incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and reasonable and prudent measures to minimize such impacts.

Section 7(a)(4) of the ESA requires that each Federal agency confer with NMFS on any agency action which is likely to jeopardize the continued existence of any species proposed for listing or likely to result in the destruction or adverse modification of critical habitat proposed for designation for such species. NMFS may request a conference if, after a review of available information, it determines that a conference is required for a particular action (50 CFR §402.10(b)). If requested by the Federal agency and deemed appropriate by NMFS, the conference may be conducted in accordance with the same procedures as a formal consultation (50 CFR §402.10(d)). A conference opinion may be adopted as a biological opinion when the species is listed or critical habitat is designated. An ITS provided with a conference opinion does not become effective unless NMFS adopts the conference opinion once the listing is final.

For the actions described in this document, the action agency is the Bureau of Ocean Energy Management (BOEM).

This biological and conference opinion (Opinion) and ITS were prepared by NMFS ESA Interagency Cooperation Division in accordance with Section 7(b) of the ESA and implementing regulations at 50 CFR §402. This document represents NMFS' Opinion on the effects of these actions on endangered and threatened species, species proposed to be listed as endangered or threatened species, and critical habitat that has been designated for those species. A complete record of this consultation is on file at NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

The Outer Continental Shelf Lands Act (OCSLA), as amended, mandates the Secretary of the Interior (Secretary), through BOEM, to manage the exploration and development of OCS oil, gas, and marine minerals (e.g., sand and gravel) and the siting of renewable energy facilities. The Energy Policy Act (EPAct) of 2005, Public Law (P.L.). 109-58, added Section 8(p)(1)(C) to the OCSLA, which grants the Secretary the authority to issue leases, easements, or rights-of-way on the OCS for the purpose of renewable energy development (43 U.S.C. § 1337(p)(1)(C)). The Secretary delegated this authority to BOEM (30 CFR 585). These regulations provide a framework for issuing leases, easements, and rights-of-way for OCS activities that support production and transmission of energy from sources other than oil and natural gas. The action of authorizing leases, easements, and right-of-ways by BOEM is a Federal action which requires consultation under the ESA. Below we summarize previous ESA Section 7 consultations with BOEM that are relevant to this consultation.

In March 2011, BOEM initiated informal consultation with NMFS for the issuance of leases, site assessment, and site characterization activities for New Jersey, Delaware, Maryland and Virginia, which is near but not immediately proximate to the proposed action area for this consultation. The consultation concluded on September 20, 2011, with a letter from NMFS concurring with the determination that the issuance of leases associated with site characterization and subsequent site assessment activities for siting of wind energy facilities may affect, but are not likely to adversely affect, any ESA-listed species under NMFS' jurisdiction.

On April 24, 2012, BOEM initiated informal consultation with NMFS for the issuance of a five-year lease, site assessment, site characterization and technology testing activities for OCS blocks 7003, 7053, and 7054 offshore of Florida in BOEM's South Atlantic OCS planning area. The consultation concluded on July 25, 2013, with NMFS concurring with the determination that the action may affect, but is not likely to adversely affect, any ESA-listed species under NMFS' jurisdiction. This action was near but not immediately adjacent to or in the proposed action area for this consultation.

On May 24, 2012, BOEM initiated formal consultation for G&G activities, including site characterization activities, for BOEM's program areas (oil and gas, marine minerals, and renewable energy) in the Mid- and South Atlantic OCS planning areas from 2013-2020. This included vessel traffic, buoy placement, HRG and seismic surveys. The assessment of the renewable energy program's geological and geophysical (G&G) survey activity produced some new modeled estimates of the areas ensonified to behavioral harassment and potentially injurious (although injury or mortality was not expected or authorized) levels during site characterization. On July 30, 2013, NMFS issued a biological opinion with an ITS containing several reasonable and prudent measures and, to minimize the impacts of those activities on ESA-listed species, an ITS for ESA-listed marine mammals and sea turtles. The BOEM's biological assessment for the action considered in this consultation also considered activities included in BOEM's programmatic environmental impact statement, such as buoy placement and sonar activities, but did not consider pile driving. An ITS was issued with the biological opinion, but issues take only for marine mammals and largely for seismic survey activities.

On October 19, 2012, BOEM initiated formal consultation with NMFS for the issuance of leases, site assessment, and site characterization activities in several offshore wind planning areas in the North Atlantic planning area. NMFS issued a programmatic biological opinion covering BOEM seismic, sonar, vessel operation, and other activities on April 10, 2013 that included several reasonable and prudent measures and an ITS for ESA-listed marine mammals and sea turtles. Pile driving was not included in this consultation.

1.2 Consultation History

In November, 2014, BOEM provided a biological assessment on the establishment of a meteorological tower and buoys off of Georgia to NMFS' Southeast Regional Office. During discussions between BOEM, NMFS' Southeast Regional Office , and NMFS Headquarters, it was agreed that the consultation would be conducted at NMFS' Headquarters. During the ensuing months, the NMFS ESA Interagency Cooperation Division agreed to accept responsibility for completing the ESA consultation. The BOEM's biological assessment was revised to include all activities in the proposed action, including surveys that were considered under the 2013 programmatic biological opinion on BOEM's 2013-2020 authorized activities in the Atlantic.

On April 20, 2015, BOEM provided a revised Biological Assessment to NMFS.

On June 9, 2015, BOEM requested formal consultation with the NMFS Endangered Species Act Interagency Cooperation Division on the proposed action.

On July 13, 2015, the NMFS ESA Interagency Cooperation Division requested additional information on the meteorological tower and buoy activities proposed to occur off the Georgia coast. BOEM responded the same day with the information requested.

On July 30, 2015, BOEM provided new information regarding the action based upon another ESA consultation. Specifically, BOEM informed NMFS that a "soft-start" procedure would be followed for both hammer and vibratory pile driving.

On September 8, 2015, the NMFS ESA Interagency Cooperation Division requested additional information on decommissioning as part of the action and details of how effects were assessed or not assessed analytically. The BOEM responded the same day. These responses were sufficient to initiate consultation with BOEM on the proposed action.

On November 18, 2015, the NMFS ESA Interagency Cooperation Division requested more information on the analytical approach for assessing impacts from the proposed project, including critical information such as sound propagation distances, estimation of the densities of ESA-listed marine mammals and sea turtles, and analytical approaches. The BOEM responded with this information on November 22 and 23 and December 1, 2015.

On February 18, 2016, BOEM and NMFS discussed conference procedures for the proposed North Atlantic green sea turtle DPS in the consultation.

On February 19, 2016, BOEM requested that NMFS confirm on the proposed North Altanitc green sea turtle DPS during the formal consultation process for the proposed action.

On February 24, 2016, the NMFS responded confirming the proposed North Atlantic green sea turtle DPS would be included in the consultation.

2 Description of the Proposed Action

Action means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies. In this formal consultation, BOEM proposes to authorize Southern Company to construct, install, operate, maintain, and decommission a single meteorological tower within an area that includes three lease blocks along the Georgia coast (BOEM 2015). In addition, up to two meteorological buoys (including associated passive acoustic monitors, and acoustic Doppler current profilers) may be deployed, operated, relocated, maintained, and removed in the same area by Southern Company under BOEM authorization. These devices will collect environmental and meteorological data to establish the feasibility of developing renewable energy resources (activities not proposed or considered in this consultation). The meteorological tower will be established by pile driving as many as three piles while meteorological buoys would be deployed from vessels.

2.1 Scope of the Consultation

The OCS Lands Act, as amended, mandates the Secretary of the Interior, through BOEM, to manage the exploration and development of OCS oil, gas, and marine minerals (e.g., sand and gravel) and the siting of renewable energy facilities. The Energy Policy Act of 2005, Public Law 109-58, added Section 8(p)(1)(C) to the OCS Lands Act, which grants the Secretary of the Interior the authority to issue leases, easements, or rights-of-way on the OCS for the purpose of renewable energy development (43 United States Code §1337(p)(1)(C)). The Secretary of the Interior delegated this authority to BOEM (30 CFR 585).

The BOEM, under the authority of the OCS Lands Act, as amended, regulates or otherwise requires the G&G activities that are the subject of this consultation within Federal waters. For the Atlantic, this includes waters between 3 nautical miles (the limit for state waters) and 200 nautical miles (the limit of the Exclusive Economic Zone). Some G&G activities, however, may occur within state waters and seaward of the Exclusive Economic Zone beyond BOEM's authority. Activities that occur outside of BOEM's jurisdiction are still subject to the Marine Mammal Protection Act (MMPA). Actions authorized, funded or carried out by any Federal agency, including the issuance of MMPA authorizations, are subject to Section 7 of the ESA.

2.2 Proposed Activities

The proposed action centers on the installation, operation, and decommissioning of a single meteorological tower and up to two meteorological buoys. These activities require vessel traffic to and from the site(s). Activities and/or impacts associated with the placement of meteorological buoys authorized by BOEM were considered in a prior biological opinion on BOEM lease activities in the Atlantic from 2013-2020 (NOAA 2013), although no take was expected or authorized in the ITS. These activities are considered here again as part of the broader action being authorized by BOEM (meteorological tower installation), as buoy placement activities will be necessary to fulfill these activities. The prior biological opinion did not consider the construction, installation, operation, maintenance, and decommissioning of the meteorological tower.

2.2.1 Tower installation

The installation of the meteorological tower (Figure 1) may take up to three days, with driving of piles occurring up to eight continuous daylight hours per day. Pile driving would only occur from May 1 to October 31. The four main structural components of the meteorological tower are the pilings, jacket, platform deck, and tower. Each of the three piles will be approximately 36 inches in diameter. The components will be transported and installed with a derrick barge and anchor handling vessel. Five vessels with be used during the installation of the tower, including an anchoring and handling vessel that may travel to the tower site from New Orleans. At the site, piles will be lifted into position and driven into the sea bed to about 16 meters (m). Southern Company will not know whether vibratory or hammer-type pile driving will be used until the seafloor is surveyed via high resolution geophysical (HRG) surveys. Survey activities were considered in the 2013 programmatic consultation (NOAA 2013). Installation of the piles will take place using the derrick barge equipped with an 8-part anchoring system. An exclusion zone in which pile driving will be halted if protected species are sighted in or about to enter the zone will be established during pile driving. During the second half of driving the first pile, acoustic measurements will be taken to verify that the exclusion zone completely encompasses the 180 decibel (dB) exclusion zone. These results will be made available to BOEM prior to continuing pile driving. If the exclusion zone has been underestimated, a new exclusion zone will be estimated and applied to the site which observers will monitor for protected species occurrence.

Pile driving will involve the use of soft-start procedures for both hammer and vibratory pile driving. For hammer-type pile driving, this means that the beginning of each new pile installation, day's work, or period following shut-down for more than one hour will require one minute between strikes. The initial strike set will be at approximately 10% energy, the second strike set at approximately 25% energy and the third strike set at approximately 40% energy. The soft start procedure should not be less than 20 minutes. Strikes may continue at full operational power following the soft start period. For vibratory pile driving, the soft start requires initiation of noise from the hammers for 15 seconds at reduced energy, followed by a one-minute waiting period. This procedure must be repeated two additional times, following which the vibratory hammer can be operated at full operational power. Rocks may be placed around piles.

Following pile driving, the jacket will be attached to the piles, leveled, and welded into place. Next, the platform deck will be lifted into position on the pile–jacket assembly and welded in place. The platform deck is a three-legged tripod structure supporting an individual meteorological tower and is equipped with a deck house, lights, horns, swing ropes, and tower structure legs. Once the platform deck is welded in position, the pre-assembled tower will be secured to the tower structure legs and erected to the design height of 67 m above the platform deck (Figure 1).

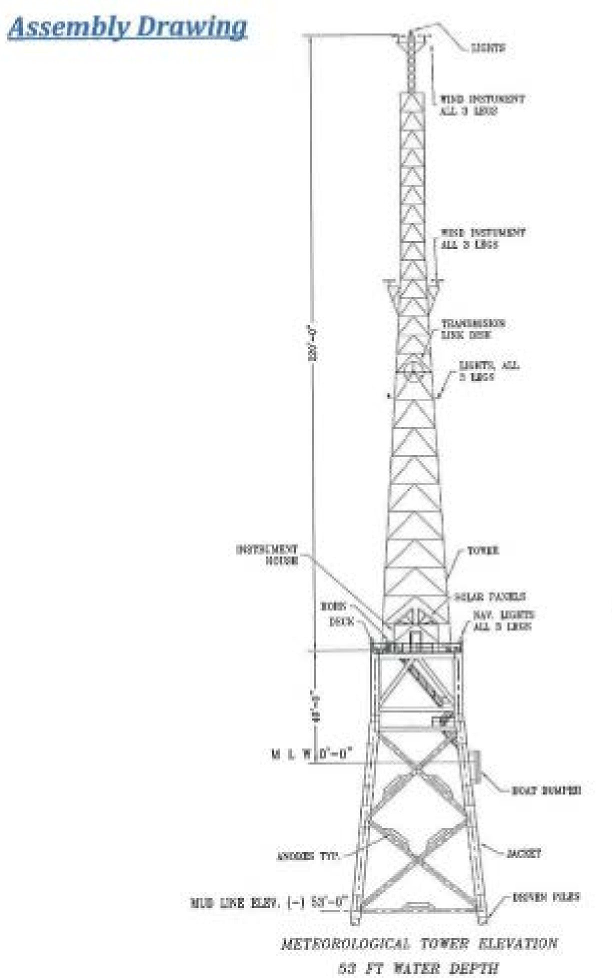

Figure 1. Schematic rendition of the proposed meteorological tower.

Buoys will be maintained in place with five-ton concrete anchors attached to chain roughly three times as long as the water depth that the buoy would be placed in, or about 150 feet long.

2.2.2 Tower operation

Once established, the buoys and/or meteorological tower will transmit data autonomously. During the five-year duration of deployment, roughly 40 trips to and from the tower and buoy locations would be undertaken to ensure they are properly maintained. This will involve the transit of 15-17 m long vessels to and from the sites from different, unidentified ports along the surrounding coastline.

2.2.3 Tower and buoy decommissioning

Tower decommissioning will take one week or less. A derrick barge will anchor near the tower and the tower mast will be removed onto the barge. The tower deck will then be cut from the pilings and moved to the barge. Piles will be cut at least 5 m below the mudline without excavating around piles and removed onto the barge. If rocks are placed around piles, these will be removed with a dredge. No explosives will be used. Buoys, their chains, and anchors will be winched onto a vessel and returned to shore. BOEM requires the Southern Company to submit a decommissioning application prior to decommissioning the meteorological tower. Specific details of the decommissioning plan will be re-assessed by BOEM at that time to ensure that impacts are within the scope of what was analyzed in this Opinion. The results of that assessment will be shared with NMFS and consultation reinitiated if appropriate.

2.2.4 Geophysical surveys

Choosing the actual site within the three lease blocks for installation of the meteorological tower requires that the Southern Company employ the equipment and vessels necessary to conduct geotechnical and HRG surveys to locate suitable areas of seabed to construct the meteorological tower's foundation piles and erect the structure with its associated equipment. The HRG surveys and geotechnical activities, described in more detail below, are interrelated and interdependent activities as they would not occur but for the installation of the meteorological tower and have no independent utility apart from the installation of the meteorological tower.

The Southern Company will conduct HRG surveys using a single, small (<23-30 m) vessel moving at <9.3 kilometers per hour (km/h). Geotechnical surveys for renewable energy sites are expected to be conducted from a small barge or ship of a similar size. A typical duration for an individual survey would be three days or less. Approximately 450 hours of HRG surveying are estimated for site characterization purposes (see Table 3-2 of the biological assessment). Assuming that HRG survey vessels would operate on eight-hour working days, the scenario would require 56 days and the same number of vessel round trips.

Also included in the surveys are one to three geotechnical sampling locations where cone penetrometer testing, geologic coring, and grab sampling would be conducted. Assuming that one sampling location could be completed per work day, there would be approximately one to three vessel round trips (likely departing from Charleston, Savannah, or Jacksonville) associated with these surveys.

Surveys would be conducted by a high-resolution boomer, sparker, or chirp subbottom profiler and include a single beam or multibeam depth sounders and side-scan sonar. Boomers are electromechanical sound sources that generate short, broadband acoustic pulses generally mounted on a sled and towed off the stern or alongside the ship. The reflected signal is received by a towed hydrophone streamer. Sparkers are also electromechanical sound sources that provide seabed profiles. Multibeam depth sounders emit brief pings of medium- or high-frequency sound in a fan-shaped beam extending downward and to the sides of the ship. Table 1 summarizes acoustic properties of these sources.

Table 1. Representative acoustic sound sources for renewable energy HRG surveys.

Source	Broadband source level (dB re 1 micropascal [μPa] at 1m)	Pulse duration	Operating frequencies
Boomer	212	180 microsecond	200 Hertz (Hz)–14 kilohertz (kHz)
Sparker	210-230	--	50-500 Hz
Side-scan sonar	226	20 millisecond (ms)	100-900 kHz
Chirp subbottom profiler	222	64 ms	500 Hz-24 kHz and 200 kHz
Single beam depth sounder	213	>100 ms	3.5-540 kHz
Swath depth sounder	Not available	--	100-600 kHz
Multibeam depth sounder	213	>100 ms	70-500 kHz
Acoustic channel Doppler profiler	Not available	Not available	190 kHz to 2 megaHertz

The 2013 programmatic biological opinion on Atlantic G&G activities included a condition that HRG surveys will not be conducted in North Atlantic right whale critical habitat using sound sources with frequencies less than 30 kHz during the period of November 1 through April 31 (the time during which right whales are anticipated to possibly be present). That same condition will apply to the proposed action, the action area of which is wholly encompassed by North Atlantic right whale critical habitat.

2.2.5 Meteorological buoy installation, operation, and decommissioning

Meteorological buoys were considered as part of ESA consultation between BOEM and NMFS in 2013 as part of programmatic consultation on BOEM lease issuances in the Atlantic for G&G activities. However, as this activity is fundamental to the purpose of this activity, we present it here as well. From two to nine bottom-founded meteorological buoys may be installed. These buoys would be anchored at fixed locations and regularly collect observations from many different atmospheric and oceanographic sensors. Meteorological buoys would typically be towed or carried aboard a vessel to the installation location. Once at the location site, the buoy would be either lowered to the surface from the deck of the transport vessel or placed over the final location and then the mooring anchor dropped. A boat-shaped buoy in shallower waters may be moored with an all-chain mooring, while a larger discus-type buoy would use a combination of chain, nylon, and buoyant polypropylene materials. After installation, the transport vessel would remain in the area for several hours while technicians configure proper operation of all systems. Buoys would typically take one day to install. Transport and installation vessel anchoring for one day is anticipated for these types of buoys. Decommissioning of buoys is essentially the reverse of the installation process. Anchors for boat-shaped and discus-shaped buoys would have a footprint of about 0.55 m^2 and an anchor sweep of about 3.4 hectares.

2.2.6 Interrelated and Interdependent Actions

The section 7 regulations (50 CFR 402.02 and 402.14) require us to assess the direct and indirect effects of proposed actions as well as the direct or indirect effects of other activities that are interrelated or interdependent with the actions we consider in a consultation. The Section 7 regulations define “interrelated actions” as those actions that are part of a larger action and depend on the larger action for their justification; the regulatory definition of interdependent actions” is those that have no independent utility apart from the action under consideration (50 CFR402.02).

On July 19, 2013, NMFS issued a programmatic biological opinion for BOEM’s proposed G&G activities in the Mid- and South Atlantic Planning Areas from 2013 to 2020 (NMFS 2013). The proposed G&G activities included HRG surveys and subsurface sampling activities in support of site characterization and foundation studies for renewable energy projects. Although the HRG surveys and geotechnical activities were addressed within the July 19, 2013 biological opinion, these activities would not occur under the proposed action for this consultation but for the installation of the meteorological tower and have no independent utility apart from the installation of the meteorological tower; therefore, we are also addressing the direct and indirect effects of these activities on listed resources in this biological opinion.

The proposed action includes HRG surveys to detect geohazards and archaeological resources as well as subsurface sampling activities to support decisions about where to site renewable energy structures. As explained in the *Description of the Proposed Action* section, the HRG surveys and geotechnical activities are interrelated and interdependent activities as they would not occur but for the installation of the meteorological tower and have no independent utility apart from the installation of the meteorological tower. Choosing the actual site within the three lease blocks for installation of the meteorological tower requires that the Southern Company employ the equipment and vessels necessary to conduct geotechnical and HRG surveys to locate suitable areas of seabed to construct the meteorological tower’s foundation piles and erect the structure with its associated equipment.

2.2.7 Standard operating conditions for protected species regarding vessel strike avoidance under BOEM

The BOEM developed and refined operating conditions for these and similar activities during consultations under Section 106 of the National Historic Preservation Act and under Section 7 of the

ESA. The BOEM has stated that it will require Southern Company to ensure all vessels conducting activity associated with the lease will comply with the vessel strike avoidance measures specified below except under extraordinary circumstances when the safety of the vessel or crew are in doubt or the safety of human life at sea is in question.

1) The Southern Company must ensure that vessel operators and crews maintain a vigilant watch for cetaceans and sea turtles and slow down or stop their vessel to avoid striking protected species.
2) The Southern Company must ensure that all vessel operators comply with the 18.5 km/h or less, speed restrictions in any Dynamic Management Area or Seasonal Management Area for North Atlantic right whales. In addition, the Southern Company must ensure that all vessels 65 feet or larger operating from November 1 through April 30 operate at speeds of 18.5 km/h or less. Vessel operators may send a blank email to ne.rw.sightings@noaa.gov for an automatic response listing all current Seasonal Management Areas and Dynamic Management Areas.
3) North Atlantic right whales
   a) The Southern Company must ensure all vessels maintain a separation distance of 500 m or greater from any sighted North Atlantic right whale and the Early Warning System, Sighting Advisory System, and Mandatory Ship Reporting System data notifying mariners of right whale presence must be monitored during transit and operations.
   b) The Southern Company must ensure that the following avoidance measures are taken if a vessel comes within 500 m of a right whale:
      i) Vessel operators must ensure that while underway, any vessel must steer a course away from the right whale(s) at 18.5 km/h or less until the minimum separation distance has been established (unless (ii) below applies).
      ii) If a North Atlantic right whale is sighted within 100 m of an underway vessel, the vessel operator must immediately reduce speed and promptly shift the engine to neutral. The vessel operator must not engage the engines until the right whale has moved beyond 100 m from the vessel, at which point the vessel operator must comply with 3(b)(i)
      iii) If a vessel is stationary, the vessel operator must not engage engines until the North Atlantic right whale has moved beyond 100 m, at which time the vessel operator must comply with 3(b)(i).
4) Non-delphinoid cetaceans other than the North Atlantic right whale (only humpback whales are expected to occur in the action area other than North Atlantic right whales)
   a) The Southern Company must ensure all vessels maintain a separation distance of 100 m or greater from any sighted non-delphinoid cetacean.
   b) The Southern Company must ensure that the following avoidance measures are taken if a vessel comes within 100 m of a non-delphinoid cetacean:
      i) The Southern Company must ensure that when a non-delphinoid cetacean (other than a North Atlantic right whale) is sighted, the vessel underway must reduce speed and

shift the engine to neutral, and must not engage the engines until the non-delphinoid cetacean has moved beyond 100 m.

ii) The Southern Company must ensure that if a vessel is stationary, the vessel must not engage engines until the non-delphinoid cetacean has moved beyond 100 m.

5) Delphinoid cetaceans (none are ESA-listed in the action area)
   a) The Southern Company must ensure all vessels maintain a separation distance of 50 m or greater from any sighted delphinoid cetacean.
   b) The Southern Company must ensure that the following avoidance measures are taken if the vessel comes within 50 m of a delphinoid cetacean:
      i) The Southern Company must ensure that any vessel underway remain parallel to a sighted delphinoid cetacean's course whenever possible, and avoid excessive speed or abrupt changes in direction. Course and speed may be adjusted once the delphinoid cetacean has moved beyond 50 m or the delphinoid cetacean has moved abeam of the underway vessel.
      ii) In addition, the Southern Company must ensure that the speed of any vessel underway is reduced to 18.5 km/h or less when pods (including mother/calf pairs) or large assemblages of delphinoid cetaceans are observed. The Southern Company must ensure that the vessel does not adjust course and speed until the delphinoid cetaceans have moved beyond 50 m or abeam of the underway vessel.
6) Sea turtles
   a) The Southern Company must ensure all vessels maintain a separation distance of 50 m or greater from any sighted sea turtle.
7) The Southern Company must ensure that vessel operators are briefed to ensure they are familiar with the above requirements.

2.2.8 Marine debris measures

The BOEM will require that the Southern Company must ensure that vessel operators, employees, and contractors engaged in activity conducted under the lease are briefed on marine trash and debris awareness elimination as described in the Bureau of Safety and Environmental Enforcement Notice to Applicants Number 2012-G01 (Marine Trash and Debris Awareness and Elimination). The BOEM will not require the Southern Company to undergo formal training or post placards, as described under this Notice to Applicants. Instead, the Southern Company must ensure that its employees and contractors are made aware of the environmental and socioeconomic impacts associated with marine trash and debris and their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into the marine environment. The above referenced Notice to Applicants provides information the Southern Company may use for this awareness training.

2.2.9 BOEM-required geological and geophysical operating conditions

1) Visibility. The Southern Company must not conduct G&G surveys under the lease at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state) prevents visual monitoring of the exclusion zones for HRG surveys and geotechnical surveys as specified below. This requirement may be modified as specified below.
2) Modification of visibility requirement. If the Southern Company intends to conduct G&G survey operations at night or when visual observation is otherwise impaired, the Southern Company must submit to BOEM an alternative monitoring plan detailing the alternative monitoring methodology (e.g., active or passive acoustic monitoring technologies). The BOEM may decide to allow the Southern Company to conduct G&G surveys in support of plan submittal at night or when visual observation is otherwise impaired using the proposed alternative monitoring methodology.
3) Protected-species observer. The Southern Company must ensure that the exclusion zone for all G&G surveys performed under the lease is monitored by a NMFS-approved protected species observer. The Southern Company must provide to BOEM a list of observers and their résumés no later than forty-five calendar days prior to the scheduled start of surveys performed in support of plan submittal. The résumés of any additional observers must be provided fifteen calendar days prior to each observer’s start date. The BOEM will send the observer information to NMFS for approval.
4) Optical device availability. The Southern Company must ensure that reticle binoculars and other suitable equipment are available to each observer to adequately perceive and monitor distant objects within the exclusion zone during surveys conducted under the lease.

2.2.10 High resolution geophysical survey requirements

The BOEM requires the following requirements will apply to all HRG survey work actively using electromechanical survey equipment where one or more acoustic sound source is operating at frequencies below 200 kHz:

1) Establishment of exclusion zone. The Southern Company must ensure that a 200 m default exclusion zone for cetaceans and sea turtles will be monitored by a protected species observer around any active sound sources on a survey vessel actively using electromechanical survey equipment where one or more acoustic sound sources is operating at frequencies below 200 kHz. In the case of the North Atlantic right whale, the minimum separation distance of 500 m is in effect when the vessel is underway as described in the vessel-strike avoidance measures.
2) If BOEM determines that the exclusion zone does not encompass the 180 dB radius calculated for the acoustic source having the highest source level, BOEM will consult with NMFS about additional requirements. This could include expanding the exclusion zone, altering conditions of the pile driving set-up to reduce source level, or employing additional migratory measures.

3) The BOEM may authorize surveys having an exclusion zone larger than 200 m to encompass the 160 dB radius if the Southern Company can demonstrate the zone can be effectively monitored.
4) Field verification of exclusion zone. The Southern Company may choose to conduct field verification of the exclusion zone for specific HRG survey equipment operating below 200 kHz. The Southern Company must take acoustic measurements at a minimum of two reference locations and be sufficient to establish the following: source level (peak at 1 m) and distance to the 180, 160, and 150 dB re 1μPa root mean square (rms) isopleths as well as the 187 dB re 1μPa cumulative sound exposure level. Sound measurements must be taken at the reference locations at two depths (i.e., a depth at mid-water and a depth at approximately 1 m above the seafloor). An infrared range finder may be used to determine distance from the sound source to the reference location.
5) Modification of exclusion zone. The Southern Company must use the field-verification method described above to modify the HRG survey exclusion zone for specific HRG survey equipment operating below 200 kHz. This modified exclusion zone may be greater than or less than the 200 m default exclusion zone depending on the results of the field tests. Any new exclusion zone radius must be based on the most conservative measurement (i.e., the largest safety zone configuration) of the target (160 dB or 180 dB) zone. This modified zone must be used for all subsequent use of field-verified equipment and may be periodically reevaluated based on the regular sound monitoring. The Southern Company must obtain BOEM approval of any new exclusion zone before it may be implemented.
6) Clearance of exclusion zone. The Southern Company must ensure that active acoustic sound sources must not be activated until the protected species observer has reported the exclusion zone clear of all cetaceans and sea turtles for 60 minutes.
7) Electromechanical survey equipment ramp-up. The Southern Company must ensure that when technically feasible a "ramp-up" of the electromechanical survey equipment occur at the start or re-start of HRG survey activities. A ramp-up would begin with the power of the smallest acoustic equipment for the HRG survey at its lowest power output. The power output would be gradually turned up and other acoustic sources added in a way such that the source level would increase in steps not exceeding 6 dB per 5-minute period.
8) Shut down for non-delphinoid cetaceans and sea turtles. If a non-delphinoid cetacean or sea turtle is sighted at or within the exclusion zone, an immediate shutdown of the electromechanical survey equipment is required. The vessel operator must comply immediately with such a call by the observer. Any disagreement or discussion should occur only after shut-down. Subsequent restart of the electromechanical survey equipment must use the ramp-up provisions described above and may only occur following clearance of the exclusion zone of all cetaceans and sea turtles for 60 minutes.
9) Power down for delphinoid cetaceans. If a delphinoid cetacean or pinniped is sighted at or within the exclusion zone, the electromechanical survey equipment must be powered down to the lowest power output that is technically feasible. The vessel operator must comply

immediately with such a call by the observer. Any disagreement or discussion should occur only after power-down. Subsequent power up of the electromechanical survey equipment must use the ramp up provisions described above and may occur after (1) the exclusion zone is clear of a delphinoid cetacean and/or pinniped or (2) a determination by the protected species observer after a minimum of 10 minutes of observation that the delphinoid cetacean and/or pinniped is approaching the vessel or towed equipment at a speed and vector that indicates voluntary approach to bow-ride or chase towed equipment. An incursion into the exclusion zone by a non-delphinoid cetacean or sea turtle during a power-down requires implementation of the shut-down procedures described above.

10) Pauses in electromechanical survey sound source. The Southern Company must ensure that if the electromechanical sound source shuts down for reasons other than encroachment into the exclusion zone by a non-delphinoid cetacean or sea turtle, including, but not limited to, mechanical or electronic failure, resulting in the cessation of the sound source for a period greater than 20 minutes, the Southern Company must restart the electromechanical survey equipment using the full ramp-up procedures and clearance of the exclusion zone of all cetaceans and sea turtles for 60 minutes. If the pause is less than 20 minutes the equipment may be re-started as soon as practicable at its operational level as long as visual surveys were continued diligently throughout the silent period and the exclusion zone remained clear of cetaceans and sea turtles. If visual surveys were not continued diligently during the pause of 20 minutes or less, the Southern Company must restart the electromechanical survey equipment using the full ramp-up procedures and clearance of the exclusion zone of all cetaceans and sea turtles for 60 minutes.
11) Dynamic management area shutdown. The Southern Company must ensure that vessels cease HRG survey activities within 24 hours of NMFS establishing a dynamic management area (DMA) in the Southern Company's HRG survey area. HRG surveys may resume in the affected area after the DMA has expired.

2.2.11 Protected species reporting requirements

The BOEM will require the Southern Company to ensure compliance with the following reporting requirements for site characterization activities performed under the lease and must use contact information provided by BOEM, to fulfill these requirements:

1) Reporting observed impacts to protected species. The protected species observer must report any observations concerning impacts on ESA-listed marine mammals or sea turtles to BOEM and the NMFS within 48 hours.
2) Reporting injured or dead protected species.
    a. The Southern Company must ensure that sightings of any injured or dead protected species (e.g., marine mammals or sea turtles) are reported to NMFS Southeast Region's Stranding Hotline (877-433-8299 or current) within 24 hours of sighting, regardless of whether the injury or death is caused by a vessel. In addition, if the injury or death was caused by a collision with a project-related

vessel, the Southern Company must ensure that the incident is immediately reported to BOEM and NMFS Southeast Region's Stranding Hotline (877-433-8299 or current). The Southern Company must report any injuries or mortalities using the Incident Report in Attachment B-1 of BOEM's permit. If the Southern Company's activity is responsible for the injury or death, the Southern Company must ensure that the vessel assist in any salvage effort as requested by NMFS.

b. The Southern Company must ensure that any collision with or injury to a manatee shall be reported immediately to the Florida Fish and Wildlife Conservation Commission Hotline at 1-888-404-3922. Collision and/or injury should also be reported to the US Fish and Wildlife Service in Vero Beach (1-772-562-3909) and to Florida Fish and Wildlife Conservation Commission at www.ImperiledSpecies@myFWC.com. The Southern Company must report any injuries or mortalities using the Incident Report in Attachment B-1 of BOEM's permit.

3) Report information. The protected species observer must record all observations of protected species using standard marine mammal observer data collection protocols. The list of required data elements for these reports is provided in Attachment B-2 of BOEM's permit.
4) The HRG plan for field verification of the exclusion zone. The Southern Company must submit a plan for verifying the sound source levels of any electromechanical survey equipment operating at frequencies below 200 kHz to BOEM no later than 45 days prior to the commencement of the field verification activities. BOEM may require that the Southern Company modify the plan to address any comments BOEM submits to the Southern Company on the contents of the plan in a manner deemed satisfactory to BOEM prior to the commencement of the field verification activities.
5) Report of activities and observations. The Southern Company must provide BOEM and the NMFS with a report within 90calendar days following the commencement of HRG and/or geotechnical exploration activities that includes a summary of the survey activities, all protected species observer reports, a summary of the survey activities and an estimate of the number of listed marine mammals and sea turtles observed or taken during these survey activities.
6) Final technical report for meteorological tower construction and meteorological buoy installation. The Southern Company must provide BOEM and NMFS a report within 120 days after completion of the pile-driving and construction activities. The report must include full documentation of methods and monitoring protocols, summaries of the data recorded during monitoring, estimates of the number of listed marine mammals and sea turtles that may have been taken during construction activities, and provide an interpretation of the results and effectiveness of all monitoring tasks. The report must also include acoustic monitoring results from any pile-driving activity conducted during the installation of a meteorological tower. Reports must be sent to:

Bureau of Ocean Energy Management
Environment Branch for Renewable Energy
Phone: 703-787-1340
Email: renewable_reporting@boem.gov

National Marine Fisheries Service
Southeast Regional Office, Protected Resources Division
Section 7 Coordinator
Phone: 727-824-5312
Email: incidental.take@noaa.gov

2.3 Action Area

Action area means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 CFR 402.02). The BOEM proposes to allow Southern Company to place a single meteorological tower and meteorological buoys within three outer continental shelf blocks (Brunswick NH 17-02 6074, 6174, and 6126) roughly 3.0 to 11.6 nautical miles offshore of Tybee Island, Georgia (Figure 2). As acoustic activities associated with the action can propagate several kilometers from the acoustic sources in these blocks, the action area extends beyond these blocks and into surrounding waters. Activities could occur during any time of year with the exception of pile driving and other activities associated with the construction or decommissioning of the meteorological tower, which can only occur from May 1 to October 31. In addition, a vessel may transit from New Orleans to the action area, expanding the action area along the vessels path through the Gulf of Mexico, Straits of Florida, and up along the Florida coast.

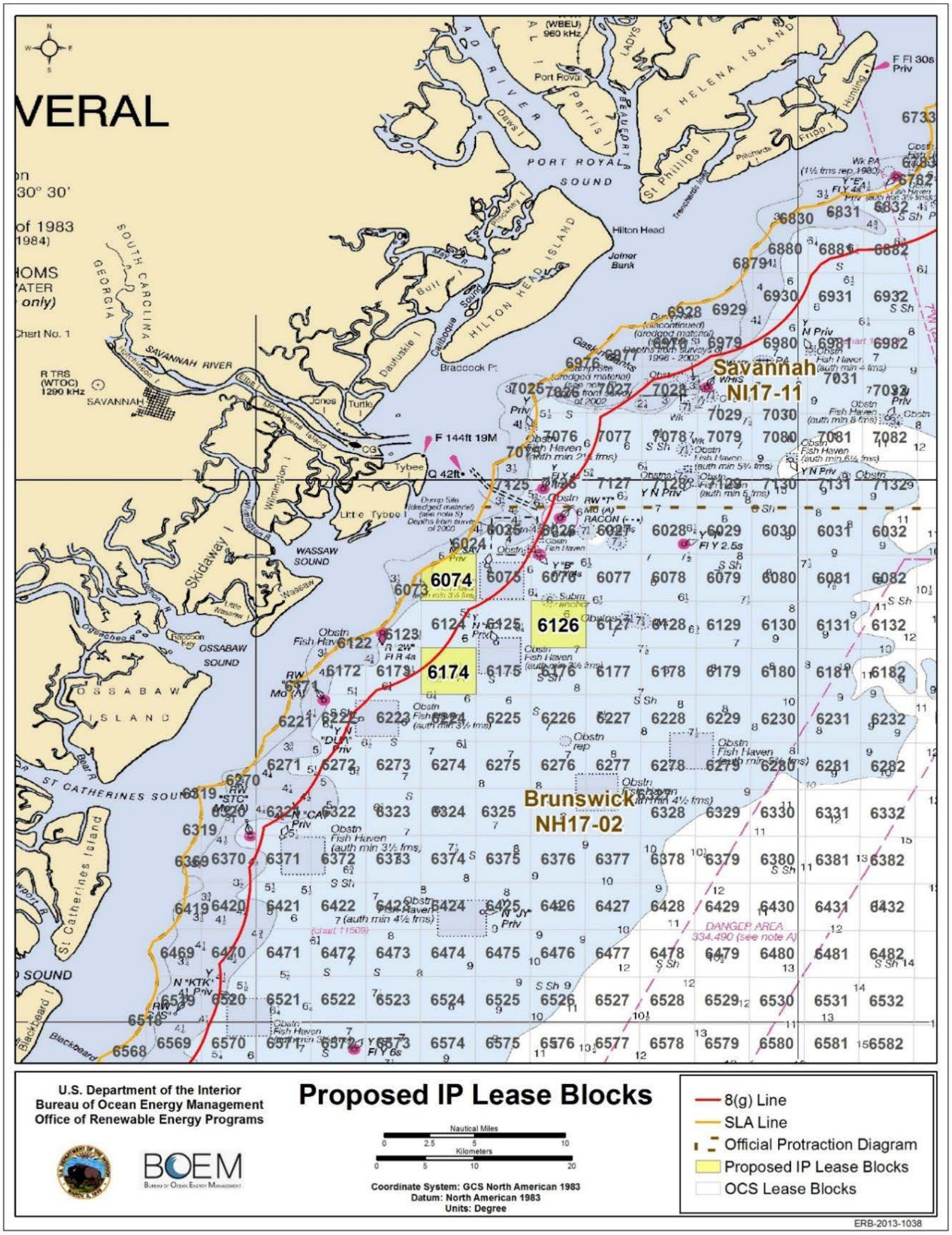

Figure 2. Map of area for establishment and decommissioning of meteorological tower. Lease blocks 6074, 6174, and 6126 are highlighted in yellow.

3 Overview of NMFS' Assessment Framework

Section 7 (a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to insure that their actions either are not likely to jeopardize the continued existence of endangered or threatened species; or adversely modify or destroy their designated critical habitat.

"To jeopardize the continued existence of an ESA-listed species" 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 an ESA-listed or proposed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). The jeopardy analysis considers both survival and recovery of the species.

Section 7 assessment involves the following steps:

1) We identify the proposed action and those aspects (or stressors) of the proposed action that are likely to have direct or indirect effects on the physical, chemical, and biotic environment within the action area, including the spatial and temporal extent of those stressors.

2) We identify the ESA-listed or proposed species and designated critical habitat that are likely to co-occur with those stressors in space and time. We assess the base condition of the entire species, as they are listed, and critical habitat, as it is designated, given their exposure to human activities and natural phenomena throughout their geographic distribution.

3) We describe the environmental baseline in the action area including: past and present impacts of Federal, state, or private actions and other human activities in the action area; anticipated impacts of proposed Federal projects that have already undergone formal or early Section 7 consultation, impacts of state or private actions that are contemporaneous with the consultation in process.

4) We identify the number, age (or life stage), and gender of ESA-listed or proposed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. This is our exposure analysis.

5) We evaluate the available evidence to determine how those ESA-listed or proposed species are likely to respond given their probable exposure. This is our response analyses.

6) We assess the consequences of these responses to the individuals that have been exposed, the populations those individuals represent, and the species those populations comprise. This is our risk analysis.

7) The adverse modification analysis considers the impacts of the proposed action on the critical habitat features and conservation value of designated critical habitat. This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at

50 CFR 402.02. Instead, we relied upon a new regulatory definition that defines destruction or adverse modification as "a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features." (81 FR 7214). For designated critical habitat, we assess the consequences of responses given exposure on the value of the critical habitat for the conservation of the species for which the habitat has been designated.

8) We describe any cumulative effects of the proposed action in the action area.

   Cumulative effects, as defined in our implementing regulations (50 CFR §402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate Section 7 consultation.

9) We integrate and synthesize the above factors by considering the effects of the action to the environmental baseline and the cumulative effects to determine whether the action could reasonably be expected to:

   a) Reduce appreciably the likelihood of both survival and recovery of the ESA-listed or proposed species in the wild by reducing its numbers, reproduction, or distribution; or

   b) Reduce the conservation value of designated or proposed critical habitat. These assessments are made in full consideration of the status of the species and critical habitat.

10) We state our conclusions regarding jeopardy and the destruction or adverse modification of critical habitat.

If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed or proposed species or destroy or adversely modify designated critical habitat, we must identify a reasonable and prudent alternative to the action. The reasonable and prudent alternative must not be likely to jeopardize the continued existence of ESA-listed or proposed species nor adversely modify their designated critical habitat and it must meet other regulatory requirements.

To comply with our obligation to use the best scientific and commercial data available, we incorporated evidence from the biological assessment submitted by BOEM, monitoring reports submitted by previous operators, reports from NMFS Science Centers, reports prepared by state natural resource agencies, reports from non-governmental organizations involved in marine conservation issues, the general scientific literature, and our expert opinion and best professional judgement. We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies like the Bureau of Ocean Energy Management, United States (US) Coast Guard, and US Navy whose operations extend into the marine environment. During the consultation, we conducted electronic searches of the general scientific literature using search engines, including Agricola, Ingenta Connect, Aquatic Sciences and Fisheries Abstracts, Journal Storage (JSTOR), Conference Papers Index, First Search (Article First, ECO, WorldCat), Web of Science, Oceanic Abstracts, Google Scholar, and Science Direct. We also referred to an internal electronic library that represents a major repository on the biology of ESA-listed species under the NMFS' jurisdiction. We supplemented these searches with electronic searches of doctoral dissertations and master's theses.

Information was used to determine whether ESA-listed resources may be affected by the proposed action and to draw conclusions about the likely risks to the continued existence of these species, the conservation value of their critical habitat, and the incidental take that would be expected as a result of the proposed actions. These searches specifically tried to identify data or other information that supports a particular conclusion (for example, a study that suggests whales will exhibit a particular response to acoustic exposure or close vessel approach) as well as data that do not support that conclusion. When data are equivocal or when faced with substantial uncertainty, our decisions are designed to avoid the risks of incorrectly concluding that an action would not have an adverse effect on listed species when, in fact, such adverse effects are likely (i.e., Type II error).

4 Status of ESA-listed and Proposed Species

This section identifies the ESA-listed and proposed species that potentially occur within the action area (Figure 2) that may be affected by the proposed action. It then summarizes the biology and ecology of those species and what is known about their life histories in the action area. The species potentially occurring within the action area that are ESA-listed or proposed to be listed are presented in Table 2, along with their regulatory status and critical habitats (if listed).

Table 2. Proposed, threatened, and endangered species potentially occurring in the action area.

Species	ESA Status	Critical Habitat	Recovery Plan
Cetaceans			
Blue Whale (*Balaenoptera musculus)*	Endangered E – 35 Federal Register (FR) 18319	-- --	07/1998
Fin Whale (*Balaenoptera physalus)*	Endangered E – 35 FR 18319	-- --	75 FR 47538
Humpback Whale (*Megaptera novaeangliae*)[1]	Endangered E – 35 FR 18319	-- --	55 FR 29646
North Atlantic Right Whale (*Eubalaena glacialis*)	Endangered E – 73 FR 12024	59 FR 28805 81 FR 4837	70 FR 32293
Sei Whale (*Balaenoptera borealis*)	Endangered E – 35 FR 18319	-- --	76 FR 43985
Sperm Whale (*Physeter macrocephalus*)	Endangered E – 35 FR 18319	-- --	75 FR 81584
Sea Turtles			
Green Sea Turtle (*Chelonia mydas*): Florida breeding population	Threatened E – 43 FR 32800	63 FR 46693	63 FR 28359
Green Sea Turtle (*Chelonia mydas*): North Atlantic DPS	Proposed threatened E – 80 FR 15271		
Hawksbill Sea Turtle (*Eretmochelys imbricata)*	Endangered E – 35 FR 8491	63 FR 46693	57 FR 38818

[1] Humpback whales are currently listed as a single, globally endangered species. However, NMFS has proposed that humpback whales be listed as separate distinct population segments (DPSs) (E - 80 FR 22304). The individuals that may occur in the action area would only be from the proposed West Indies DPS, which is proposed to be delisted.

Species	ESA Status	Critical Habitat	Recovery Plan
Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)	Endangered E – 35 FR 18319	-- --	75 FR 12496
Leatherback Sea Turtle (*Dermochelys coriacea*)	Endangered E – 61 FR 17	44 FR 17710	63 FR 28359
Loggerhead Sea Turtle (*Caretta caretta*) – Northwest Atlantic DPS	Threatened E – 76 FR 58868	-- --	63 FR 28359
Fishes			
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)			
Atlantic Sturgeon, Gulf of Maine DPS	T – 77 FR 5880	-- --	-- --
Atlantic Sturgeon, New York Bight DPS	E - 77 FR 5880	-- --	-- --
Atlantic Sturgeon, Chesapeake Bay DPS	E - 77 FR 5880	-- --	-- --
Atlantic Sturgeon, Carolina DPS	E – 77 FR 5914	-- --	-- --
Atlantic Sturgeon, South Atlantic DPS	E – 77 FR 5914	-- --	-- --
Smalltooth Sawfish (*Pristis pectinata*)	E – 68 FR 15674	74 FR 45353	74 FR 3566

4.1 ESA-Listed and Proposed Species and Critical Habitat not Likely to be Adversely Affected

NMFS uses two criteria to identify the ESA-listed or proposed species or designated critical habitat that are not likely to be adversely affected by the proposed action, as well as the effects of activities that are interrelated to or interdependent with the Federal agency's proposed action. The first criterion is exposure, or some reasonable expectation of a co-occurrence, between one or more potential stressors associated with the proposed activities and ESA-listed or proposed species or designated critical habitat. If we conclude that an ESA-listed or proposed species or designated critical habitat is not likely to be exposed to the proposed activities, we must also conclude that the species or critical habitat is not likely to be adversely affected by those activities.

The second criterion is the probability of a response given exposure. ESA-listed or proposed species or designated critical habitat that is exposed to a potential stressor but is likely to be unaffected by the exposure is also not likely to be adversely affected by the proposed action. We applied these criteria to the ESA-listed or proposed species in Table 2 and we summarize our results below.

An action warrants a "may affect, not likely to be adversely affected" finding when its effects are wholly *beneficial*, *insignificant* or *discountable*. *Beneficial* effects have an immediate positive effect without any adverse effects to the species or habitat. Beneficial effects are usually discussed when the project has a clear link to the ESA-listed or proposed species or its specific habitat needs and consultation is required because the species may be affected.

Insignificant effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. Insignificant is the appropriate effect conclusion when plausible effects are going to happen, but will not rise to the level of constituting an adverse effect. That means the ESA-listed or proposed species may be expected to be affected, but not harmed or harassed.

Discountable effects are those that are extremely unlikely to occur. For an effect to be discountable, there must be a plausible adverse effect (i.e., a credible effect that could result from the action and that would be an adverse effect if it did impact a listed species), but it is very unlikely to occur.

4.1.1 Whales

NMFS discounts the possibility that blue, fin, humpback, sei, and sperm whales are likely to be adversely affected by the proposed action. This is because individuals of these species are not reasonably likely to be present in the action area or are not reasonably expected to be exposed to the proposed actions. Although much marine mammal survey effort has been undertaken in the region, sighting records do not support blue, fin, sei, or sperm whales occurring in the action area (http://seamap.env.duke.edu/serdp). Humpback whales have been sighted in the area surrounding the action area, but only four records of seven individuals are known. In addition, blue, fin, sei, and sperm whales generally do not occur in the shallow, coastal waters of the action area (Clark 1995; Clarke 1956; Cotte et al. 2009; Hain et al. 1985; Nasu 1974; Reeves and Whitehead 1997; Rice 1989; Watkins 1977). Humpback whales do occur in such waters, but generally only in specific areas where they forage, mate, and/or calve. The action area is not such a location for humpback whales. We must also keep in mind that a vessel for tower construction may transit from New Orleans to waters off the Georgia coast, which include areas where sperm whales are known to occur. However, we find the likelihood that this single vessel will impact any individual sperm whale in a meaningful way, such as through vessel noise or shipstrike, to be insignificant. This is because the sound produced by the vessel, relative to the large number of other vessels in the region, is expected to be small and the vessel would only briefly be near sperm whales (if at all), and sperm whales are not known to be struck by vessels except on rare occassion. Therefore, we believe the proposed action is not likely to adversely affect blue, fin, humpback, sei, and sperm whales.

We also do not expect North Atlantic right whales to be adversely affected by the proposed action. Construction and decommissioning of the meteorological tower as well as operation of HRG equipment sources of frequencies believed to be audible to North Atlantic right whales will not occur during times when this species is expected to be present in the action area. North Atlantic right whales may be present when other HRG sources, vessel noise, potential shipstrike, as well as HRG oceanographic survey equipment deployment, buoy installation, and operation (entanglement potential). However, right whales are not expected to hear frequencies above 30 kHz, and BOEM permitting requirements only allow HRG equipment with frequencies above this to operate during times when North Atlantic right whales may be present. Therefore, we discount the possibility of HRG survey devices to adeversely affect North Atlantic right whales.

Several dozen vessel roundtrips associated with meteorological tower construction, maintenance, and decommissioning, buoy deployment and decommissioning, as well as up to 450 hours of HRG surveys are expected to occur which involve unavoidable sound emissions from vessels machinery and propulsion into the surrounding marine environment where and when North Atlantic right whales may occur. Some of these sound sources (such as vessel transits and buoy deployments) are expected to be audible to North Atlantic right whales. However, the amplitude and duration of these exposures is not expected to have a meaningful biological consequence to exposed individuals. We do not expect any individual to respond in a physiological or behavioral way to this noise, neither as individual events nor in a way we can meaningfully evaluate in combination with other existing background acoustic noise levels. We therefore find the effects of vessel noise on North Atlantic right whales to be insignificant.

Vessel operations also present the possibility of shipstrike to North Atlantic right whales. The BOEM has articulated several restrictions on vessel operations to avoid approaching marine mammals closely, with a particular emphasis on North Atlantic right whales. These conditions include reduced speed of all vessels when North Atlantic right whales may be present and maintaining separation distance. Several studies suggest slower speeds reduce the risk of collision, injury, or mortality to North Atlantic right whales (Conn and Silber 2013; Kite-Powell et al. 2007; Vanderlaan and Taggart 2007; Vanderlaan et al. 2008). No whales are known to have been struck by vessels in association with BOEM-permitted activities. This information leads us to conclude that the possibility of shipstrike to North Atlantic right whales, or any other ESA-listed whale species, is insignificant. Although the oceanographic equipment lowered in a controlled manner over-the-side could come in direct contact with an ESA-listed species, entanglements are highly unlikely and considered highly improbable based on investigation into the use of these devices during the activities of other oceanographic activities based upon many thousands of similar events conducted by operators in the past (such as with Woods Hole Oceanographic Institute and Scripps Oceanographic Institute) without incident. Similarly, information from the US Coast Guard indicates that entanglement in buoy lines is highly unlikely. Given this, we expect that the risk of entanglement in oceanographic equipment so low as to be insignificant.

4.1.2 Hawksbill turtle

We do not expect hawksbill sea turtles to be present in the action area. Although common in areas further south, such as the Dry Tortugas (Hart et al. 2012) and generally throughout the Caribbean Sea (Musick and Limpus 1997; Plotkin 2003), occurrence in the action area is not expected. Only two records (both well offshore of the action area) and one stranding record (http://seamap.env.duke.edu/serdp) are known from the region. Therefore, we do not expect hawksbill sea turtles to be present in the action area or to be exposed to the proposed activities and therefore find that they are not likely to be adversely affected by the proposed action.

4.1.3 Fishes

Two bycatch records of smalltooth sawfish exist near the action area (none in it) (Simpfendorfer and Wiley 2006). Given the very limited number of encounter reports from the east coast of Florida, Simpfendorfer and Wiley (2004) hypothesized the population previously undertaking the summer migration through the action area has declined to a point where the migration is undetectable or does not occur. Based upon the few records to support the species occurring in the general region and no reports of smalltooth sawfish in the action area, we do not expect smalltooth sawfish to occur in the action area. We conclude that the action would have no effect on smalltooth sawfish.

Atlantic sturgeon may occur in nearshore waters of the action area (ASSRT 2007). However, occurrence quickly declines with distance from shore in this area (personal communication from Jason Kahn, NMFS 2015). We could not identify any bycatch, sighting, or other records to support that the species occurs in areas where high-intensity (and potentially biologically-significant) sound sources would occur or where we expect vessel operations to take place. Therefore, we expect the proposed action will not adversely affect Atlantic sturgeon.

4.1.4 Designated critical habitat

The only designated critical habitat that overlaps the action area is that for North Atlantic right whale. The southern critical habitat is along Georgia and northeastern Florida coasts (waters from the coast out 15 nautical miles between the latitudes of 31°15’ North and 30°15’ North and from the coast out five nautical miles between 30°15’ North and 28°00’ North). Southern critical habitat is designated to protect calving and breeding grounds for North Atlantic right whales, which generally calve and breed in shallow coastal waters. Physical and biological features that make this habitat critical are: (1) Calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) sea surface temperatures from a minimum of 7 °Celsius (C), and never more than 17 °C; and (3) water depths of 6 to 28 m, where these features simultaneously co-occur over contiguous areas of at least 231 square nautical miles of ocean waters during the months of November through April (81 FR 4837). Although the critical habitat occurs within the lease blocks, we do not expect the effects of the action to in any way impact the physical or biological features of the critical habitat. Therefore, we do not expect an adverse effect as part of the action to designated North Atlantic right whale critical habitat.

Because no other designated critical habitat occurs within the action area, none will be affected. Therefore, we do not discuss designated critical habitat further in this Opinion.

4.2 ESA-Listed Species Likely to be Adversely Affected

This Opinion examines the status of each ESA-listed or proposed species that would be affected by the proposed action, which include green, Kemp's ridley, leatherback, and loggerhead sea turtles. The status is determined by the level of risk that the ESA-listed or proposed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The *Status of ESA-Listed and Proposed Species* section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02.

4.2.1 Climate change as a broad threat to ESA-listed turtles

One factor affecting the range-wide status of sea turtles, and aquatic habitat at large is climate change. We primarily discuss climate change as a threat common to all species addressed in this Opinion, rather than in each of the species-specific narratives. As we better understand responses to climate change on a species-by-species basis, we will address these effects in the relevant species-specific sections.

In general, based on forecasts made by the Intergovernmental Panel on Climate Change, climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the near future (IPCC 2002). From 1906 to 2006, global surface temperatures have risen 0.74º C and continue at an accelerating pace; 11 of the 12 warmest years on record since 1850 have occurred since 1995 (Poloczanska et al. 2009). Furthermore, the Northern Hemisphere (where a greater proportion of ESA-listed species occur) is warming faster than the Southern Hemisphere, although land temperatures are rising more rapidly than over the oceans (Poloczanska et al. 2009). North Atlantic and Pacific sea surface temperatures have shown trends in being anonymously warm in recent years (Blunden and Arndt 2013). The ocean along the US eastern seaboard is also much saltier than historical averages (Blunden and Arndt 2013). As we describe below, these can all have important impacts to ESA-listed species in the action area.

The direct effects of climate change will result in increases in atmospheric temperatures, changes in sea surface temperatures, patterns of precipitation, and sea level. For sea turtles, temperature regimes generally lead toward female-biased nests (Hill et al. 2015). As described in the *Status of Listed and Proposed Species* for each sea turtle species, temperature regimes are generally leading towards female-biased nests. This can result in heavily feminized populations incapable of fertilization of available females (Laloë et al. 2014). This is not considered to be an imminent threat and presently has the advantage of shifting the natural rates of population growth higher (Laloë et al. 2014). Oceanographic models project a weakening of the thermohaline circulation resulting in a reduction of heat transport into high latitudes of Europe as well as an increase in the mass of the Antarctic and Greenland ice sheets, although the magnitude of these changes remain unknown. Species that are shorter-lived, larger body size, or generalist in nature are liable to be better able to adapt to climate change over the long term versus those that are longer-lived, smaller-sized, or rely upon specialized habitats (Brashares 2003; Cardillo 2003; Cardillo et al.

2005; Issac 2009; Purvis et al. 2000). Climate change is most likely to have its most pronounced effects on species whose populations are already in tenuous positions (Isaac 2008). As such, we expect the risk of extinction to ESA-listed species to rise with the degree of climate shift associated with global warming.

Acevedo-Whitehouse and Duffus (2009) proposed that the rapidity of environmental changes, such as those resulting from global warming, can harm immunocompetence and reproductive parameters in wildlife to the detriment of population viability and persistence. An example of this is the altered sex ratios observed in sea turtle populations worldwide (Fuentes et al. 2009a; Mazaris et al. 2008; Reina et al. 2008; Robinson et al. 2008). This does not appear to have yet affected population viabilities through reduced reproductive success, although nesting and emergence dates of days to weeks in some locations have changed over the past several decades (Poloczanska et al. 2009). Altered ranges can also result in the spread of novel diseases to new areas via shifts in host ranges (Schumann et al. 2013; Simmonds and Eliott. 2009). It has also been suggested that increases in harmful algal blooms could be a result from increases in sea surface temperature (Simmonds and Eliott. 2009).

Climate change has been linked to changing ocean currents as well. Rising carbon dioxide levels have been identified as a reason for a poleward shift in the Eastern Australian Current, shifting warm waters into the Tasman Sea and altering biotic features of the area (Johnson et al. 2011; Poloczanska et al. 2009). Similarly, the Kuroshio Current in the western North Pacific (an important foraging area for juvenile sea turtles) has shifted southward as a result of altered long-term wind patterns over the Pacific Ocean (Blunden and Arndt 2013; Poloczanska et al. 2009). The Gulf Stream is a major feature of the action area and drives much of the biology of the region. If similar changes have, are, or do happen to the Gulf Stream as other currents where changes have been found, it could profoundly change the biological community of the action area.

Changes in global climatic patterns will likely have profound effects on the coastlines of every continent by increasing sea levels and the intensity, if not the frequency, of hurricanes and tropical storms (Wilkinson and Souter 2008). A half degree Celsius increase in temperatures during hurricane season from 1965-2005 correlated with a 40% increase in cyclone activity in the Atlantic. Sea levels have risen an average of 1.7 mm/year over the 20th century due to glacial melting and thermal expansion of ocean water; this rate will likely increase. The current pace is nearly double this, with a 20-year trend of 3.2 millimeter/year (Blunden and Arndt 2013). This is largely due to thermal expansion of water, with minor contributions from melt water (Blunden and Arndt 2013). Based on computer models, these phenomena would inundate nesting beaches of sea turtles, change patterns of coastal erosion and sand accretion that are necessary to maintain those beaches, and would increase the number of turtle nests destroyed by tropical storms and hurricanes (Wilkinson and Souter 2008). Inundation itself reduces hatchling success by creating hypoxic conditions within inundated eggs (Pike et al. 2015). In addition, flatter beaches preferred by smaller sea turtle species would be inundated sooner than would steeper beaches preferred by larger species (Hawkes et al. 2014). The loss of nesting beaches, by itself, would have catastrophic effects on sea turtle populations globally if they are unable to colonize new beaches that form or if the beaches do not provide the habitat attributes (sand depth, temperature regimes, refuge) necessary for egg survival. In some areas, increases in sea level alone may be sufficient to inundate sea turtle nests and reduce hatching success (Caut et al. 2009b). Storms may also cause direct harm to sea turtles, causing “mass” strandings and mortality (Poloczanska et al. 2009). Increasing temperatures in sea turtle nests alters sex ratios, reduces incubation times (producing smaller hatchling), and reduces nesting success due to exceeded thermal tolerances (Fuentes et al. 2009b; Fuentes et al. 2010; Fuentes et al. 2009c). Smaller individuals likely experience increased predation (Fuentes et al. 2009b). These changes can have important implications for the reproductive potential of individuals nesting along the coast of the action area, or individuals nesting elsewhere and traveling to the action area, particularly in reducing a population’s lifetime reproductive potential.

Climactic shifts also occur due to natural phenomena. In the North Atlantic, this primarily concerns fluctuations in the NAO, which results from changes in atmospheric pressure between a semi-permanent high pressure feature over the Azores and a subpolar low pressure area over Iceland (Curry and McCartney 2001; Hurrell 1995; Stenseth et al. 2002a). This interaction affects sea surface temperatures, wind patterns, and oceanic circulation in the North Atlantic (Stenseth et al. 2002a). The NAO shifts between positive and negative phases, with a positive phase having persisted since 1970 (Hurrell 1995). North Atlantic conditions experienced during positive NAO phases include warmer than average winter weather in central and eastern North America and Europe and colder than average temperatures in Greenland and the Mediterranean Sea (Visbeck 2002). Marine debris as an Atlantic-basin threat to ESA-listed turtles.

4.2.2 Marine debris as a broad threat to ESA-listed turtles

Marine debris is another significant concern for ESA-listed species and their habitats. Marine debris has been discovered to be accumulating in gyres throughout the oceans. Law et al. (2010) presented a time series of plastic content at the surface of the western North Atlantic Ocean and Caribbean Sea from 1986 to 2008. More than 60% of 6,136 surface plankton net tows collected small, buoyant plastic pieces. The data identified an accumulation zone east of Bermuda that is similar in size to the accumulation zone in the Pacific Ocean. For sea turtles, marine debris is a problem due primarily to individuals ingesting debris and blocking the digestive tract, causing death or serious injury (Laist et al. 1999; Lutcavage et al. 1997a). Gulko and Eckert (2003) estimated that between one-third and one-half of all sea turtles ingest plastic at some point in their lives; this figure is supported by data from Lazar and Gracan (Lazar and Gračan 2010), who found 35% of loggerheads had plastic in their gut. Plastic is possibly ingested out of curiosity or due to confusion with prey items; for example, plastic bags can resemble jellyfish (Milton and Lutz 2003). Sea turtles can also become entangled and die in marine debris, such as discarded nets and monofilament line (Laist et al. 1999; Lutcavage et al. 1997a; NRC 1990b; O'Hara et al. 1988). This fundamentally reduces the reproductive potential of affected populations, many of which are already declining (such as loggerhead and leatherback sea turtle populations in the action area).

4.2.3 Ship strike of ESA-listed turtles in the North Atlantic

Sea turtle ship strikes are a poorly-studied threat to sea turtles, but have the potential to be highly-significant (Work et al. 2010). All sea turtles must surface to breath and several species are known to bask at the surface for long periods, including loggerhead sea turtles. Although sea turtles can move rapidly, sea turtles apparently are not well able to move out of the way of vessels moving at more than 4 km/h; most vessels move far faster than this in open water (Hazel and Gyuris 2006; Hazel et al. 2007; Work et al. 2010). This, combined with the massive level of vessel traffic in the Gulf of Mexico and coastal Atlantic, has the potential to result in frequent injury and mortality to sea turtles in the region (MMS 2007). Hazel et al. (2007) suggested that green 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. Overall, ship strike is likely highly underestimated as a source of injury or mortality to sea turtles in the action area.

4.2.4 Fisheries bycatch of sea turtles in the North Atlantic

Fishery interaction remains a major factor in sea turtle recovery and, frequently, the lack thereof. Wallace et al. (2010) estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries. NMFS (2002b) estimated that 62,000 loggerhead sea turtles have been killed as a result of incidental capture and drowning in shrimp trawl gear. Although TEDs and other bycatch reduction devices have significantly reduced the level of bycatch of sea turtles and other marine species in U.S. waters, mortality still occurs. The fisheries that have the most significant demographic effect on sea turtles are the Gulf of Mexico shrimp trawl fisheries. The estimated annual number of interactions and mortalities between sea turtles and shrimp trawls in the Gulf shrimp fisheries (state and federal) are believed to have declined versus prior years with the implementation of new regulations on the shrimping industry (Epperly et al. 2002b; Nance et al. 2008) (Table 3). Although participants in this and other fisheries are required to use TEDS, which are estimated to reduce the number of sea turtles trapped in nets by as much as 97%, each year these fisheries are expected to capture about 185,000 sea turtles annually and kill about 5,000 of them. Loggerhead sea turtles account for most of these: capturing about 163,000 loggerhead sea turtles, killing almost 4,000 of them. However, more recent estimates suggest interactions and mortality has decreased from pre-regulatory periods, with a conservative estimate of 26,500 loggerheads captured annually in US Atlantic fisheries causing mortality to 1,400 individuals per year (Finkbeiner et al. 2011). These are followed by green sea turtles: about 18,700 green sea turtles are expected to be captured each year with more than 500 of them dying as a result of their capture (NMFS 2002c). Each year, various fisheries capture about 2,000 loggerhead sea turtles in Pamlico Sound, of which almost 700 die (Finkbeiner et al. 2011). The action area and its surrounding region appears to be a location of moderate sea turtle longline bycatch relative to long-term global levels (Lewison et al. 2014).

Table 3. Estimated annual interactions between sea turtles and shrimp trawls in the Gulf of Mexico shrimp fisheries associated estimated mortalities based on 2007 Gulf effort data taken from Nance et al. (2008).

Species	Estimated interactions	Estimated mortalities
Leatherback	520	15
Loggerhead	23,336	647
Kemp’s ridley	98,184	2,716
Green	11,311	319

Mortality of leatherbacks in the U.S. shrimp fishery is now estimated at 54 turtles per year. Data collected by the Northeast Fisheries Science Center Fisheries Observer Program from 1994 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54 to 92%. Trinidad and Tobago's Institute for Marine Affairs estimated that more than 3,000 leatherbacks were captured incidental to gillnet fishing in the coastal waters of Trinidad in 2000.

Even with TED measures in place, in 2002, NMFS (2002) expected these fisheries to capture about 323,600 sea turtles each year and kill about 5,600 (~1.7%) of the turtles captured. Loggerhead sea turtles account for most of this total: 163,000 captured, killing almost 4,000 (~2.5%) of them. Kemp’s ridleys account for the second-most interactions: 155,503 captures with 4,200 (~2.7%) deaths. These are followed by green sea turtles: about 18,700 captured with more than 500 (~2.7%) dying as a result of capture. Leatherback sea turtle interactions were estimated at 3,090 captures with 80 (~2.6%) deaths as a result (NMFS 2002c). Since 2002, however, effort in the Atlantic shrimp fisheries has declined from a high of 25,320 trips in 2002 to approximately 13,464 trips in 2009, roughly 47% less effort. Since sea turtle takes are directly linked to fishery effort, these takes are expected to decrease proportionately. However, hundreds to a possible few thousand sea turtle interactions are expected annually, with hundreds of deaths (NMFS 2014).

Portions of the Atlantic pelagic fisheries for swordfish, tuna, shark, and billfish also operate in the action area and capture and kill the second highest number of sea turtles along the Atlantic coast. These fisheries include purse seine fisheries for tuna, harpoon fisheries for tuna and swordfish, commercial and recreational rod and reel fisheries, gillnet fisheries for shark, driftnet fisheries, pelagic longline fisheries, and bottom longline fisheries. Lewison et al. (2004) estimated that 30,000-60,000 leatherbacks were taken in all Atlantic longline fisheries in 2000 (including the US Atlantic tuna and swordfish longline fisheries, as well as others). Between 1992 and 1998, the longline components of these fisheries are estimated to have captured more than 10,000 sea turtles (4,585 leatherback sea turtles and 5,280 loggerhead sea turtles), killing 168 of these, not including sea turtles that might have died after being released (Johnson et al.

1999; Yeung 1999). Finkbeiner et al. (2011) estimated that annual bycatch interactions total 1,400 leatherbacks annually for US Atlantic fisheries (resulting in roughly 40 mortalities).

On 4 July 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. This is expected to have significantly reduced sea turtle mortality from pelagic longlines.

In 2008, the Southeast Fisheries Science Center observer programs and subsequent analyses indicated that the overall amount and extent of incidental take for sea turtles specified in the ITS of the 2005 Opinion on the reef fish fishery had been severely exceeded by the bottom longline component of the fishery (approximately 974 captures and at least 325 mortalities estimated for the period July 2006-2007). The 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 a prohibition on the use of bottom longline gear in the Gulf of Mexico reef fish fishery, shoreward of a line approximating the 35-fathom contour east of Cape San Blas, Florida, from June through August; 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 of Mexico reef fish bottom longline vessel to 1,000, only 750 of which may be rigged for fishing. These changes are expected to greatly reduce the mortality of loggerhead sea turtles resulting from the operation of this fishery.

Observation of the directed highly migratory shark fisheries has been ongoing since 1994, but a mandatory program was not implemented until 2002. Neritic juvenile and adult loggerhead sea turtles are the primary species taken, but leatherback sea turtles have also been observed caught. From 1994-2002, observers covered 1.6% of all hooks, observing bycatch of 31 loggerhead, 4 leatherback, and 8 unidentified sea turtles with estimated annual average take levels of 30, 222, and 56, respectively (NMFS 2003).

4.2.5 Green sea turtle

Populations. Populations are distinguished generally by ocean basin and more specifically by nesting location. However, NMFS recently proposed to designate green sea turtles in the North Atlantic as a separate DPS (80 FR 15271) based upon genetic discreetness and lack of overlap in breeding range of other DPSs (Seminoff et al. 2015).

Distribution. Green sea turtles have a circumglobal distribution, occurring throughout tropical, subtropical waters, and, to a lesser extent, temperate waters. Occurrence in the region around the action area tends to be higher in continental shelf waters and highest in winter and spring (BOEM 2015; IOC 2014; U.S. Navy 2008a; U.S. Navy 2008b; Waring et al. 2012).

Growth and reproduction. Most green sea turtles exhibit particularly slow growth rates, which have been attributed to their largely plant-eating diet (Bjorndal 1982). Growth rates of juveniles vary substantially among populations, ranging from <1 centimeters (cm)/year (Green 1993) to >5 cm/year (McDonald Dutton and Dutton 1998), likely due to differences in diet quality, duration of foraging season (Chaloupka et al. 2004), and density of turtles in foraging areas (Balazs and Chaloupka 2004; Bjorndal et al. 2000; Seminoff et al. 2002b). Hart et al. (2013a) found growth rates of green sea turtles in the US Virgin Islands to range from 0 to 9.5 cm annually (mean of 4.1, Standard deviation of 2.4). The largest growth rates were in the 30-39 cm class. If individuals do not feed sufficiently, growth is stunted and apparently does not compensate even when greater-than-needed resources are available (Roark et al. 2009). In general, there is a tendency for green sea turtles to exhibit monotonic growth (declining growth rate with size) in the Atlantic and non-monotonic growth (growth spurt in mid-size classes) in the Pacific, although this is not always the case (Balazs and Chaloupka 2004; Chaloupka and Musick 1997; Seminoff et al. 2002b). It is estimated that green sea turtles reach a maximum size just under 100 cm in carapace length (Tanaka 2009). A female-bias has been identified from studies of green sea turtles (Wibbels 2003).

Consistent with slow growth, age-to-maturity for green sea turtles appears to be the longest of any sea turtle species and ranges from about 20 to 40 years or more (Balazs 1982; Chaloupka et al. 2004; Chaloupka and Musick 1997; Frazer and Ehrhart 1985b; Hirth 1997; Limpus and Chaloupka 1997; Seminoff et al. 2002b; Zug et al. 2002; Zug and Glor 1998). Estimates of reproductive longevity range from 12 to 26 years in the North Atlantic beaches studied (Frazer and Ladner 1986; Richards et al. 2011). Considering that mean duration between females returning to nest ranges from 2 to 3 years (Troëng and Chaloupka 2007a; Witherington and Ehrhart 1989; Zurita et al. 1994), these reproductive longevity estimates suggest that a female may nest 3 to 11 seasons over the course of her life. Each female deposits 1-7 clutches (usually 2-3) during the breeding season at 9-18 day intervals (Hart et al. 2013b; Johnson and Ehrhart 1996; Troeng et al. 2005; Witherington and Ehrhart 1989). Mean clutch size is highly variable among populations, but averages 110-115 eggs/nest. Roughly 62% of eggs hatch in Florida nests (Seminoff et al. 2015). Females usually have 2-4 or more years between breeding seasons, whereas males may mate every year (Balazs 1983). Based on reasonable means of three nests per season and 100 eggs per nest (Hirth 1997), a female may deposit 9 to 33 clutches, or about 900 to 3,300 eggs, during her lifetime. Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010). Temperatures affects sex determination, with 81% of green sea turtle eggs being female in Florida nests (Rogers 2013).

Once hatched, sea turtles emerge and orient towards a light source, such as light shining off the ocean. They enter the sea in a “frenzy” of swimming activity, which decreases rapidly in the first few hours and then gradually over the first several weeks (Ischer et al. 2009; Okuyama et al. 2009). Factors in the ocean environment have a major influence on reproduction (Chaloupka 2001; Limpus and Nicholls 1988; Solow et al. 2002). It is also apparent that during years of heavy nesting activity, density dependent factors (beach crowding and digging up of eggs by nesting females) may impact hatchling production (Tiwari et al. 2005; Tiwari et al. 2006). Precipitation, proximity to the high tide line, and nest depth can also significantly affect nesting success (Cheng et al. 2009). Precipitation can also be significant in sex determination, with greater nest moisture resulting in a higher proportion of males (Leblanc and Wibbels 2009). Green sea turtles often return to the same foraging areas following nesting migrations (Broderick et al. 2006; Godley et al. 2002). Once there, they move within specific areas, or home ranges, where they routinely visit specific localities to forage and rest (Godley et al. 2003; Makowski et al. 2006; Seminoff and Jones 2006; Seminoff et al. 2002a; Taquet et al. 2006). It is also apparent that some green sea turtles remain in pelagic habitats for extended periods, perhaps never recruiting to coastal foraging sites (Pelletier et al. 2003).

In general, survivorship tends to be lower for juveniles and subadults than for adults. Adult survivorship has been calculated to range from 0.82-0.97 versus 0.58-0.89 for juveniles (Chaloupka and Limpus 2005; Seminoff et al. 2003; Troëng and Chaloupka 2007b), with lower values coinciding with areas of human impact on green sea turtles and their habitats (Bjorndal et al. 2003; Campbell and Lagueux 2005).

Habitat. Green turtles appear to prefer waters that usually remain around 20º (C) in the coldest month, but may occur considerably north of these regions during warm-water events, such as El Niño. Stinson (1984) found green turtles to appear most frequently in US coastal waters with temperatures exceeding 18º C. Further, green sea turtles seem to occur preferentially in drift lines or surface current convergences, probably because of the prevalence of cover and higher prey densities that associate with flotsam. For example, in the western Atlantic Ocean, drift lines commonly containing floating *Sargassum* spp. are capable of providing juveniles with shelter (NMFS and USFWS 1998). Underwater resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance. Available information indicates that green turtle resting areas are near feeding areas (Bjorndal and Bolten 2000). Strong site fidelity appears to be a characteristic of juveniles green sea turtles along the Pacific Baja coast (Senko et al. 2010).

Green sea turtles in the Gulf of Mexico tend to remain along the coast (lagoons, channels, inlets, and bays), with nesting primarily occurring in Florida and Mexico and infrequent nesting in all other areas (Landry and Costa 1999; Meylan et al. 1995a; NMFS and USFWS 1991; USAF 1996). Foraging areas seem to be based upon seagrass and macroalgae abundance, such as in the Laguna Madre of Texas. However, green sea turtles may also occur in offshore regions, particularly during migration and development. Sea turtles frequently forage far from their nesting beaches. Sea turtles foraging in the western Gulf of Mexico almost exclusively stem from Gulf of Mexico and northern Caribbean rookeries (Anderson et al. 2013).

Diving. Based on the behavior of post-hatchlings and juvenile green turtles raised in captivity, we presume that those in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters in depth (Hazel et al. 2009; NMFS and USFWS

1998). Recent data from Australia indicate green sea turtles rarely dive deep, staying in upper 8 m of the water column (Hazel et al. 2009). Also, time spent resting and dive duration increased significantly with decreases in seasonal water temperatures. The maximum recorded dive depth for an adult green turtle was just over 106 m (Berkson 1967), while subadults routinely dive to 20 m for 9-23 min, with a maximum recorded dive of over 1 hr (Brill et al. 1995; I-Jiunn 2009). Green sea turtles along Taiwan may rest during long, shallow dives (I-Jiunn 2009). Dives by females may be shorter in the period leading up to nesting (I-Jiunn 2009).

Vocalization and hearing. Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999b; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50-1,600 Hz (maximum sensitivity at 200-400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50-1600 Hz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200-400 Hz for the green turtle with a range of 100-500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999b). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

Status and trends. Federal listing of the green sea turtle occurred on July 28, 1978, with all populations listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are endangered (43 FR 32800). The International Union for Conservation of Nature (IUCN) has classified the green turtle as “endangered.”

On March 23, 2015, NMFS proposed to relist green sea turtles as separate DPSs globally (80 FR 15271). If finalized, the new listing designations would have the North Atlantic DPS (proposed threatened) co-occurring with the action area. The North Atlantic DPS extends from the boundary of South and Central America, north to 10.5°N, 77°W, then extending due east across the Atlantic Ocean at 19°N latitude to the African continent, and extending north along the western coasts of Africa and Europe (west of 5.5°W longitude) to 48°N latitude (Figure 3).

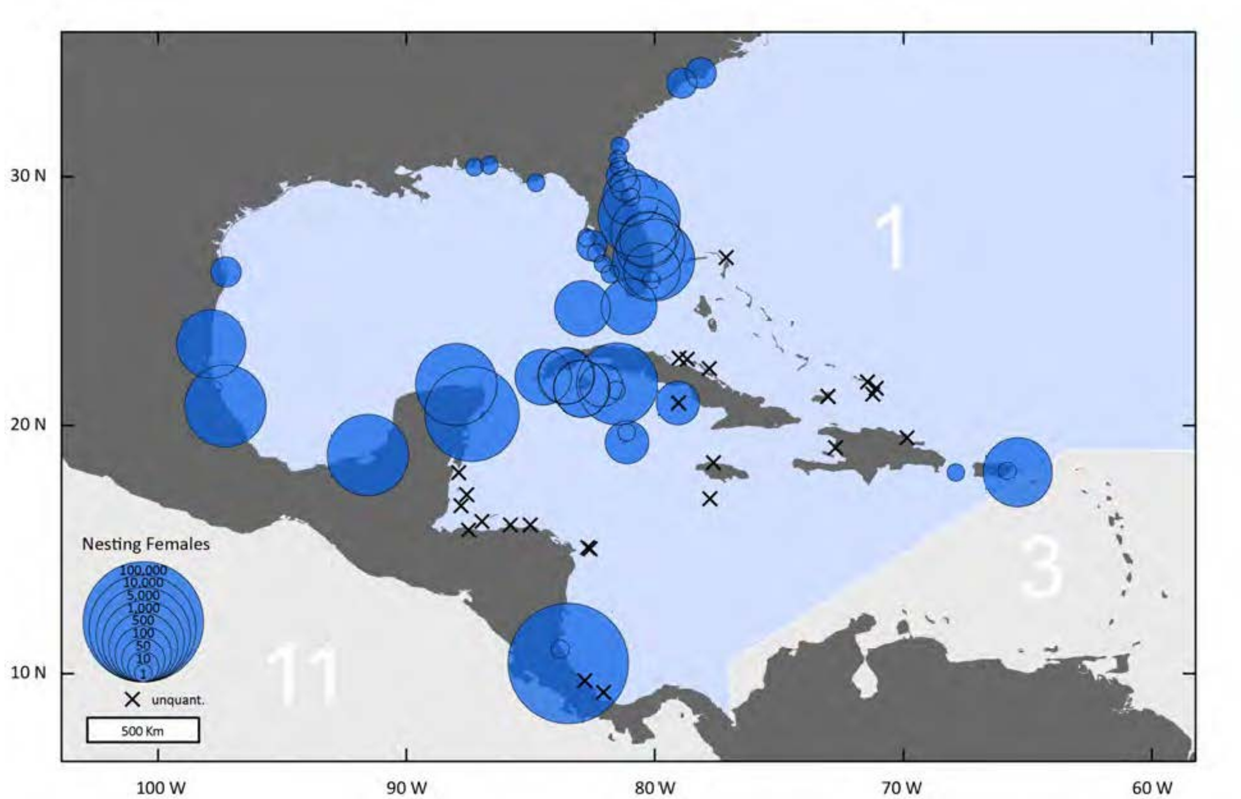

Figure 3. Close up of nesting distribution of green turtles in the proposed North Atlantic DPS (blue shading). Size of circles indicates estimated nester abundance. Locations marked with 'x' indicate nesting sites lacking abundance information (Limpus 2008).

No trend data are available for almost half of the important nesting sites, where numbers are based on recent trends and do not span a full green sea turtle generation, and impacts occurring over four decades ago that caused a change in juvenile recruitment rates may have yet to be manifested as a change in nesting abundance. The numbers also only reflect one segment of the population (nesting females), who are the only segment of the population for which reasonably good data are available and are cautiously used as one measure of the possible trend of populations.

Atlantic Ocean. A total of 73 nesting beaches are known to host green sea turtle nesting in the North Atlantic, of which 48 have been assessed for abundance (Seminoff et al. 2015). Primary sites for green sea turtle nesting in the Atlantic/Caribbean include: (1) Yucatán Peninsula, Mexico; (2) Tortuguero, Costa Rica; (3) Aves Island, Venezuela; (4) Galibi Reserve, Suriname; (5) Isla Trindade, Brazil; (6) Ascension Island, United Kingdom; (7) Bioko Island, Equatorial Guinea; and (8) Bijagos Achipelago, Guinea-Bissau (NMFS and USFWS 2007a). Nesting at all of these sites was considered to be stable or increasing with the exception of Bioko Island and the Bijagos Archipelago where the lack of sufficient data precludes a meaningful trend assessment for either site (NMFS and USFWS 2007a). Tortuguero hosts roughly 79% of the 167,000 nesters estimated to occur in the North Atlantic DPS (Seminoff et al. 2015).

Seminoff (2004) reviewed green sea turtle nesting data for eight sites in the western, eastern, and central Atlantic. Seminoff (2004) concluded that all sites in the central and western Atlantic showed increased nesting, with the exception of nesting at Aves Island, Venezuela, while both sites in the eastern Atlantic demonstrated decreased nesting. These sites are not inclusive of all green sea turtle nesting in the Atlantic. However, other sites are not believed to support nesting levels high enough that would change the overall status of the species in the Atlantic (NMFS and USFWS 2007a). Only one nester was observed in 2011-2012 in Manatee County (Seminoff et al. 2015), which forms the southern border of the action area.

By far, the most important nesting concentration for green sea turtles in the western Atlantic is in Tortuguero, Costa Rica (NMFS and USFWS 2007a). Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggest nesting by 17,402-37,290 females per year (NMFS and USFWS 2007a). The number of females nesting per year on beaches in the Yucatán, at Aves Island, Galibi Reserve, and Isla Trindade number in the hundreds to low thousands, depending on the site (NMFS and USFWS 2007a).

The vast majority of green sea turtle nesting within the southeastern US occurs in Florida (Johnson and Ehrhart 1994; Meylan et al. 1995b). Green sea turtle nesting in Florida has been increasing since 1989 (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute Index Nesting Beach Survey Database). Since establishment of index beaches in 1989, the pattern of green turtle nesting shows biennial peaks in abundance with a generally positive trend during the ten years of regular monitoring. This is perhaps due to increased protective legislation throughout the Caribbean (Meylan et al. 1995b). A total statewide average (all beaches, including index beaches) of 5,039 green turtle nests were laid annually in Florida between 2001 and 2006, with a low of 581 in 2001 and a high of 9,644 in 2005 (NMFS and USFWS 2007a). Data from index nesting beaches substantiate the dramatic increase in nesting. In 2007, there were 9,455 green turtle nests found just on index nesting beaches, the highest since index beach monitoring began in 1989. The number fell back to 6,385 in 2008, further dropping under 3,000 in 2009, but that consecutive drop was a temporary deviation from the normal biennial nesting cycle for green turtles, as 2010 saw an increase back to 8,426 nests on the index nesting beaches (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute Index Nesting Beach Survey Database). Occasional nesting has been documented along the Gulf coast of Florida (Meylan et al. 1995b). More recently, green turtle nesting occurred on Bald Head Island, North Carolina; just east of the mouth of the Cape Fear River; on Onslow Island; and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Recent modeling by Chaloupka et al. (2008) using data sets of 25 years or more has resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9%, and the Tortuguero, Costa Rica, population growing at 4.9%.

There are no reliable estimates of the number of immature green sea turtles that inhabit coastal areas of the southeastern US. However, information on incidental captures of immature green sea turtles at the St. Lucie Power Plant in St. Lucie County, Florida, shows that the annual number of immature green sea turtles captured by their offshore cooling water intake structures has increased significantly. Green sea turtle annual captures averaged 19 for 1977-1986, 178 for 1987-1996, and 262 for 1997-2001 (Florida Power and Light Company St. Lucie Plant 2002). More recent unpublished data shows 101 captures in 2007, 299 in 2008, 38 in 2009 (power output was cut—and cooling water intake concomitantly reduced—for part of that year) and 413 in 2010. Ehrhart et al. (2007) documented a significant increase in in-water abundance of green turtles in the Indian River Lagoon area.

Connectivity of nesting groups seems good, with a given foraging region generally supporting individuals from multiple breeding areas (Seminoff et al. 2015).

Natural threats. Herons, gulls, dogfish, and sharks prey upon hatchlings. Adults face predation primarily by sharks and to a lesser extent by killer whales. Predators (primarily of eggs and hatchlings) also include dogs, pigs, rats, crabs, sea birds, reef fishes, and groupers (Bell et al. 1994; Witzell 1981). All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can be lethal. Several such events have occurred over the past decade from Texas to New England, involving hundreds of green sea turtles each time (Seminoff et al. 2015). For unknown reasons, the frequency of a disease called fibropapillomatosis is much higher in green sea turtles than in other species and threatens a large number of existing subpopulations. The incidence of fibropapillomatosis varies widely by location (including areas close to one another), but ranges from 8-72% in Florida waters and seems to be linked to degradation of foraging habitat (Seminoff et al. 2015). A to-date unidentified virus may aid in the development of fibropapillomatosis (Work et al. 2009). Green sea turtles with an abundance of barnacles have been found to have a much greater probability of having health issues (Flint et al. 2009). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* can kill in excess of 90% of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

Anthropogenic threats. Major anthropogenic impacts to the nesting and marine environment affect green sea turtle survival and recovery (Patino-Martinez 2013). At nesting beaches, green sea turtles rely on intact dune structures, native vegetation, and normal beach temperatures for nesting (Ackerman 1997). Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997b). These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to nesting females and may evoke a change in the natural behaviors of adults and hatchlings (Ackerman 1997; Witherington et al. 2003; Witherington et al. 2007). Ingestion of plastic and other marine debris is another source of morbidity and mortality (Stamper et al. 2009), apparently due to the resemblance to jellyfish prey (Schuyler et al. 2014). Marine debris easily blocks the digestive tract (Santos et al. 2015). Vessel strike has been documented in about 18% of stranded green sea turtles in the southeastern US from 2005 to 2009, so vessel strike is likely a significant cause of injury and mortality in the region (Seminoff et al. 2015). Further, the introduction of alien algae species threatens the stability of some coastal ecosystems and may lead to the elimination of preferred dietary species of green sea turtles (De Weede 1996). Low-level bycatch has also been documented in longline fisheries (Petersen et al. 2009). From 1997 to 2009, 481 (just under 10%) of stranded green sea turtles in Florida were reported entangled, hooked, or otherwise involved with fishery gear such as hook and lines or trap pots (Seminoff et al. 2015). Very few green sea turtles are bycaught in US fisheries (Finkbeiner et al. 2011), with the exception of shrimp trawl fisheries. From 1997 to 1998, Epperly et al. (2002a) estimated 48,239 green sea turtle interactions with shrimp trawls. NMFS (2002a) estimated 4,620-7,055 green sea turtles are killed or injured in Gulf of Mexico and southern US shrimp trawls annually. Between 1991 and 2011, an average of 8,169 green sea turtles were harvested annually along the Caribbean coast of Nicaragua (over 171,000 over this period); a rate that has been in decline potentially due to population depletion (Lagueux et al. 2014). Low-levels of female nester and egg harvest occur at Tortuguero Beach, but are much reduced compared to former levels (Seminoff et al. 2015). Green sea turtles are also harvested illegally in Cuba (Seminoff et al. 2015). Nicaragua formerly harvested 10,000 green sea turtles annually until the practice was outlawed in 1977 (Seminoff et al. 2015). Illegal levels are now reduced, but remain a threat for local breeding groups as thousands of turtles have still been taken in recent years (Seminoff et al. 2015). Harvesting, either legal or illegal, also continues in Belize, Puerto Rico, The Bahamas, Jamaica, and the Cayman Islands (Seminoff et al. 2015).

Sea level rise may have significant impacts upon green turtle nesting on Pacific atolls. These low-lying, isolated locations could be inundated by rising water levels associated with global warming, eliminating nesting habitat (Baker et al. 2006; Fuentes et al. 2010). Green sea turtles along Florida nest earlier in association with higher sea surface temperatures (Weishampel et al. 2010). Fuentes et al. (2010) predicted that rising temperatures would be a much greater threat in the long term to the hatching success of sea turtle turtles in general and green sea turtles along northeastern Australia particularly. Green sea turtles emerging from nests at cooler temperatures likely absorb more yolk that is converted to body tissue than do hatchlings from warmer nests (Ischer et al. 2009). Predicted temperature rises may approach or exceed the upper thermal tolerance limit of sea turtle incubation, causing widespread failure of nests (Fuentes et al. 2010). Although the timing of loggerhead nesting depends upon sea-surface temperature, green sea turtles do not appear to be affected (Pike 2009).

Green sea turtles have been found to contain the organochlorines chlordane, lindane, endrin, endosulfan, dieldrin, DDT, and PCB (Gardner et al. 2003; Miao et al. 2001). Levels of PCBs found in eggs are considered far higher than what is fit for human consumption (Van de Merwe et al. 2009). The heavy metals copper, lead, manganese, cadmium, and nickel have also been found in various tissues and life stages (Barbieri 2009). Arsenic also occurs in very high levels in green sea turtle eggs (Van de Merwe et al. 2009). These contaminants have the potential to cause deficiencies in endocrine, developmental, and reproductive health, as well as depress immune function in loggerhead sea turtles (Keller et al. 2006; Storelli et al. 2007). Exposure to sewage effluent may also result in green sea turtle eggs harboring antibiotic-resistant strains of bacteria (Al-Bahry et al. 2009). The chemical DDE has not been found to influence sex determination at levels below cytotoxicity (Keller and McClellan-Green 2004; Podreka et al. 1998). To date, no tie has been found between pesticide concentration and susceptibility to fibropapillomatosis, although degraded habitat and pollution have been tied to the incidence of the disease (Aguirre et al. 1994; Foley et al. 2005). Flame retardants have been measured from healthy individuals (Hermanussen et al. 2008). It has been theorized that exposure to tumor-promoting compounds produced by the cyanobacteria *Lyngbya majuscule* could promote the development of fibropapillomatosis (Arthur et al. 2008). It has also been theorized that dinoflagellates of the genus *Prorocentrum* that produce the tumorogenic compound okadoic acid may influence the development of fibropapillomatosis (Landsberg et al. 1999).

4.2.6 Kemp’s ridley sea turtle

Population. Kemp’s ridley sea turtles are considered to consist of a single population, although expansion of nesting may indicate differentiation.

Distribution. The Kemp's ridley was formerly known only from the Gulf of Mexico and along the Atlantic coast of the US (TEWG 2000b). However, recent records support Kemp’s ridley sea turtles distribution extending into the Mediterranean Sea on occasion (Tomas and Raga 2008). The vast majority of individuals stem from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of Mexico. Kemp’s ridley sightings in the Mid-Atlantic Bight are largely over the continental shelf, with a few summer sightings over the continental shelf break (Belford et al. 2014; Danton and Prescott 1988; Frazier et al. 2007; IOC 2014; Morreale et al. 1989; Musick et al. 1994). Sightings in the region around the lease blocks are most numerous in winter (Waring et al. 2012). However, strandings occur most frequently in spring and fall (U.S. Navy 2008a; U.S. Navy 2008b).

Growth and reproduction. Kemp's ridleys require approximately 1.5 to two years to grow from a hatchling to a size of approximately 7.9 inches long, at which size they are capable of making a transition to a benthic coastal immature stage, but can range from one to four years or more (Caillouet et al. 1995; Ogren 1989; Schmid 1998; Schmid and Witzell 1997b; Snover et al. 2007b; TEWG 2000b; Zug et al. 1997). Based on the size of nesting females, it is assumed that turtles must attain a size of approximately 23.6 inches long prior to maturing (Marquez-M. 1994). Growth models based on mark-recapture data suggest that a time period of seven to nine years would be required for this growth from benthic immature to mature size (Schmid and Witzell 1997b; Snover et al. 2007b). Currently, age to sexual maturity is believed to range from approximately 10 to 17 years for Kemp's ridleys (Caillouet Jr. et al. 1995; Schmid and Witzell 1997a; Snover et al. 2007a; Snover et al. 2007b). However, estimates of 10 to 13 years predominate in previous studies (Caillouet et al. 1995; Schmid and Witzell 1997b; TEWG 2000b).

Diving. Kemp’s ridley sea turtles can dive from a few seconds in duration to well over two and a half hours, although most dives are from 16 to 34 minutes (Mendonca and Pritchard 1986; Renaud 1995a). Individuals spend the vast majority of their time underwater; over 12-hour periods, 89% to 96% of their time is spent below the surface (Byles 1989b; Gitschlag 1996).

Vocalization and hearing. Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999b; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Juvenile Kemp‘s ridleys can hear from 100 to 500 Hz, with a maximum sensitivity between 100 and 200 Hz at thresholds of 110 dB re 1 μPa (Moein Bartol and Ketten 2006).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles are respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3000 Hz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1000 Hz and almost no responses beyond 3000 or 4000 Hz (Patterson 1966).

Habitat. Stranding data indicate that immature turtles in this benthic stage are found in coastal habitats of the entire Gulf of Mexico and US Atlantic coast (Morreale et al. 2007; TEWG 2000b). Developmental habitats for juveniles occur throughout the entire coastal Gulf of Mexico and US Atlantic coast northward to New England (Morreale et al. 2007; Schmid 1998; Wibbels et al. 2005). Key foraging areas in the Gulf of Mexico include Sabine Pass, Texas; Caillou Bay and Calcasieu Pass, Louisiana; Big Gulley, Alabama; Cedar Keys, Florida; and Ten Thousand Islands, Florida (Carr and Caldwell 1956; Coyne et al. 1995; Ogren 1989; Schmid 1998; Schmid et al. 2002; Witzell et al. 2005b). Foraging areas studied along the Atlantic coast include Pamlico Sound, Chesapeake Bay, Long Island Sound, Charleston Harbor, and Delaware Bay. Near-shore waters of 120 feet or less provide the primary marine habitat for adults, although it is not uncommon for adults to venture into deeper waters (Byles 1989a; Mysing and Vanselous 1989; Renaud et al. 1996; Shaver et al. 2005; Shaver and Wibbels 2007a).

Benthic coastal waters of Louisiana and Texas seem to be preferred foraging areas for Kemp’s ridley sea turtles (particularly passes and beachfronts), although individuals may travel along the entire coastal margin of the Gulf of Mexico (Landry and Costa 1999; Landry et al. 1996; Renaud 1995b). Sightings are less frequent during winter and spring, but this is likely due to lesser sighting effort during these times (Keinath et al. 1996; Shoop and Kenney 1992b).

Status and trends. The Kemp’s ridley sea turtle was listed as endangered on December 2, 1970 (35 FR 18319). Internationally, the Kemp’s ridley is considered the most endangered sea turtle (NRC 1990a; USFWS 1999).

During the mid-20th century, the Kemp's ridley was abundant in the Gulf of Mexico. Historic information indicates that tens of thousands of Kemp’s ridleys nested near Rancho Nuevo, Mexico, during the late 1940s (Hildebrand 1963). From 1978 through the 1980s, arribadas were 200 turtles or less, and by 1985, the total number of nests at Rancho Nuevo had dropped to approximately 740 for the entire nesting season, or a projection of roughly 234 turtles (TEWG 2000b; USFWS and NMFS 1992). Beginning in the 1990s, an increasing number of beaches in Mexico were being monitored for nesting, and the total number of nests on all beaches in Tamaulipas and Veracruz in 2002 was over 6,000; the rate of increase from 1985 ranged from 14-16% (Heppell et al. 2005; TEWG 2000b; USFWS 2002). In 2006, approximately 7,866 nests were laid at Rancho Nuevo with the total number of nests for all the beaches in Mexico estimated at about 12,000 nests, which amounted to about 4,000 nesting females based upon three nests per female per season (Rostal 2007; Rostal et al. 1997; USFWS 2006). Considering remigration rates, the population included approximately 7,000 to 8,000 adult female turtles at that time (Marquez et al. 1989; Rostal 2007; TEWG 2000b). The 2007 nesting season included an arribada of over 4,000 turtles over a three-day period at Rancho Nuevo (P. Burchfield, pers. comm. in NMFS and USFWS 2007c). The increased recruitment of new adults is illustrated in the proportion of first time nesters, which has increased from 6% in 1981 to 41% in 1994. Average population growth was estimated at 13% per year between 1991 and 1995 (TEWG 1998). In 2008, there were 17,882 nests in Mexico (Gladys Porter Zoo 2008), and nesting in 2009 reached 21,144 (Burchfield 2010). In 2010, nesting declined significantly, to 13,302 but it is too early to determine if this is a one-time decline or if is indicative of a change in the trend. Preliminary estimates of 2011 and 2012 nesting supports 19,368 and 20,197 nests, respectively (back to 2009 levels)(Gallaway et al. 2013). Population modeling used by the TEWG (2000a) projected that Kemp’s ridleys could reach the recovery plan’s intermediate recovery goal of 10,000 nesters by the year 2015. Recent calculations of nesting females determined from nest counts show that the population trend is increasing towards that recovery goal, with an estimate of 4,047 nesters in 2006 and 5,500 in 2007 (NMFS and USFWS 2007b). Over one million hatchlings were released in 2011 and 2012 (Gallaway et al. 2013).

Nesting has also expanded geographically, with a Headstart program reestablishing nesting on South Padre Island starting in 1978. Growth remained slow until 1988, when rates of return started to grow slowly (Shaver and Wibbels 2007b). Nesting rose from 6 in 1996 to 128 in 2007, 195 in 2008, and 197 in 2009. Texas nesting then experienced a decline similar to that seen in Mexico for 2010, with 140 nests (National Park Service data, http://www.nps.gov/pais/naturescience/strp.htm), but nesting rebounded in 2011 with a record 199 nests (National Park Service data, http://www.nps.gov/pais/naturescience/current-season.htm). Gallaway et al. (2013) estimated that nearly 189,000 female Kemp’s ridley sea turtles over the age of two years were alive in 2012. Extrapolating based upon sex bias, the authors estimated that nearly a quarter million age-two or older Kemp’s ridleys were alive at this time.

Natural threats. Sea turtles face predation primarily by sharks and to a lesser extent by killer whales. All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can pose lethal effects. Kemp's ridley sea turtles are particularly prone to this phenomenon along Cape Cod (Innis et al. 2009). In the last five years (2006-2010), the number of cold-stunned turtles on Cape Cod beaches averaged 115 Kemp's ridleys. The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* can kill in excess of 90% of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

Anthropogenic threats. Population decline has been curtailed due to the virtual elimination of sea turtle and egg harvesting, as well as assistance in hatching and raising hatchlings (head-start). However, habitat destruction remains a concern in the form of bottom trawling and shoreline development. Trawling destroys habitat utilized by Kemp's ridley sea turtles for feeding and construction activities can produce hazardous runoff. Bycatch is also a source of mortality for Kemp's ridley sea turtles (McClellan et al. 2009), with roughly three-quarters of annual mortality attributed to shrimp trawling prior to turtle excluder device (TED) regulations (Gallaway et al. 2013). However, this has dropped to an estimated one-quarter of total mortality nearly 20 years after TEDS were implemented in 1990 (Gallaway et al. 2013). In 2010, due to reductions in shrimping effort and TED use, shrimp-trawl related mortality appears to have dropped to 4% (1,884) of total mortality (65,505 individuals)(Gallaway et al. 2013). This increased to 3,300 individuals in 2012 (20% of total mortality)(Gallaway et al. 2013). Finkbeiner et al. (2011) estimated that annual bycatch interactions total at least 98,300 individuals annually for US Atlantic fisheries (resulting in 2,700 mortalities or more). The vast majority of fisheries interactions with sea turtles in the US are either Kemp's ridley's or loggerhead sea turtles (Finkbeiner et al. 2011). In addition to commercial bycatch, recreational hook-and-line interaction also occurs. Cannon and Flanagan (1996) reported that from 1993 to 1995, at least 170 Kemp's ridley sea turtles were hooked or tangled by recreational hook-and-line gear in the northern Gulf of Mexico. Of these, 18 were dead stranded turtles, 51 were rehabilitated turtles, five died during rehabilitation, and 96 were reported as released by fishermen.

Toxin burdens in Kemp's ridley sea turtles include DDT, DDE, PCBs, perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), chlordane, and other organochlorines (Keller et al. 2005; Keller et al. 2004a; Lake et al. 1994; Rybitski et al. 1995). These contaminants have the potential to cause deficiencies in endocrine, developmental and reproductive health, and are known to depress immune function in loggerhead sea turtles (Keller et al. 2006b; Storelli et al. 2007b). Along with loggerheads, Kemp's ridley sea turtles have higher levels of PCB and DDT than leatherback and green sea turtles (Pugh and Becker 2001b). Organochlorines, including DDT, DDE, DDD, and PCBs have been identified as bioaccumulative agents and in greatest concentration in subcutaneous lipid tissue (Rybitski et al. 1995). Concentrations ranged from 7.46 mu g/kg to 607 mu g/kg, with a mean of 252 mu g/kg in lipid tissue. Five PCB congeners composed most of the contaminants: 153/132, 138/158, 180, 118, and 187 in order of concentration. PCBs have also been identified in the liver, ranging in concentration from 272 nanograms (ng)/g to 655 ng/g of wet weight, values that are several fold higher than in other sea turtle species (Lake et al. 1994). However, concentrations are reportedly 5% of that which causes reproductive failure in snapping turtles. DDE was identified to range from 137 ng/g to 386 ng/g wet weight. Trans-nonachlor was found at levels between 129 ng/g and 275 ng/g wet weight. Blood samples may be appropriate proxies for organochlorines in other body tissues (Keller et al. 2004a).

Perfluorinated compounds in the forms of PFOA and PFOS have been identified in the blood of Kemp's ridley turtles at concentrations of 39.4 ng/mL and 3.57 ng/mL, respectively (Keller et al. 2005). Perfluorinated carboxylic acids have also been detected. It is likely that age and habitat are linked to Perfluorinated compound bioaccumulation.

Oil can also be hazardous to Kemp's ridley turtles, with fresh oil causing significant mortality and morphological changes in hatchlings, but aged oil having no detectable effects (Fritts and McGehee 1981). Blood levels of metals are lower in Kemp's ridley sea turtles than in other sea turtles species or similar to them, with copper (215 ng/g to 1,300 ng/g), lead (0 to 34.3 ng/g), mercury (0.5 ng/g to 67.3 ng/g), silver (0.042 ng/g to 2.74 ng/g), and zinc (3,280 ng/g to 18,900 ng/g) having been identified (Innis et al. 2008; Orvik 1997). It is likely that blood samples can be used as an indicator of metal concentration. Mercury has been identified in all turtle species studied, but are generally an order of magnitude lower than toothed whales. The higher level of contaminants found in Kemp's ridley sea turtles are likely due to this species tendency to feed higher on the food chain than other sea turtles. Females from sexual maturity through reproductive life should have lower levels of contaminants than males because contaminants are shared with progeny through egg formation.

4.2.7 Leatherback sea turtle

Populations. Leatherbacks break into four nesting aggregations: Pacific, Atlantic, and Indian oceans, and the Caribbean Sea. Detailed population structure is unknown, but is likely dependent upon nesting beach location.

Atlantic Ocean. Previous genetic analyses of leatherbacks using only mitochondrial deoxyribonucleic acid (DNA) resulted in an earlier determination that within the Atlantic basin there are at least three genetically different nesting populations: the St. Croix nesting population (US Virgin Islands), the mainland nesting Caribbean population (Florida, Costa Rica, Suriname/French Guiana)(Bräutigam and Eckert 2006; Márquez 1990; Spotila et al. 1996), and the Trinidad nesting population (Dutton et al. 1999). Further genetic analyses using microsatellite markers in nuclear DNA along with the mitochondrial DNA data and tagging data has resulted in Atlantic Ocean leatherbacks now being divided into seven groups or breeding populations: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG 2007a).

Distribution. Leatherbacks range farther than any other sea turtle species, having evolved physiological and anatomical adaptations that allow them to exploit cold waters (Frair et al. 1972; Greer et al. 1973; USFWS 1995). High-latitude leatherback range includes in the Atlantic includes the North and Barents Seas, Newfoundland and Labrador, Argentina, and South Africa (Goff and Lien 1988; Hughes et al. 1998; Luschi et al. 2003; Luschi et al. 2006; Márquez 1990; Threlfall 1978). Sightings have been made in the region surrounding the action area year-round in both continental shelf and deeper offshore waters (Waring et al. 2012). Sightings are most common over the continental shelf to the shelf break, but sightings in deeper water are also frequent (Belford et al. 2014).

Growth and reproduction. It has been thought that leatherbacks reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range of 3-6 (Rhodin 1985) or 13-14 years (Zug and Parham 1996). However, recent research suggests otherwise, with western North Atlantic leatherbacks possibly not maturing until as late as 29 years of age (Avens and Goshe 2007; Avens and Goshe 2008; Avens et al. 2009). Female leatherbacks nest frequently (up to 13, average of 5-7 nests per year and about every 2-3 years; Eckert et al. 2012). The average number of eggs per clutch is roughly 85 in the Atlantic Ocean (>100 eggs; Eckert et al. 2012). However, up to ~30% of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. The eggs incubate for 55-75 days before hatching.

Habitat. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Grant and Ferrell 1993; Schroeder and Thompson 1987; Shoop and Kenney 1992a; Starbird et al. 1993). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011b; Collard 1990; Davenport and Balazs 1991; Frazier 2001; HDLNR 2002). Aerial surveys off the western US support continental slope waters as having greater leatherback occurrence than shelf waters (Bowlby et al. 1994; Carretta and Forney 1993; Green et al. 1992; Green et al. 1993). Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

Areas above 30º N in the Atlantic appear to be popular foraging locations (Fossette et al. 2009b). Northern foraging areas were proposed for waters between 35º and 50º N along North American, Nova Scotia, the Gulf of Saint-Laurent, in the western and northern Gulf Stream, the Northeast Atlantic, the Azores front and northeast of the Azores Islands, north of the Canary Islands. Southern foraging was proposed to occur between 5º and 15º N in the Mauritania upwelling, south of the Cape Verde islands, over the Guinea Dome area, and off Venezuela, Guyana and Suriname.

Migration and movement. Leatherback sea turtles migrate throughout open ocean convergence zones and upwelling areas, along continental margins, and in archipelagic waters (Eckert 1998;

Eckert 1999; Morreale et al. 1994). In a single year, a leatherback may swim more than 11,000 km to nesting and foraging areas throughout ocean basins (Benson et al. 2007a; Benson et al. 2011b; Benson et al. 2007b; Eckert 1998; Eckert 2006; Eckert et al. 2006; Ferraroli et al. 2004; Hays et al. 2004; Sale et al. 2006). Much of this travel may be due to movements within current and eddy features, moving individuals along (Sale and Luschi 2009). Return to nesting beaches may be accomplished by a form of geomagnetic navigation and use of local cues (Sale and Luschi 2009). Leatherback females will either remain in nearshore waters between nesting events (generally within 100-300 km; Benson et al. 2011a; Eckert et al. 2012), or range widely, presumably to feed on available prey (Byrne et al. 2009; Fossette et al. 2009a).

Fossette et al. (2009b) identified three main migratory strategies in leatherbacks in the North Atlantic (almost all of studied individuals were female). One involved 12 individuals traveling to northern latitudes during summer/fall and returning to waters during winter and spring. Another strategy used by six individuals was similar to this, but instead of a southward movement in fall, individuals overwintered in northern latitudes (30-40º N, 25-30º W) and moved into the Irish Sea or Bay of Biscay during spring before moving south to between 5 and 10º in winter, where they remained or returned to the northwest Atlantic. A third strategy, which was followed by three females remaining in tropical waters for the first year subsequent to nesting and moving to northern latitudes during summer/fall and spending winter and spring in latitudes of 40-50º N. Individuals nesting in Caribbean Islands migrate to foraging areas off Canada (Richardson et al. 2012).

Genetic studies support the satellite telemetry data indicating a strong difference in migration and foraging fidelity between the breeding populations in the northern and southern hemispheres of the Atlantic Ocean (Dutton et al. 2013; Stewart et al. 2013). Genetic analysis of rookeries in Gabon and Ghana confirm that leatherbacks from West African rookeries migrate to foraging areas off South America (Dutton et al. 2013). Foraging adults off Nova Scotia, Canada, mainly originate from Trinidad and none are from Brazil, Gabon, Ghana, or South Africa (Stewart et al. 2013).

Leatherbacks occur along the southeastern US year-round, with peak abundance in summer (TEWG 2007b). In spring, leatherback sea turtles appear to be concentrated near the coast, while other times of the year they are spread out at least to the Gulf Stream. From August 2009 through August 2010 off Jacksonville, Florida, surveys sighted 48 leatherback sea turtles, while simultaneous vessel surveys sighted four leatherback sea turtles (U.S. Department of the Navy 2010). Leatherbacks are most often found during spring and summer in the Mid-Atlantic Bight, with lesser occurrence during fall and winter (CETAP 1982; IOC 2014; Palka 2012; U.S. Navy 2008a; U.S. Navy 2008b).

Sex ratio. A significant female bias exists in all leatherback populations thus far studied. An examination of strandings and in-water sighting data from the US Atlantic and Gulf of Mexico coasts indicates that 60% of individuals were female. Studies of Suriname nesting beach temperatures suggest a female bias in hatchlings, with estimated percentages of females hatched over the course of each season at 75.4, 65.8, and 92.2% in 1985, 1986, and 1987, respectively (Plotkin 1995). Binckley et al. (1998) found a heavy female bias upon examining hatchling gonad histology on the Pacific coast of Costa Rica, and estimated male to female ratios over three seasons of 0:100, 6.5:93.5, and 25.7:74.3. James et al. (2007) also found a heavy female bias (1.86:1) as well as a primarily large sub-adult and adult size distribution. Leatherback sex determination is affected by nest temperature, with higher temperatures producing a greater proportion of females (Mrosovsky 1994; Witzell et al. 2005a).

Feeding. Leatherbacks may forage in high-invertebrate prey density areas formed by favorable oceanographic features (Eckert 2006; Ferraroli et al. 2004). Although leatherbacks forage in coastal waters, they appear to remain primarily pelagic through all life stages (Heppell et al. 2003). The location and abundance of prey, including medusae, siphonophores, and salpae, in temperate and boreal latitudes likely has a strong influence on leatherback distribution in these areas (Plotkin 1995).

Diving. Leatherbacks are champion deep divers among sea turtles with a maximum- recorded dive of over 4,000 m (Eckert et al. 1989; López-Mendilaharsu et al. 2009). Dives are typically 50-84 m and 75-90% of time duration is above 80 m (Standora et al. 1984). Leatherbacks off South Africa were found to spend <1% of their dive time at depths greater than 200 m (Hays et al. 2009). Dive durations are impressive, topping 86 min, but routinely 1-14 min (Eckert et al. 1989; Eckert et al. 1996; Harvey et al. 2006; López-Mendilaharsu et al. 2009). Most of this time is spent traveling to and from maximum depths (Eckert et al. 1989). Dives are continual, with only short stays at the surface (Eckert et al. 1989; Eckert et al. 1986; Southwood et al. 1999). In a study comparing diving patterns during foraging versus travelling, leatherbacks dove shallower (mean of 53.6 m) and moved more slowly (17.2 km/day) while in foraging areas while travelling to or from these areas (81.8 m and 51.0 km/day)(Fossette et al. 2009b).

Vocalization and hearing. Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999b; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found leatherback hatchlings capable of hearing underwater sounds at frequencies of 50-1,200 Hz (maximum sensitivity at 100-400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3 or 4 kHz (Patterson 1966).

Status and trends. Leatherback sea turtles received protection on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act and, since 1973, have been listed as endangered under the ESA, but declines in nesting have continued worldwide. Consideration of the status of populations outside of the action area is important under the present analysis to determine the how risk the risk to the affected population(s) bears on the status of the species as a whole. Breeding females were initially estimated at 29,000-40,000, but were later refined to ~115,000 (Pritchard 1971; Pritchard 1982). Spotila et al. (1996) estimated 34,500 females, but later issued an update of 35,860 (Spotila 2004b). The species as a whole is declining and local populations are in danger of extinction (NMFS 2001b; NMFS 2001a)(Table 4).

Table 4. Leatherback nesting population site location information where multiple-year surveys were conducted or trends are known (data type, years surveyed, annual number (nests, females, trend). Nesting population trend symbols: ▲ = increasing; ▼ = decreasing; ▬ = stable; ? = unknown.

Location	Data: Nests, Females	Years	Annual number	Trend	Reference
Atlantic					
United States (Florida)	Nests	1979 - 2008	63-754	▲	Stewart et al. (2011)
Puerto Rico (Culebra)	Nests	1993 - 2012	395-32	▼	(C. Diez, Department of Natural and Environmental Resources of Puerto Rico, unpublished data in NMFS USFWS 2013) Diez et al. (2010; Ramírez-Gallego et al. 2013)
Puerto Rico (other)	Nests	1993 - 2012	131-1,291	▲	C. Diez, Department of Natural and Environmental Resources of Puerto Rico, unpublished data in \NMFS and USFWS (2013)
United States Virgin Islands (Sandy Point National Wildlife Refuge, St. Croix)	Nests	1986 - 2004	143-1,008	▲[1]	Dutton et. al. (2005); Turtle Expert Working Group (2007c)
British Virgin Islands	Nests	1986 - 2006	0-65	▲	McGowan et al. (2008) ;Turtle Expert Working Group (2007c)
Nicaragua	Nests	2008 - 2013	42-132	?[2]	(C. Laguex and C. Campbell, Wildlife Conservation Society, unpublished data in NMFS USFWS 2013)
Costa Rica (Tortuguero)	Nests	2007 - 2011	~281	▼	Gordon and Harrison (2012)

Location	Data: Nests, Females	Years	Annual number	Trend	Reference
Costa Rica (Gandoca)	Nests	1990 - 2004	~583	▼	Chacón and Eckert (2007); Turtle Expert Working Group (2007c)
Panama (Chiriqui Beach)	Nests	2004 - 2011	1,000-4,999	?	Meylan et al. (2013)
Colombia	Nests	2006 - 2007	1,653-2,871	?	Patino-Martinez et al. (2008)
Trinidad	Females	1994 - 2005	2,096	▲	Turtle Expert Working Group (2007c)
Guyana	Nests	2007 - 2010	377-1,722	▲	De Freitas and Pritchard (2008; 2009; 2010); Turtle Expert Working Group (2007c); Kalamandeen et al. (2007)
French Guiana	Nests		5,029-63,294	▬	
Suriname	Nests		2,732-31,000	▬	Fossette et al. (2008)
Brazil	Nests	1988 - 2004	6-527	▲	Thomé et al. (Thomé et al. 2007); Turtle Expert Working Group (2007c)

[1] A more recent trend analysis was not found in the literature. However, trends since 2001 suggest the population may be declining, possibly due to a decrease in the number of new nesters, lowered productivity (number of clutches per season and lower hatch success), and an increase in remigration intervals (Garner 2012; Garner et al. 2012).

[2] The number of nests likely underrepresents the area because 22% of nesting activity was not surveyed from 2011-2013 due to military presence (Laguex and Campbell, Wildlife Conservation Society, unpublished dataNMFS USFWS 2013).

[3] Based on 12.8 km index area in Maputaland and St. Lucia Marine Reserves, South Africa.

[4] Survey distance and time differed between the two surveys at Labu Tali, but the weight of evidence from the area indicates a declining population.

Nesting aggregations occur along Gabon, Sao Tome and Principe, French Guiana, Suriname, and Florida (Bräutigam and Eckert 2006; Márquez 1990; Spotila et al. 1996). Widely dispersed but fairly regular African nesting also occurs between Mauritania and Angola (Fretey et al. 2007). Many sizeable populations (perhaps up to 20,000 females annually) of leatherbacks are known to nest in West Africa (Fretey 2001a). The population of leatherbacks nesting on Gabon beaches has been suggested as being the world's largest, with 36,185-126,480 clutches being laid by 5,865-20,499 females annually from 2002-2007 (Witt et al. 2009). The total number of females utilizing Gabon nesting beaches is estimated to be 15,730- 41,373 (Witt et al. 2009). North Atlantic leatherbacks likely number 34,000-94,000 individuals, with females numbering 18,800 and the eastern Atlantic segment numbering 4,700 (TEWG 2007a). Trends and numbers include only nesting females and are not a complete demographic or geographic cross-section. In 1996, the entire Western Atlantic population was characterized as stable at best (Spotila et al. 1996), with roughly 18,800 nesting females. A subsequent analysis indicated that by 2000, the western Atlantic nesting population had decreased to about 15,000 nesting females (NMFS 2011). Spotila et al. (1996) estimated that the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa, totaled approximately 27,600 nesting females, with an estimated range of 20,082-35,133. This is consistent with other estimates of 34,000-95,000 total adults (20,000-56,000 adult females; 10,000-21,000 nesting females)(TEWG 2007b). Nesting in Culebra, Puerto Rico has declined since 2004, has slowed in the US Virgin Islands from 2001-2010, and increased by 10% annually in Florida from 1979-2008 (NMFS USFWS 2013).

The largest nesting aggregation in the western North Atlantic occurs in French Guiana and Suriname and likely belongs to a metapopulation whose limits remain unknown (Rivalan et al. 2006). For Suriname and French Guiana, historical estimates of the number of females nesting each year range from approximately 5,000 to 20,000 (Fossette et al. 2008). Suriname and French Guiana may represent over 40% of the world’s leatherback population, although the magnitude of the West African rookery needs to be verified (Spotila et al. 1996). Heppell et al. (2003a) concluded that leatherbacks generally show less genetic structuring than green and hawksbill sea turtles. The French Guiana nesting aggregation has declined ~15% annually since 1987 (NMFS 2001a). However, from 1979-1986, the number of nests increased ~15% annually, possibly indicating the current decline may be linked with the erosion cycle of Guiana beaches (NMFS 2006e). Girondot et al. (2007a) analyzed nesting data collected between 1967 and 2002 from French Guiana and Suriname and found that the population can be classified as stable or slightly increasing. The Turtle Expert Working Group (2007c) analyzed nest numbers from 1967-2005 and found a positive population growth rate over the 39-year period for French Guiana and Suriname. Guiana nesting may have increased again in the early 2000s (NMFS 2006e). Suriname nesting numbers have recently increased from more than 10,000 nests annually since 1999 and a peak of 30,000 nests in 2001. Overall, Suriname and French Guiana nesting trends towards an increase (Girondot et al. 2007b; Hilterman and Goverse 2003). Florida (March-July) and US Caribbean nesting since the early 1980s has increased ~0.3% and 7.5% per year, respectively, but lags behind the French Guiana coast and elsewhere in magnitude (NMFS/SEFSC 2001). This positive growth was seen within major nesting areas for the stock, including Trinidad, Guyana, and the combined beaches of Suriname and French Guiana (TEWG 2007b). Trinidad supports an estimated 7,000 to 12,000 leatherbacks nesting annually (Stewart et al. 2013), which represents more than 80% of the nesting in the insular Caribbean Sea (Fournillier and Eckert 1999). Using both Bayesian modeling and regression analyses, the Turtle Expert Working Group (2007b) determined that the Southern Caribbean/Guianas stock had demonstrated a long-term, positive population growth rate (using nesting females as a proxy for population).

The Caribbean coast of Costa Rica and extending through Chiriquí Beach, Panama, represents the fourth largest known leatherback rookery in the world (Troeng et al. 2004). Examination of data from three index nesting beaches in the region (Tortuguero, Gandoca, and Pacuare in Costa Rica) using various Bayesian and regression analyses indicated that the nesting population likely was not growing during 1995-2005 (TEWG 2007b). Other modeling of the nesting data for Tortuguero indicates a 67.8% decline between 1995 and 2006 (Troëng et al. 2007).

In Puerto Rico, the primary nesting beaches are at Fajardo and on the island of Culebra. Nesting between 1978 and 2005 ranged between 469-882 nests, and the population has been growing since 1978, with an overall annual growth rate of 1.1% (TEWG 2007b). At the primary nesting beach on St. Croix, the Sandy Point National Wildlife Refuge, nesting has fluctuated from a few hundred nests to a high of 1,008 in 2001, and the average annual growth rate has been approximately 1.1% from 1986-2004 (TEWG 2007b). Overall increases are recorded for mainland Puerto Rico and St. Croix, as well as the US Virgin Islands (Ramírez-Gallego et al. 2013). Trends since 2001 suggest the population may be declining, possibly due to a decrease in the number of new nesters, lowered productivity (number of clutches per season and lower hatch success), and an increase in remigration intervals (Garner 2012; Garner et al. 2012).

The Florida nesting stock comes ashore primarily along the east coast of Florida. This stock is of growing importance, with total nests between 800-900 per year in the 2000s following nesting totals of fewer than 100 nests per year in the 1980s (NMFS 2011). Using data from the index nesting beach surveys, the TEWG (2007b) estimated a significant annual nesting growth rate of 1% between 1989 and 2005. Stewart et al. (2011) evaluated nest counts from 68 Florida beaches over 30 years (1979-2008) and found that nesting increased at all beaches with trends ranging from 3.1%-16.3% per year, with an overall increase of 10.2% per year. In 2007, a record 517 leatherback nests were observed on the index beaches in Florida, with 265 in 2008, and then an increase to a new record of 615 nests in 2009, and a slight decline in 2010 back to 552 nests (Fish and Wildlife Commission Index Nesting Beach Survey Database). This up-and-down pattern is thought to be a result of the cyclical nature of leatherback nesting. The most recent population estimate for leatherback sea turtles from the North Atlantic as a whole is between 34,000-90,000 adult individuals (20,000-56,000 adult females)(TEWG 2007b).

Reliable estimates of survival or mortality at different life history stages are not easily obtained. The annual survival rate for leatherbacks that nested at Playa Grande, Costa Rica, was estimated to be 0.654 for 1993-1994 and 0.65 for those that nested in 1994-1995 (Spotila et al. 2000). Rivalan et al. (2005) estimated the mean annual survival rate of adult leatherbacks in French Guiana to be 0.91. Pilcher and Chaloupka (2013) used capture-mark-recapture data for 178 nesting leatherbacks tagged at Lababia beach, Kamiali, on the Huon Coast of Papua New Guinea over a 10-year austral summer nesting period (2000-2009). Annual survival probability (ca.0.85) was constant over the 10-year period. Annual survival was lower than those estimated for Atlantic rookeries (Dutton et al. 2005; Rivalan et al. 2005). For the St. Croix population, the annual survival rate was approximately 0.893 (confidence interval = 0.87-0.92) for adult female leatherbacks (Dutton et al. 2005). Annual juvenile survival rate for St. Croix was estimated to be approximately 0.63, and the total survival rate from hatchling to first year of reproduction for a female hatchling was estimated to be between 0.004 and 0.02, given assumed age at first reproduction between 9 and 13 (Eguchi et al. 2006). In Florida, annual survival for nesting females was estimated to be 0.956 (Stewart 2007). Spotila et al. (1996) estimated the first year (from hatching) of survival for the global population to be 0.0625.

Natural threats. Sea turtles face predation primarily by sharks and to a lesser extent by killer whales (Pitman and Dutton 2004). Hatchlings are preyed upon by herons, gulls, dogfish, and sharks. Leatherback hatching success is particularly sensitive to nesting site selection, as nests that are overwashed have significantly lower hatching success and leatherbacks nest closer to the high-tide line than other sea turtle species (Caut et al. 2009a). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* can kill in excess of 90% of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

Anthropogenic threats. Leatherback nesting habitat and marine environments are facing increasing impacts through widespread development and tourism along nesting beaches (Hamann et al. 2006; Hernandez et al. 2007; Maison 2006; Santidrián Tomillo et al. 2007). Structural impacts to beaches include building and piling construction, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997b). In some areas, timber and marine debris accumulation as well as sand mining reduce available nesting habitat (Bourgeois et al. 2009; Chacón Chaverri 1999; Formia et al. 2003; Laurance et al. 2008). Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea (Bourgeois et al. 2009; Cowan et al. 2002; Deem et al. 2007; Witherington 1992; Witherington and Bjorndal 1991). Leatherbacks are much more likely to emerge and not nest on developed beaches and much more likely to emerge and nest on undeveloped stretches (Roe et al. 2013). One study found 37% of dead leatherback turtles had ingested various types of plastic that can block gastrointestinal tracts leading to death (Mrosovsky et al. 2009). Along the coast of Peru, 13% of 140 leatherback carcasses were found to contain plastic bags and film (Fritts 1982). A leatherback found stranded along the northern Adriatic had been weakened by plastic ingestion, likely leading to an infection that ultimately killed the individual (Poppi et al. 2012). Although global warming may expand foraging habitats into higher latitude waters, increasing temperatures may increase feminization of nests (Hawkes et al. 2007b; James et al. 2006; McMahon and Hays 2006; Mrosovsky et al. 1984). Rising sea levels may also inundate nests on some beaches. Egg collection is widespread and attributed to catastrophic declines, such as in Malaysia. Harvest of females along nesting beaches is of concern worldwide.

Bycatch, particularly by longline fisheries, is a major source of mortality for leatherback sea turtles (Crognale et al. 2008; Fossette et al. 2009a; Gless et al. 2008; Petersen et al. 2009). Wallace et al. (2010) estimated that between 1990 and 2008, at least 85,000 sea turtles were captured as bycatch in fisheries worldwide. This estimate is likely at least two orders of magnitude low, resulting in a likely bycatch of nearly half a million sea turtles annually (Wallace et al. 2010); many of these turtles are expected to be leatherbacks. Donoso and Dutton (2010) found that 284 leatherbacks were bycaught between 2001 and 2005 as part of the Chilean longline fishery, with two individuals observed dead; leatherbacks were the most frequently bycaught sea turtle species. Observer coverage for this period ranged from 54 to 92%. Trinidad and Tobago's Institute for Marine Affairs estimated that more than 3,000 leatherbacks were captured incidental to gillnet fishing in the coastal waters of Trinidad in 2000. Half or more of the gravid turtles in Trinidad and Tobago waters may be killed (Lee Lum 2003), though many of the turtles do not die as a result of drowning, but rather because the fishermen butcher them in order to get them out of their nets (NMFS 2001b).

Leatherback sea turtles are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (Castroviejo et al. 1994; Graff 1995). Gillnets are one of the suspected causes for the decline in the leatherback turtle population in French Guiana (Chevalier et al. 1999), and gillnets targeting green and hawksbill turtles in the waters of coastal Nicaragua also incidentally catch leatherback turtles (Lagueux 1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six leatherbacks from 13,600 trawls (Marcano and Alió-M 2000). An estimated 1,000 mature female leatherback turtles are caught annually off of Trinidad and Tobago with mortality estimated to be between 50-95% (Eckert and Lien 1999). There are known to be many sizeable populations of leatherbacks nesting in West Africa, possibly as many as 20,000 females nesting annually (Fretey 2001b). In Ghana, nearly two thirds of the leatherback turtles that come up to nest on the beach are killed by local fishermen.

Sea turtles are known to ingest and attempt to ingest tar balls, which can cause their jaws to become adhered or block their digestive systems, impairing foraging or digestion and potentially causing death (NOAA 2003). Oil exposure can also cause acute damage upon direct exposure to oil, including skin, eye, and respiratory irritation, reduced respiration, burns to mucous membranes such as the mouth and eyes, diarrhea, gastrointestinal ulcers and bleeding, poor digestion, anemia, reduced immune response, damage to kidneys or liver, cessation of salt gland function, reproductive failure, and death (NOAA 2003; NOAA 2010; Vargo et al. 1986c; Vargo et al. 1986a; Vargo et al. 1986b). Nearshore spills or large offshore spills can oil beaches on which sea turtles lay their eggs, causing birth defects or mortality in the nests (NOAA 2003; NOAA 2010).

We know little about the effects of contaminants on leatherback sea turtles. The metals arsenic, cadmium, copper, mercury, selenium, and zinc bioaccumulate, with cadmium in highest concentration in leatherbacks versus any other marine vertebrate (Caurant et al. 1999; Gordon et al. 1998). Along with these, lead has also been reported in high concentrations, potentially to the detriment of the individual (Perrault et al. 2013; Poppi et al. 2012). A diet of primarily jellyfish, which have high cadmium concentrations, is likely the cause (Caurant et al. 1999).

Organochlorine pesticides have also been found in various body tissues (Mckenzie et al. 1999). PCB concentrations are reportedly equivalent to those in some marine mammals, with liver and adipose levels of at least one congener being exceptionally high (PCB 209: 500-530 ng/g wet weight Davenport et al. 1990; Oros et al. 2009). No studies have been conducted to determine what affect, if any, these toxin levels have on sea turtles. However, these concentrations are concerning for the health of sea turtles (Alam and Brim 2000; Keller et al. 2004d) and may depress the immune system in loggerhead sea turtles (Keller et al. 2006a; Rousselet et al. 2013) .

4.2.8 Loggerhead sea turtle-Northwest Atlantic DPS

Populations. Five groupings represent loggerhead sea turtles by major sea or ocean basin: Atlantic, Pacific, and Indian oceans, as well as Caribbean and Mediterranean seas. As with other sea turtles, populations are frequently divided by nesting aggregation (Hutchinson and Dutton 2007). On September 22, 2011, the NMFS designated DPSs of loggerhead sea turtles: South Atlantic Ocean and southwest Indian Ocean as threatened as well as Mediterranean Sea, North Indian Ocean, North Pacific Ocean, northeast Atlantic Ocean, northwest Atlantic Ocean, South Pacific Ocean, and southeast Indo-Pacific Ocean as endangered (75 FR 12598). Recent ocean-basin scale genetic analysis supports this conclusion, with additional genetic differentiation apparent based upon nesting beaches (Shamblin et al. 2014).

Atlantic Ocean. Western Atlantic nesting locations include The Bahamas, Brazil, and numerous locations from the Yucatán Peninsula to North Carolina (Addison 1997; Addison and Morford 1996; Marcovaldi and Chaloupka 2007). This group comprises five nesting subpopulations: Northern, Southern, Dry Tortugas, Florida Panhandle, and Yucatán. Additional nesting occurs on Cay Sal Bank (Bahamas), Cuba, the Bahamian Archipelago, Quintana Roo (Yucatan Peninsula), Colombia, Brazil, Caribbean Central America, Venezuela, and the eastern Caribbean Islands. Genetic studies indicate that, although females routinely return to natal beaches, males may breed with females from multiple populations and facilitate gene flow Bowen et al. (2005).

Distribution. Loggerheads are circumglobal, occurring throughout temperate and tropical regions of the Atlantic Ocean. Loggerheads are the most abundant species of sea turtle found in US coastal waters. Loggerheads are sighted more frequently in the region than any other sea turtle species (Belford et al. 2014; Waring et al. 2012), with thousands of sightings off of Virginia and North Carolina (IOC 2014). Sightings are concentrated over the continental shelf, but are routine east over the shelf break and into deeper waters, particularly in winter and spring (IOC 2014; Waring et al. 2012).

Reproduction and growth. Loggerhead nesting is confined to lower latitude temperate and subtropic zones but absent from tropical areas (NMFS and USFWS 1991b; NRC 1990c; Witherington et al. 2006b). The life cycle of loggerhead sea turtles can be divided into seven stages: eggs and hatchlings, small juveniles, large juveniles, subadults, novice breeders, first year emigrants, and mature breeders (Crouse et al. 1987). Hatchling loggerheads migrate to the ocean (to which they are drawn by near ultraviolet light Kawamura et al. 2009), where they are generally believed to lead a pelagic existence for as long as 7-12 years (Avens et al. 2013; NMFS 2005). Loggerhead sea turtles born along the northern Gulf of Mexico are likely to leave the Gulf of Mexico after hatching (Lamont et al. 2015). Loggerheads in the Mediterranean, similar to those in the Atlantic, grow at roughly 11.8 cm/year for the first six months and slow to roughly 3.6 cm/year at age 2.5-3.5. As adults, individuals may experience a secondary growth pulse associated with shifting into neritic habitats, although growth is generally monotypic (declines with age Casale et al. 2009a; Casale et al. 2009b). Individually-based variables likely have a high impact on individual-to-individual growth rates (Casale et al. 2009b). At 15-38 years, loggerhead sea turtles become sexually mature, although the age at which they reach maturity varies widely among populations (Casale et al. 2009b; Frazer and Ehrhart 1985a; Frazer et al. 1994; NMFS 2001b; Witherington et al. 2006). However, based on new data from tag returns, strandings, and nesting surveys, NMFS (2001b) estimated ages of maturity ranging from 20-38 years and the benthic immature stage lasting from 14-32 years. Notably, data from several studies showed decreased growth rates of loggerheads in US Atlantic waters from 1997-2007, corresponding to a period of 43% decline in Florida nest counts (Bjorndal et al. 2013). Adult females tend to forage in neritic habitats between nesting events and just after nesting (Lamont et al. 2015).

Loggerhead mating likely occurs along migration routes to nesting beaches, as well as in offshore of nesting beaches several weeks prior to the onset of nesting (Dodd 1988; NMFS and USFWS 1998d). Females usually breed every 2-3 years, but can vary from 1-7 years (Dodd 1988; Richardson et al. 1978). Females lay an average of 4.1 nests per season (Murphy and Hopkins 1984) , although recent satellite telemetry from nesting females along southwest Florida support 5.4 nests per female per season, with increasing numbers of eggs per nest during the course of the season (Tucker 2009). The authors suggest that this finding warrants revision of the number of females nesting in the region. The western Atlantic breeding season is March-August. Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

Gender, age, and survivorship. Although information on males is limited, several studies identified a female bias in populations, although a single study has found a strong male bias to be possible (Dodd 1988; NMFS 2001b; Rees and Margaritoulis 2004). Nest temperature seems to drive sex determination. Along Florida, males primarily derive from earlier-season nests (LeBlanc et al. 2012). Here, nests ranged from an average sex ratio of 55% female to 85% female between 2000 and 2004 (LeBlanc et al. 2012). This number has been found to be even higher in some cases (89%Rogers 2013). Juvenile and adult age classes have a slight female bias in the central Mediterranean Sea of 51.5% (Casale et al. 2014).

Little is known about longevity, although Dodd (1988) estimated the maximum female life span at 47-62 years. Towaszewicz et al. (2015) estimated that loggerhead sea turtles in the Gulf of

California may not reach maturity until 25 years of age. Heppell et al. (2003a) estimated annual survivorship to be 0.81 (southeast US adult females) and 0.68-0.89 (southeast US benthic juveniles). Another recent estimate suggested a survival rate of 0.41 or 0.60 (CIs 0.20-0.65 and 0.40-0.78, respectively), depending upon assumptions within the study (Sasso et al. 2011). Survival rates for hatchlings during their first year are likely very low (Heppell et al. 2003a; Heppell et al. 2003). Higher fecundity is associated with warmer February and lower May temperatures for loggerheads emerging from nests on the northern Gulf of Mexico (Lamont and Fujisaki 2014).

Diving. Loggerhead diving behavior varies based upon habitat, with longer surface stays in deeper habitats than in coastal ones. Off Japan, dives were shallower than 30 m (Sakamoto et al. 1993). Routine dives can last 4–172 minutes (Byles 1988; Renaud and Carpenter 1994; Sakamoto et al. 1990). The maximum-recorded dive depth for a post-nesting female was over 230 m, although most dives are far shallower (9-21 m)(Sakamoto et al. 1990). Loggerheads tagged in the Pacific over the course of 5 months showed that about 70% of dives are very shallow (<5 m) and 40% of their time was spent within 1 m of the surface (Polovina et al. 2003; Spotila 2004c). During these dives, there were also several strong surface temperature fronts that individuals were associated with, one of 20° C at 28° North latitude and another of 17° C at 32° North latitude. In the Mediterranean, dives of over 300 minutes have been recorded in association with depressed water temperatures and are proposed as an overwintering strategy (Luschi et al. 2013).

Vocalization and hearing. Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999b; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Bartol et al. (1999b) reported effective hearing range for juvenile loggerhead turtles is from at least 250-750 Hz. Both yearling and two-year old loggerheads had the lowest hearing threshold at 500 Hz (yearling: about 81 dB re 1 μPa and two-year-olds: about 86 dB re 1 μPa), with thresholds increasing rapidly above and below that frequency (Moein Bartol and Ketten 2006).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles are respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3000 Hz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3 or 4 kHz (Patterson 1966).

Status and trends. Loggerhead sea turtles were listed as threatened under the ESA of 1973 on July 28, 1978 (43 FR 32800).

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at the adult life stage, even though there are doubts about the ability to estimate the overall population size (Bjorndal et al. 2005). An important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates well. Adult nesting females often account for less than 1% of total population numbers. The global abundance of nesting female loggerhead turtles is estimated at 43,320–44,560 (Spotila 2004b).

Atlantic Ocean. The greatest concentration of loggerheads occurs in the Atlantic Ocean and the adjacent Caribbean Sea, primarily on the Atlantic coast of Florida, with other major nesting areas located on the Yucatán Peninsula of Mexico, Columbia, Cuba, and South Africa (EuroTurtle 2006 as cited in LGL Ltd. 2007; Márquez 1990).

Among the five subpopulations, loggerhead females lay 53,000-92,000 nests per year in the southeastern US and the Gulf of Mexico, and the total number of nesting females are 32,000-56,000. All of these are in decline or data are insufficient to access trends (NMFS 2001b; TEWG 1998). Loggerheads from western North Atlantic nesting aggregations may or may not feed in the same regions from which they hatch. Loggerhead sea turtles from the northern nesting aggregation, which represents about 9% of the loggerhead nests in the western North Atlantic, comprise 25-59% of individuals foraging from Georgia up to the northeast US (Bass et al. 1998; Norrgard 1995; Rankin-Baransky 1997; Sears 1994; Sears et al. 1995). Loggerheads associated with the South Florida nesting aggregation occur in higher frequencies in the Gulf of Mexico (where they represent ~10% of the loggerhead captures) and the Mediterranean Sea (where they represent ~45% of loggerhead sea turtles captured). About 4,000 nests per year are laid along the Brazilian coast (Ehrhart et al. 2003).

The northern recovery unit along Georgia, South Carolina, and North Carolina has a forty-year time-series trend showing an overall decline in nesting, but the shorter comprehensive survey data (20 years) indicate a stable population (Georgia Department of Natural Resources, North Carolina Department of Natural Resources, and South Carolina Department of Natural Resources, nesting data located at www.seaturtle.org). NMFS scientists have estimated that the northern subpopulation produces 65% males (NMFS 2001b).

The peninsular Florida recovery unit is the largest loggerhead nesting assemblage in the northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed a mean of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females annually (NMFS and USFWS 2008). The statewide estimated total for 2010 was 73,702 (Florida Wildlife Research Institute nesting database). An analysis of index nesting beach data shows a 26% nesting decline between 1989 and 2008, and a mean annual rate of decline of 1.6% despite a large increase in nesting for 2008, to 38,643 nests (Florida Wildlife Research Institute nesting database)(Florida Wildlife Research Institute nesting database; NMFS and USFWS 2008; Witherington et al. 2009). In 2009, nesting levels, while still higher than the lows of 2004, 2006, and 2007, dropped below 2008 levels to approximately 32,717 nests, but in 2010 a large increase was seen, with 47,880 nests on the index nesting beaches (Florida Wildlife Research Institute nesting database). The 2010 index nesting number is the largest since 2000. With the addition of data through 2010, the nesting trend for the northwestern Atlantic DPS is slightly negative and not statistically different from zero (no trend; NMFS and USFWS 2010). Preliminary, unofficial reports indicate that 2011 nesting may be a high nesting year on par with 2010. Although not directly comparable to these index nesting numbers, nesting counts from 2010-2014 have shown no clear trend.

Because of its size, the south Florida subpopulation of loggerheads may be critical to the survival of the species in the Atlantic, and in the past it was considered second in size only to the Oman nesting aggregation (NMFS 2006e; NMFS and USFWS 1991b). The South Florida population increased at ~5.3% per year from 1978-1990, and was initially increasing at 3.9-4.2% after 1990. An analysis of nesting data from 1989-2005, a period of more consistent and accurate surveys than in previous years, showed a detectable trend and, more recently (1998-2005), has shown evidence of a declining trend of approximately 22.3% (FFWCC 2007a; FFWCC 2007b; Witherington et al. 2009). This is likely due to a decline in the number of nesting females within the population (Witherington et al. 2009). Nesting data from the Archie Carr Refuge (one of the most important nesting locations in southeast Florida) over the last 6 years shows nests declined from approximately 17,629 in 1998 to 7,599 in 2004, also suggesting a decrease in population size[2]. Loggerhead nesting is thought to consist of just 60 nesting females in the Caribbean and Gulf of Mexico (NMFS 2006). Based upon the small sizes of almost all nesting aggregations in the Atlantic, the large numbers of individuals killed in fisheries, and the decline of the only large nesting aggregation, we suspect that the extinction probabilities of loggerhead sea turtle populations in the Atlantic are only slightly lower than those of populations in the Pacific.

Natural threats. Sea turtles face predation primarily by sharks and to a lesser extent by killer whales. All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can pose lethal effects. In January 2010, an unusually large cold-stunning event occurred throughout the southeast US, with well over 3,000 sea turtles (mostly greens but also hundreds of loggerheads) found cold-stunned. Most survived, but several hundred were found dead or died after being discovered in a cold-stunned state. High temperatures before hatchlings emerge from their nests can also reduce hatchling success, as can bacterial contamination and woody debris in nests (Trocini 2013). Eggs are commonly eaten by raccoons and ghost crabs along the eastern US (Barton and Roth 2008), in Australia (Trocini 2013), and on Cape Verde Island, where an average of 50% of eggs are consumed by ghost crabs (Marco et al. 2015). In the water, hatchlings are hunted by herons, gulls, dogfish, and sharks. Heavy loads of barnacles are associated with unhealthy or dead stranded loggerheads (Deem et al. 2009). Brevetoxin-producing algal blooms can result in loggerhead sea turtle death and pathology, with nearly all stranded loggerheads in affected areas showing signs of illness or

[2] While this is a long period of decline relative to the past observed nesting pattern at this location, aberrant ocean surface temperatures complicate the analysis and interpretation of these data. Although caution is warranted in interpreting the decreasing nesting trend given inherent annual fluctuations in nesting and the short time period over which the decline has been noted, the recent nesting decline at this nesting beach is reason for concern.

death resulting from exposure (Fauquier et al. 2013). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* can kill in excess of 90% of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

Anthropogenic threats. Anthropogenic threats impacting loggerhead nesting habitat are numerous: coastal development and construction, placement of erosion control structures, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach nourishment, beach pollution, removal of native vegetation, and planting of non-native vegetation (Baldwin 1992; Margaritoulis et al. 2003; Mazaris et al. 2009b; Patino-Martinez 2013; USFWS 1998). Surprisingly, beach nourishment also hampers nesting success, but only in the first year post-nourishment before hatching success increases (Brock et al. 2009). Loggerhead sea turtles face numerous threats in the marine environment as well, including oil and gas exploration, marine pollution, trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries, underwater explosions, dredging, offshore artificial lighting, power plant entrapment, entanglement in debris, ingestion of marine debris, marina and dock construction and operation, boat collisions, and poaching.

A major factor inhibiting loggerhead recovery include mortalities caused by fishery interactions and degradation of the beaches on which they nest. Shrimp trawl fisheries account for the highest number of captured and killed loggerhead sea turtles. Along the Atlantic coast of the US, NMFS estimated that shrimp trawls capture almost 163,000 loggerhead sea turtles each year in the Gulf of Mexico, of which 3,948 die. However, more recent estimates from suggest interactions and mortality has decreased from pre-regulatory periods, with a conservative estimate of 26,500 loggerheads captured annually in US Atlantic fisheries causing mortality up to 1,400 individuals per year (Finkbeiner et al. 2011). Commercial gillnet fisheries are estimated to have killed 52 loggerheads annually along the US mid-Atlantic (Murray 2013). Each year, various fisheries capture about 2,000 loggerhead sea turtles in Pamlico Sound, of which almost 700 die.

Wallace et al. (2010) estimated that between 1990 and 2008, at least 85,000 sea turtles were captured as bycatch in fisheries worldwide. This estimate is likely at least two orders of magnitude low, resulting in a likely bycatch of nearly half a million sea turtles annually (Wallace et al. 2010); many of these are expected to be loggerhead sea turtles. Major sea turtle bycatch in longline fisheries occurs off the US east coast (Lewison et al. 2014).

Marine debris ingestion can be a widespread issue for loggerhead sea turtles. More than one-third of loggerheads found stranded or bycaught had ingested marine debris in a Mediterranean study, with possible mortality resulting in some cases (Lazar and Gračan 2010). Another study in the Tyrrhenian Sea found 71% of stranded and bycaught sea turtles had plastic debris in their guts (Campani et al. 2013). Another threat marine debris poses is to hatchlings on beaches escaping to the sea. Two thirds of loggerheads contacted marine debris on their way to the ocean and many became severely entangled or entrapped by it (Triessnig et al. 2012).

Climate change may also have significant implications on loggerhead populations worldwide. In addition to potential loss of nesting habitat due to sea level rise, loggerhead sea turtles are very sensitive to temperature as a determinant of sex while incubating. Ambient temperature increase by just 1º-2º C can potentially change hatchling sex ratios to all or nearly all females in tropical and subtropical areas (Hawkes et al. 2007a). Over time, this can reduce genetic diversity, or even population viability, if males become a small proportion of populations (Hulin et al. 2009). Sea surface temperatures on loggerhead foraging grounds correlate to the timing of nesting, with higher temperatures leading to earlier nesting (Mazaris et al. 2009a; Schofield et al. 2009) as well as to greater fecundity (Lamont and Fujisaki 2014). Higher ocean temperatures during February and lower May temperatures were associated with higher nesting success in the Gulf of Mexico (Lamont and Fujisaki 2014). Increasing ocean temperatures may also lead to reduced primary productivity and eventual food availability. Warmer temperatures may also decrease the energy needs of a developing embryo (Reid et al. 2009). Pike (2014) estimated that loggerhead populations in tropical areas produce about 30% fewer hatchlings than do populations in temperate areas. Historical climactic patterns have been attributed to the decline in loggerhead nesting in Florida, but evidence for this is tenuous (Reina et al. 2013).

Tissues taken from loggerheads sometimes contain very high levels of organochlorines chlorobiphenyl, chlordanes, lindane, endrin, endosulfan, dieldrin, perfluorooctanesulfonic acid, perfluorooctanoic acid, DDT, and PCB (Alava et al. 2006; Corsolini et al. 2000; Gardner et al. 2003; Guerranti et al. 2013; Keller et al. 2005; Keller et al. 2004a; Keller et al. 2004b; Mckenzie et al. 1999; Monagas et al. 2008; Oros et al. 2009; Perugini et al. 2006; Rybitski et al. 1995; Storelli et al. 2007a). It appears that levels of organochlorines have the potential to suppress the immune system of loggerhead sea turtles and may affect metabolic regulation (Keller et al. 2004c; Keller et al. 2006b; Oros et al. 2009). These contaminants could cause deficiencies in endocrine, developmental, and reproductive health (Storelli et al. 2007a). It is likely that the omnivorous nature of loggerheads makes them more prone to bioaccumulating toxins than other sea turtle species (Godley et al. 1999; Mckenzie et al. 1999). Polycyclic aromatic hydrocarbon pollution from petroleum origins has been found in Cape Verde loggerheads, where oil and gas extraction is not undertaken in the marine environment (Camacho et al. 2012).

Heavy metals, including arsenic, barium, cadmium, chromium, iron, lead, nickel, selenium, silver, copper, zinc, and manganese, have also been found in a variety of tissues in levels that increase with turtle size (Anan et al. 2001; Fujihara et al. 2003; Garcia-Fernandez et al. 2009; Gardner et al. 2006; Godley et al. 1999; Saeki et al. 2000; Storelli et al. 2008). These metals likely originate from plants and seem to have high transfer coefficients (Anan et al. 2001; Celik et al. 2006; Talavera-Saenz et al. 2007). Elevated mercury levels are associated with deformities in hatchlings versus healthy individuals (Trocini 2013).

Loggerhead sea turtles have higher mercury levels than any other sea turtle studied, but concentrations are an order of magnitude less than many toothed whales (Godley et al. 1999;

Pugh and Becker 2001a). Arsenic occurs at levels several fold more concentrated in loggerhead sea turtles than marine mammals or seabirds.

Also of concern is the spread of antimicrobial agents from human society into the marine environment. Loggerhead sea turtles may harbor antibiotic-resistant bacteria, which may have developed and thrived as a result of high use and discharge of antimicrobial agents into freshwater and marine ecosystems (Foti et al. 2009).

4.3 Summary of Threats to ESA-Listed Species

Species that are listed under the ESA have numerous threats, both natural and anthropogenic in nature, throughout the Atlantic Ocean and around the world. Here, we summarize these broader threats before presenting action area-specific threats in the *Environmental Baseline*.

4.3.1 Sea turtles

Bycatch is perhaps the greatest immediate threat to sea turtles. Although only small percentages of sea turtles are estimated to have died as a result of their capture incidental to fisheries, the actual number could be substantial if considered over the past 5-10 years. When we add the percentage of sea turtles that have suffered injuries or handling stress sufficient to have caused them to delay the age at which they reach maturity or the frequency at which they return to nesting beaches, the consequences of these fisheries on nesting aggregations of sea turtles would be greater than we have estimated. Sea turtle bycatch is the greatest known source of anthropogenic mortality in sea turtles along the US eastern seaboard. Dozens to thousands of green, Kemp’s ridley, leatherback, and loggerhead sea turtles die every year in association with fisheries bycatch. However with declining fishing effort, we expect mortalities will decrease as well. Recent data regarding the three largest subpopulations that comprise the Northwest Atlantic loggerhead DPS indicated either that these subpopulations do not show a nesting decline significantly different from zero (Peninsular Florida and The Greater Caribbean subpopulation) or are showing possible signs of stability in nest numbers (Northern subpopulation). These trends were recently declining. Additional mortalities each year along with other impacts remain a threat to the survival and recovery of this species and could slow recovery green, Kemp’s ridley, leatherback, and Northwest Atlantic loggerhead sea turtles.

Contaminant concentrations have also been found in numerous sea turtle species. Although toxicological data are not yet available to clearly indicate the impact that toxin burdens may play in sea turtle biology, we expect these levels have the potential to cause harm.

Also of concern are impacts from climate change, which are expected to become more pronounced through time. Egg, juvenile, and adult harvest remain a concern in some areas and have the potential to alter the growth trajectory of some populations.

5 Environmental Baseline

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 (50 CFR 402.02).

5.1 Dredging

Marine dredging vessels are common within US coastal waters. Although the underwater noises 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. Hopper dredges in the dredging mode are capable of moving relatively quickly compared to sea turtle swimming speed and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge overtakes the resting or swimming turtle. Entrained sea turtles rarely survive. Relocation trawling frequently occurs in association with dredging projects to reduce the potential for dredging to injure or kill sea turtles (Dickerson et al. 2007).

Georgia has two final ocean dredged material disposal sites offshore of Georgia (40 CFR § 228.15). One is located offshore Brunswick Harbor and the second offshore Savannah, ranging in size from 6.9-14.6 km^2, respectively. According to the Site Management Plan developed by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency, the average volume of dredged material disposed at the Savannah site was anticipated to be one million cubic yards per year. In 2012, plans were published to expand the Savannah Harbor port and channel, and the amount of material disposed was anticipated to rise for one year to between four million cubic yards and 12 million cubic yards depending on the depth of the channel agreed upon for the expansion. The operation and maintenance dredging volume would be an additional one million cubic yards. The expansion project is projected to lower the remaining time to reaching ocean dredged material disposal site capacity from 50 to 40 years (USACE 2012).

The site offshore Savannah, Georgia, is located northeast of Block 6174 (within OCS Block 6125). Vessel traffic associated with the disposal site would likely not travel through the action area because the lease blocks are not adjacent to the shipping lanes or in the path of the port of Savannah, locations where dredged material would be collected. The location of the disposal site is north of the lease blocks and direct travel from the dredged material collection sites and the disposal site does not require passing through any of the action area.

Typically, dredge sites are permitted for continuing use, and the activity level varies depending on the dredging requirements for particular ports. Dredging and the disposal of dredged materials are conducted with industry-standard practices to reduce potential effects to the environment, including the prevention of suspension of contaminated sediments into the water column. The US Army Corps of Engineers is the permitting authority for dredged material disposal. However, when issuing a permit, the US Army Corps of Engineers must obtain the US Environmental

Protection Agency's concurrence, use US Environmental Protection Agency-developed dumping criteria, and use US Environmental Protection Agency-designated ocean disposal sites to the maximum extent feasible (33 CFR § 324.4(b)).

5.2 Vessel Traffic

Vessel noise could affect marine animals in the study area. Shipping and seismic noise generally dominate ambient noise at frequencies from 20 to 300 Hz (Andrew et al. 2002; Hildebrand 2009; Richardson et al. 1995b). Background noise has increased significantly in the past 50 years as a result of increasing vessel traffic, and particularly shipping, with increases of as much as 12 dB in low frequency ranges; background noise may be 20 dB higher now versus preindustrial periods (Hildebrand 2009; Jasny et al. 2005; McDonald et al. 2006; NRC 1994; NRC 2003; NRC 2005; Richardson et al. 1995a). Over the past 50 years, the number of commercial vessels has tripled, carrying an estimated six times as much cargo (requiring larger, more powerful vessels) (Hildebrand 2009). Seismic signals emanating from sources a great distance from the action area also contribute to the low frequency ambient sound field (Hildebrand 2009). Sonars and small vessels also contribute significantly to mid-frequency ranges (Hildebrand 2009).

5.3 US Navy Training and Testing Activities

The US Navy conducts training and testing activities in multiple ranges along the US east coast. A biological opinion completed in 2013 estimated the number of exposures of ESA-listed species to those activities that are expected to occur annually through 2018 (Table 5).

Table 5. Anticipated incidental "take" of ESA-listed species within US Navy Jacksonville Training Range Complex that encompasses the action area (NMFS 2013a).

Sea turtle species	Jacksonville operating area	
	Harass	Harm
Hardshell sea turtles	11	1
Kemp's ridley	2	0
Leatherback	11	1
Northwest Atlantic loggerhead	19	1

Anticipated impacts from these exposures include changes from foraging, resting, and other behavioral states that require lower energy expenditures to traveling, avoidance, and other behavioral states that require higher energy expenditures and, therefore, would represent significant disruptions of the normal behavioral patterns of the animals that have been exposed. Behavioral responses that result from stressors associated with these training activities are expected to be temporary and would not affect the reproduction, survival, or recovery of these species. Instances of harm identified generally represent animals that would have been exposed to underwater detonations at 205 dB re μPa^2-s or 13 pounds per square inch, which corresponds to an exposure in which 50% of exposed individuals would be expected to experience rupture of their tympanic membrane, an injury that correlates with measures of permanent hearing impairment (Ketten 1998). Lung or gastrointestinal tract injury may also result.

Several training activities occurring within the Jacksonville Range Complex are anticipated to result in "take" of ESA-listed species incidental to those training activities. US Navy aerial bombing training in the ocean off the southeast US involving live ordnance (500 and 1,000-pound bombs) has been estimated to have injured or killed several loggerhead, leatherback, and green or Kemp's ridley sea turtles (NMFS 1997). From 2009-2012, NMFS issued a series of biological opinions to the US Navy for training activities occurring within their Jacksonville Range Complex that anticipated annual levels of "take" of ESA-listed species incidental to those training activities through 2014. During the proposed activities hardshell sea turtles (any combination of green, hawksbill, Kemp's ridley or Northwest Atlantic loggerhead sea turtles), Kemp's ridley sea turtles, leatherback sea turtles, and Northwestern Atlantic loggerhead sea turtles may be harassed as a result of their behavioral responses to mid- and high frequency active sonar transmissions. In addition, Kemp's ridley and Northwestern Atlantic loggerhead turtles may be injured during exposure to underwater detonations, but lethal outcomes are not expected.

5.4 Wind Energy

Efforts to develop wind energy facilities offshore of the US east coast have increased over the past several years. The BOEM assumed that the entire area of each Mid-Atlantic Wind Energy Area would be leased based on the expressions of commercial wind energy interest received (BOEM 2012). Site characterization and assessment activities would occur over a period of about 5.5 years per lease (BOEM 2012). Several leases have been issued that would allow for testing and investigation of wind resources (such as that being considered here, with minor impacts expected) at various sites (BOEM 2012). According to BOEM's estimates and presented in Table 3 of the 2013 programmatic biological opinion on BOEM lease activities in the Atlantic for 2013-2020, up to 27,830 km over 4,510 hours of HRG surveys, roughly 4,000 hours of geotechnical surveys, and up to six monitoring buoy may be placed along Georgia may take place. It is not known whether migratory species deflect to avoid facilities such as these once constructed.

5.5 Oil and Gas Activities

On May 13 2013, NMFS completed programmatic consultation on BOEM-authorized geological and geophysical activities in the Mid- and South Atlantic Planning Areas from 2013 to 2020

(NMFS 2013b). No sea turtle "takes" were estimated as part of this, as specific activities would tier from this consultation. No G&G activities have occurred in or near the action area since this biological opinion was issued.

5.6 Scientific and Research Activities

Scientific research permits issued by the NMFS currently authorize studies of ESA-listed species in the North Atlantic Ocean, some of which extend into portions of the action area for the proposed project. Authorized research on ESA-listed sea turtles includes capture, handling, and restraint, satellite, sonic, and passive integrated transponder tagging, blood and tissue collection, lavage, ultrasound, captive experiments, laparoscopy, and imaging. Research activities involve "takes" by harassment, with some resulting in mortality.

5.7 Physical and Oceanographic Features of the Action Area

The presence of key habitat features, such as shelter or foraging opportunities, are the primary reasons why ESA-listed individuals occur where they do. In the marine environment, this is fundamentally built upon local physical and oceanographic features that influence the marine environment. As such, we describe the physical and oceanographic environment here to establish a rationale for why ESA-listed species occur in the action area.

The Blake Plateau is the largest physical feature of the region, shaped by the largest oceanographic feature, the Gulf Stream. The continental shelf, known as the Florida-Hatteras Shelf south of Cape Hatteras, is narrow at its northern extent (about 45 km) but broadens steadily to about 105 km off Cape Fear (Newton et al. 1971). The continental slope in the region is relatively smooth and splits in two on either side of the Blake Plateau. The eastern half of the slope merges with the Blake Escarpment while the western slope follows the coastline (Emery and Uchupi 1972; Tucholke 1987).

The NAO affects sea surface temperatures, wind conditions, and ocean circulation throughout the North Atlantic Ocean (Stenseth et al. 2002b). The NAO is an intensity alteration of the atmospheric pressure between the semi-permanent high pressure center over the Azores Islands and the subpolar low-pressure center over Iceland (Curry and McCartney 2001; Stenseth et al. 2002b). Sea-level atmospheric pressure in the two regions tends to vary inversely, creating "positive" and "negative" phases. However, these phases are stable for years to decades. The NAO was generally positive from 1900 to 1950, mainly negative in the 1960s and 1970s, and mainly positive since 1970 (Hurrell et al. 2001).

The upper slope-water system off the US east coast is affected by the NAO (Pershing et al. 2001). During low NAO periods, the Labrador Current intensifies, leading to the advance of cold slope water along the continental shelf as far south as the Mid-Atlantic Bight Although the NAO influences the northern North Atlantic most, its effects remain significant south through the Outer Banks (Hurrell et al. 2001). These affects include the primary and secondary productivity that occurs which marine megafauna depend upon for foraging opportunities.

The Gulf Stream Current is a powerful surface current, carrying warm water into the cooler North Atlantic through the action area and separates the warm, tropical/subtropical waters found to the south from the cool, temperate waters found to the north (Pickard and Emery 1990; Verity et al. 1993). Cape Hatteras is considered to be the dividing point between the oceanic provinces of the South Atlantic Bight and the Middle Atlantic Bight (Newton et al. 1971; Pickard and Emery 1990). Surface velocities range from 2-5 nautical miles per hour and the temperature is generally 25° to 28° C (Mann and Lazier 1991). The Gulf Stream is usually sharply defined on its west and north side but much less so on its east or south sides (Pickard and Emery 1990).

In general, the Gulf Stream flows parallel to shore from the Florida Straits to Cape Hatteras, where it flows northeastward past the Grand Banks away from land. While stratification of the water column and other factors may play a role, climactic factors such as the NAO likely cause its variation in position (Pershing et al. 2001; Schmeits and Dijkstra 2000). Warm-core rings bring warm water and associated plankton to colder inshore areas. Cold-core rings form when a cyclonic loop pinches off from the Gulf Stream, resulting in a counterclockwise rotating ring of cool slope water in the warm Sargasso Sea (Pickard and Emery 1990). Twice as many cold-core rings are formed as warm-core rings every year (Pickard and Emery 1990). They are larger (100-300 km across) and longer lasting (months to years) than warm-core rings (Pickard and Emery 1990). Frontal eddies commonly occur over the continental shelf, forming south of the action area and moving north and enclosing cold, nutrient rich upwelled water (Mann and Lazier 1991; Yoder et al. 1981). This leads to temporary, locally enhanced primary production that can support zooplankton and larger ESA-listed sea turtle foraging. The Gulf Stream region acts to facilitate transport of some species (through entrainment in its flow) and restrict it for others (bounding cold-water and warm-water species from moving further south or north, respectively)(Wishner et al. 1988).

During fall, winter, and spring in the South Atlantic Bight, upwelling is usually restricted to the outer shelf of the Gulf Stream, but in summer, upwelled water intrudes onto the continental shelf under the warmer, less dense shelf water, leading to upwelling and resultant increases in productivity (Atkinson and Yoder 1984; Lee et al. 1991).

Primary productivity fluctuates little in the action area. Chlorophyll α concentrations decrease quickly away from the coast to less than 1 mg m-3 beyond the shelf break in all seasons. However, transient upwelling events associated with intrusion of Gulf Stream waters onto the Florida-Hatteras Shelf can support phytoplankton increases (Flierl and Davis 1993; García-Moliner and Yoder 1994; Lohrenz et al. 1993).

Diatoms, cyanobacteria, cryptophytes, and prasinophytes make up most of the phytoplankton community in the action area, although haptophytes and dinoflagellates are more common closer to shore (Lohrenz et al. 2003). Assemblages depend greatly on highly-variable currents (Lohrenz et al. 2003). Coccolithophores and pyrrhophyceans predominate in Gulf Stream waters, and are generally least abundant in winter.

Zooplankton, the next higher level in the marine food chain from phytoplankton and the prey of several ESA-listed sea turtles, are generally higher in slope water versus other locations (Wiebe et al. 1987). Spring is a time of higher abundance temporally, particularly within the upper 200 m of the water column (Wiebe et al. 1987). Zooplankton concentrate in areas of increased primary productivity, such as along Gulf Stream frontal boundaries and eddy peripheries (Oschlies and Garcon 1998). Zooplankton abundance changes with seasons, phytoplankton abundance, and oceanographic conditions, but is generally higher in cold-core eddies and along fronts (Quattrini et al. 2005; Wormuth et al. 2000). When shelf water intrudes over slope water, high nutrient concentrations and a shallow mixed layer will give rise to enhanced primary production, which then fuels an increase in zooplankton biomass or secondary production.

5.8 The Impact of the Baseline on ESA-Listed and Proposed Species

ESA-listed species and designated critical habitat are exposed to a wide variety of past and present state, Federal, or private actions and other human activities that have already occurred or continue to occur in the action area. Federal projects in the action area that have already undergone formal or early Section 7 consultation, and state or private actions that are contemporaneous with this consultation also impact ESA-listed species and designated critical habitat. To the best of our ability, we summarize the effects we can determine based upon the information available to us.

5.8.1 Sea turtles

Several of the activities described in this *Environmental Baseline* have significant and adverse consequences for nesting sea turtle aggregations whose individuals occur in the action area. The action area is a dynamic region, with productivity that can attract sea turtles to the region driven by complex, dynamic current patterns. Dredging activities, which occur in and near the action area, are also lethal to sea turtles. Naval activities are expected to cause behavioral responses as well as pathological effects to sea turtles in the action area and surrounding waters. Research activities authorized by NMFS also cause stress, behavioral changes to hundreds or thousands of individuals, and potentially mortality in rare instances. No oil and gas or wind energy activities have occurred in recent years in the action area; the ones described in this consultation will be the first recent ones. Vessel traffic has been increasing baseline sound levels in the marine environment for years. Although the impact of this on sea turtles is not known, sound is an important sensory component (perhaps the most important) for many marine megafauna.

6 Effects of the Action on ESA-Listed and Proposed Species

Section 7 regulations define “effects of the action” as the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the *Environmental Baseline* (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but are reasonably certain to occur. This effects analyses section is organized following the stressor, exposure, response, risk assessment framework.

As was stated in the *Introduction*, this Opinion includes both a jeopardy analysis, an adverse modification analysis, and a conference analysis.

The jeopardy analysis relies upon the regulatory definition of “to jeopardize the continued existence of a listed species,” which is “to engage in an action that 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). Therefore, the jeopardy analysis considers both survival and recovery of the species.

The adverse modification analysis considers the impacts on the conservation value of designated critical habitat. This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02, which was invalidated by Gifford Pinchot Task Force v. USFWS, 378 F.3d 1059 (9th Cir. 2004), amended by 387 F.3d 968 (9th Cir. 2004). Instead, we relied upon a new regulatory definition that defines destruction or adverse modification as “a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features” (81 FR 7214).

The conference analysis operates similar to the jeopardy analysis, but recognizes that the species (in this case, proposed threatened North Atlantic DPS green sea turtles) is not yet listed.

6.1 Stressors Associated with the Proposed Action

The potential stressors we expect to result from the proposed action are:

1. pollution by oil or fuel leakage;
2. acoustic disturbance from engine noise;
3. ship-strikes;
4. entanglement potential from bottom sampling;
5. buoy lines
6. sound fields produced by pile-driving
7. sound fields produced by HRG systems; and

8. sound fields associated with construction and decommissioning

Based on a review of available information, we determined which of these possible stressors would be likely to occur. We then determine the probable responses upon exposure to these stressors and whether those responses are discountable, insignificant, or require further analysis for probable risks to ESA-listed species.

6.2 Stressors Not Likely to Adversely Affect ESA-Listed Species

Based on a review of available information, we determined which of these possible stressors would be discountable or insignificant and therefore not likely to adversely affect ESA-listed species.

6.2.1 Pollution by oil or fuel leakage

Fuel oil and leaks would likely pose a significant risk to the construction barge or maintenance vessel and its crew and actions to correct a leak should occur immediately, to the extent possible. In the event that a leak should occur, the amount of fuel and oil onboard the vessel or its smaller counterparts is unlikely to cause widespread, high dose contamination (excluding the remote possibility of severe damage to the vessel) that would impact ESA-listed species directly or pose hazards to their food sources. Leaks would likely pose a significant risk to the construction barge or maintenance vessel and its crew and actions to correct a leak should occur immediately, to the extent possible. As the vessels involved are small to medium in size, the amount of fuel and oil on board is not very large and would likely disperse fairly quickly. Because the potential for fuel or oil leakage is extremely unlikely to occur, we find that the risk from this potential stressor is discountable. Therefore, we conclude that pollution by oil or fuel leakage is not likely to adversely affect ESA-listed or proposed sea turtles.

6.2.2 Disturbance from engine noise

Although noise originating from vessel propulsion systems and onboard machinery will propagate into the marine environment, this amount of noise generated would be small. Construction and maintenance vessels will be traveling at generally slow speeds, reducing the amount of noise produced by the propulsion system. The vessel’s passage past a sea turtle would be brief and not likely to be significant in impacting any individual’s ability to feed, reproduce, or avoid predators. Because the potential acoustic interference from engine noise would be undetectable or so minor that it could not be meaningfully evaluated, we find that the risk from this potential stressor is insignificant. Therefore, we conclude that acoustic interference from engine noise is not likely to adversely affect ESA-listed or proposed sea turtles.

6.2.3 Ship strike

The slow speed of construction and maintenance vessels reduces the probability of a ship-strike (Kite-Powell et al. 2007; Vanderlaan and Taggart 2007), as does the permitting conditions BOEM places on the Southern Company. Our expectation of ship strike is discountably small due to the lack of documented shipstrike during BOEM-authorized activities even though hundreds of thousands to millions of kilometers have been travelled by these types of vessels, the limited number of trips and number of vessels to be employed in the proposed action, the inherently slow speed of those vessels, as well as BOEM measures for avoiding ESA-listed species and reducing speed in North Atlantic right whale critical habitat. All factors considered, we have concluded the potential for ship strike from the vessel is highly improbable. Because the potential for ship strike is extremely unlikely to occur, we find that the risk from this potential stressor is discountable. Therefore, we conclude that ship strike is not likely to adversely affect ESA-listed or proposed sea turtles.

6.2.4 Bottom sampling and buoy lines

ESA-listed species could interact directly with deployed oceanographic equipment for bottom sampling. However, we are unaware of such events with ESA-listed or proposed sea turtles are unknown to us. Although the oceanographic equipment lowered in a controlled manner over-the-side could come in direct contact with an ESA-listed species, entanglements are highly unlikely and considered highly improbable based information from NMFS analysis on US Coast Guard buoys indicates that entanglement in buoy lines is highly unlikely {NMFS, 2013 #335}. Given this, we expect that the risk of entanglement in oceanographic equipment so low as to be insignificant. Therefore, it is not likely to adversely affected ESA-listed or proposed species and will not be considered further in this Opinion.

6.3 Stressors that May Affect ESA-Listed Resources

Based upon those stressors which we identified as possible and which were subsequently determined to be not likely to adversely affect ESA-listed resources, this consultation focused on the following stressors likely to occur from the proposed activities: 1) acoustic energy introduced into the marine environment by pile driving and 2) acoustic energy introduced by the HRG sonars, and 3) sounds associated with construction and decommissioning.

6.4 Mitigation to Minimize or Avoid Exposure

Numerous mitigation measures will be required to be implemented by Southern Company as part of BOEM’s authorization of the action. See Sections 2.2.6 through 2.1.10 for a full description of these measures. However, several measures are key to our analysis, including:

1. pile driving is disallowed from November 1 through April 30 annually
2. presence of marine protected species observers during pile driving
3. establishment of an exclusion zone which, if sea turtles are seen by the marine protected species observers to enter, pile driving would be temporarily suspended, and
4. observance of speed rules by construction and maintenance vessels.

We expect these measures will produce a meaningful decrease in the frequency and intensity of exposure ESA-listed individuals may experience and consider this in our *Effects Analysis*.

6.5 Exposure and Response Analysis

The exposure analysis identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the actions' effects and the population(s) or subpopulation(s) those individuals represent. As discussed in the Approach to the Assessment section, the response analysis determine how listed resources are likely to respond after being exposed to an action's effects on the environment or directly on listed species themselves. For the purposes of consultations on pile driving and HRG surveys, our assessments try to detect the probability of lethal responses, sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), behavioral responses, and social responses that might result in reducing the fitness of listed individuals. Ideally, our response analysis considers and weighs evidence of adverse consequences, beneficial consequences, or the absence of such consequences.

6.5.1 Exposure analysis

Although there are several acoustic and non-acoustic stressors associated with the proposed action, the stressor of primary concern is the acoustic impacts of pile driving. NMFS applies certain acoustic thresholds to help determine at what point during exposure to pile driving (and other acoustic sources) individuals are likely to be affected by the acoustic source. These thresholds are used to develop exclusion radii around a source and the necessary power-down or shut-down criteria to limit sea turtles' exposure to harmful levels of sound (NMFS 1995). The 120 dB re 1 μParms threshold is the distance at which ESA "take," by behavioral harassment, is expected to occur during continuous sound, such as during vibratory pile driving. However, sea turtles have not been observed to respond adversely to anthropogenic sound sources at this level. The 166 dB re 1 μParms threshold is the distance normally applied to impulsive sound and the distance at which "take" is expected. The ESA does not define harassment nor has the NMFS defined the term pursuant to the ESA through regulation. The USFWS defines "harass" as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). For this Opinion, we define harassment similarly: an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents.

6.5.1.1 Pile driving

Estimates of animals exposed to potentially disturbing levels of noise were computed according to the following formula:

Number of sea turtle exposures at behavioral harassment or injurious levels = D x A x T

Where:

D = local species occurrence rate during season of greatest abundance (number per 1,000 km^2)

A = maximum ensonified area to 120 dB (behavioral; vibratory-style pile driving), 166 dB (behavioral; hammer-style pile driving) or 207 dB (injury)

T = number of days

Sea turtle densities are difficult to establish in the marine environment. The action area is one of the few locations globally where density estimates for sea turtles, either at the species level or for hardshell turtles as a group, are available based upon several years of robust turtle survey data and habitat modeling. These data have been incorporated into a model developed by Duke University in collaboration with other partners, known as the Strategic Environmental Research and Development Program spatial decision support system (SERDP SDSS). This model was updated in 2015[3].

Based on the turtle surveys, the model estimates densities on a seasonal basis for most sea turtle species, including leatherback, loggerhead, and Kemp's ridley sea turtles. There were too few green sea turtle sightings for the model to generate a density estimate for green turtles. During the surveys, some observed turtles could not be identified at the species level; these sightings were combined into a "hardshell" turtle group. The hardshell turtle estimate includes green, loggerhead, and Kemp's ridley turtles that were not identified to species when they were sighted.

To estimate the number of sea turtles of each species that would be exposed to the proposed action, we did the following calculations. First, we gathered data on the confirmed sightings and bycatch records for each species in the action area and surrounding region. We tallied the sightings of hardshell species (green, loggerhead, and Kemp's ridley) and calculated the proportion of each species in those sightings (Table 6).

The final step was to multiply these proportions to the hardshell sea turtle density. This estimated the number of loggerhead, Kemp's, and green turtles that comprised the hardshell group. Because we already had a density estimate from SERDP SPSS for Kemp's and loggerhead sea turtles, we added the estimate of the number of each of the species was in the hardshell group for our final estimate. These totals allow us to more accurately represent the densities for Kemp's ridley and loggerhead sea turtles rather than just the species-specific SERDP SPSS density values alone because they account for unknown hardshell sightings that are likely to actually be sightings of Kemp's ridley and loggerhead sea turtles. For green sea turtles, we used the proportion derived from the hardshell sea turtle category to represent the total estimated density for green sea turtles because no green sea turtle density was available from SERDP SPSS.

[3] (http://seamap.env.duke.edu/serdp/serdp_map.php)

Table 6. Density (individuals per square kilometer) estimates for sea turtles in the action area.

Sea turtle species	SERDP species estimate	Density proportion from SERDP hardshell turtle category	Total expected density
Green	n/a	26.1%; 0.015586	0.015586
Kemp's ridley	0.023376	13.1%; 0.007823	0.031199
Hardshell turtle	0.059717	n/a	n/a
Leatherback	0.018889	4.3%; 0.002568	0.021457
Loggerhead	0.170139	56.5%; 0.033561	0.2037

We do not know whether impact or vibratory pile-driving will be used for the proposed action, as this decision is dependent upon ocean bottom characteristics that cannot be known until after the project begins. Vibratory hammers use oscillatory hammers that vibrate the pile, causing the sediment surrounding the pile to liquefy and allow pile penetration. The sound from these hammers rises relatively slowly, and the sound energy is spread out over time. As a result, sound levels are generally 10 to 20 dB re: 1 μPa lower than impact pile driving (CDOT 2009). Almost all available literature on sound levels produced by vibratory hammers is modeled or measured in shallow water (2-15 m), usually in harbors and bays, using smaller diameter monopiles (CDOT 2009; DoN 2013) compared to offshore installation sites (14-100 m) such as is being used for this action. The proposed action will occur within 6-11 nautical miles offshore at 15-20 m depths.

BOEM provided estimates of isopleth ranges from the stationary pile driving sources based upon modeling of sound sources that could be used as well as previous sound-source verification work. Modeling was conducted for proposed meteorological tower sites located offshore New Jersey and Delaware for other recent, similar projects using impact pile driving. The 160 dB re 1μPa isopleth was modeled at 7,230 m for Delaware and 6,600 m for New Jersey (Table 7). The information from Cape Wind Associates and the Bluewater Wind are a good representation of the potential range of ensonified area with both the 180 dB re 1 μPa and 160 dB re 1 μPa SPLs (Table 7), although the sources and monopole diameters are different sizes and the environmental characteristics are likely different, causing the isopleths to vary. In addition, BOEM modeled distances to the 166 and 207 dB re 1 μPa isopleth (Table 8).

Table 7. Modeled range at three sound pressure levels within the ensonification area produced by pile driving.

Project (modeled)	Additional Info	180 dB re 1µPa (rms)	160 dB re 1µPa (rms)	120 dB re 1µPa (rms)
Bluewater Wind (Interim Policy Lease offshore Delaware)	3.0-meter (10 ft) diameter monopile; 900 kJ hammer	760 meters (2,493 ft)	7,230 meters (23,721 ft)	N/A
Bluewater Wind (Interim Policy Lease offshore New Jersey)	3.0-meter (10 ft) diameter monopole; 900 kJ hammer	1,000 meters (3,281 ft)	6,600 meters (21,654 ft)	N/A
Cape Wind Energy Project (Lease in Nantucket Sound)	5.05-meter (16.57 ft) diameter monopole; 1,200 kJ hammer	500 meters (1,640 ft)	3,400 meters (11,155 ft)	N/A
Naval Facilities Engineering Command (2013) page 40; California Dept. of Transportation (2009) (Appendix 1)	0.6 to1.8-meter (2-6 ft) diameter monopoles; vibratory hammer	≤10 meters (33 ft)	N/A	>7,000 meters (22,966 ft)

Source: USDOI, BOEM (2012).

Table 8. Estimated ranges (meters) to 166 and 207 dB re: 1 µPa isopleths.

Pile type	166 dB re: 1 µPa impact	207 dB re: 1 µPa impact	166 dB re: 1 µPa vibratory	207 dB re: 1 µPa vibratory
3 m monopole	2,238	8.7	66.7	n/a
5 m monopole	4,436	17.3	131.2	n/a
0.6-1.8 m monopile	1,000	3.9	17.2	n/a

The model used to develop estimates represented in Table 8 included several assumptions. A surrogate project area (Gray's Reef) previously analyzed by BOEM was used that is believed to have the same water depths, same sediment and general oceanographic features as the proposed action area. The frequency used for calculation was 200 Hz since higher frequencies have higher transmission loss than lower frequencies, but is a reasonable frequency that sea turtles can be expected to hear. Sound was assumed to emanate from the middle of the water column, which tends to maximize the distance to which sound may propagate. Although modeling was undertaken for different seasons and the pile driving is forbidden from May through October, the season with the longest range propagation estimate was selected as a conservative factor. The seafloor was assumed to be sloped and smooth, as this generally maximizes propagation distances versus bottom topography with topographical features that can block or reflect sound energy. The equation for calculating transmission loss was 17 log (radius), as this is a compromise between spherical spreading (ideally applied in deep oceanic environments) and cylindrical spreading (better suited for shallow coastal areas).

In regard to source levels required by sea turtles to perceive sounds, Ridgeway et al. (1969) reported that 110-126 dB re 1 μPa were required for animals to hear sounds. McCauley et al. (2000a; 2000b) reported that source levels of 166 dB re 1 μPa were required to evoke behavioral reactions from captive sea turtles. As the pile driving source(s) will be stationary, we expect sound to propagate throughout the water column to ensonify areas identified in Table 9. We multiplied these areas by the estimated densities to generate an expected number of exposures for each species to 166 or 207 dB re 1 μPa levels (Table 10). These are the levels at which expect behavioral and pathological effects to be experienced by sea turtles, respectively.

Table 9. Estimated areas (square kilometers) ensonified by pile driving to behavioral and injurious levels for sea turtles.

Pile type	166 dB re: 1 μPa impact	207 dB re: 1 μPa impact	166 dB re: 1 μPa vibratory	207 dB re: 1 μPa vibratory
3 m monopole	15.74	2.38×10^{-4}	0.014	~0
5 m monopole	61.8	9.4×10^{-4}	0.054	~0
0.6-1.8 m monopile	3.14	4.78×10^{-5}	9.29×10^{-4}	~0

Table 10. Estimated number of exposures to 166 or 207 dB re 1 μPa sound levels from pile driving under various possible pile driving configurations for each day of pile driving (up to three days may be undertaken).

Piling type/species	166 dB re: 1 μPa impact	207 dB re: 1 μPa impact	166 dB re: 1 μPa vibratory	207 dB re: 1 μPa vibratory
3 m monopole/ green	0.2453	0.000004	0.0002	0
5 m monopole/ green	0.9632	0.00001	0.0008	0
0.6-1.8 m/ green	0.0489	0.0000007	0.00001	0
3 m monopole/ Kemp's ridley	0.4911	0.000007	0.0004	0
5 m monopole/ Kemp's ridley	1.9281	0.00009	0.0017	0

0.6-1.8 m/ Kemp's ridley	0.0980	0.000001	0.00003	0
3 m monopole/ leatherback	0.3377	0.000005	0.0003	0
5 m monopole/ leatherback	1.326	0.00002	0.0012	0
0.6-1.8 m/ leatherback	0.6396	0.000001	0.00002	0
3 m monopole/ loggerhead	3.2062	0.00005	0.0029	0
5 m monopole/ loggerhead	12.59	0.0002	0.0110	0
0.6-1.8 m/ loggerhead	0.6396	0.00001	0.0002	0

Based upon this density x area x days calculation for the various pile driving configurations identified in Table 10 (with exposures per day rounded to the next whole number), up to three green, six Kemp's ridley, six leatherback, and 39 loggerhead sea turtles may be exposed to sound levels that are expected to produce a behavioral response (166 dB re: 1 µPa). The unmitigated likelihood that a sea turtle may be exposed to sound levels that are expected to cause injury is very small (0.000239 total exposures expected per day by summing the third column of Table 10). This likelihood can be further qualitatively reduced based upon soft-start procedures, the presence of observers who will initiate a shut down if a sea turtle is observed approaching the pile being driven, an expectation that if sound levels increase to a level that cause significant stress or discomfort sea turtles will move away from the stressor, and a lack of expectation that motivating factors will be present to draw sea turtles close to the pile driving locations. With or without mitigation, we do not expect any individual to be exposed to pile driving sound levels sufficient to cause injury.

We do not expect sound generated by the proposed action to expose eggs on land because we do not expect these life stages to be present in the action area. However, the oceanic environment of the North Atlantic is an important developmental habitat for hatchling, juvenile, and subadults of all turtle species and we expect these to occur in the action area. In addition, adult stages of all species are expected to be exposed to sound.

6.5.1.2 Exposure to construction/decommissioning

We expect additional noise to be associated with construction and decommissioning activities outside of pile driving. We do not know what levels these levels will reach, but do not expect it to be any higher than the normal operation of machinery on-board vessels. Additional sounds can include banging of metal parts, welding activities, and operation of cranes and other machinery.

We cannot quantify a number of exposures to these activities as we cannot quantify the duration of activities, characterize the sounds that would be produced by these activities, and have no information to indicate sea turtles will respond to such sounds. Because we cannot estimate the characteristics of these sounds or their occurrence rates, we cannot quantify a number of exposures to these activities.

6.5.1.3 Exposure to sea turtles to HRG surveys

The typical duration for an individual survey would be three days or less. Approximately 450 hours of HRG surveying is estimated for site characterization purposes. Assuming that HRG survey vessels would operate on eight hour working days, the scenario would require 56 days and the same number of vessel round trips. Surveys could include any of the sources identified in Table 11.

Table 11. Representative acoustic sound sources for renewable energy HRG surveys.

Source	Broadband source level (dB re 1 μPa)	Pulse duration	Operating frequencies
Boomer	212	180 μs	200 Hz–14 kHz
Sparker	210-230	--	50-500 Hz
Side-scan sonar	226	20 ms	100-900 kHz
Chirp subbottom profiler	222	64 ms	500 Hz-24 kHz and 200 kHz
Single beam depth sounder	213	>100 ms	3.5-540 kHz
Swath depth sounder	Not available	--	100-600 kHz
Multibeam depth sounder	213	>100 ms	70-500 kHz
ACDP	Not available	Not available	190 kHz to 2 MHz

Sea turtle exposure in the 2013 NMFS programmatic biological opinion on BOEM Atlantic G&G activities was not quantitatively undertaken due to lack of dive and density estimates. Although density estimates are available here, dive estimates remain unknown and, therefore, models developed for marine mammals for the 2013 NMFS programmatic biological opinion on BOEM Atlantic G&G activities and the BOEM programmatic environmental impact statement cannot be used. In addition, we remain unable to estimate propagation distances and exposure intensity levels because information regarding which, how much, and where specific HRG sources will be used is not known.

We expect that sea turtles can only perceive sound from a subset of the HRG sources (boomer, sparker, and chirp sub-bottom profiler) due to expected or known sea turtle hearing frequency ranges and frequency parameters of the HRG systems to be employed. We expect green, Kemp's ridley, leatherback, and loggerhead sea turtles will be exposed to HRG survey systems in the action area but are unable to quantify the number of individuals that will be exposed.

6.5.2 Responses of sea turtles

When anthropogenic disturbances elicit responses from sea turtles, it is not always clear whether they are responding to visual stimuli, the physical presence of humans or man-made structures, or acoustic stimuli. However, because sound travels well underwater, it is reasonable to assume that, in many conditions, marine organisms would be able to detect sounds from anthropogenic activities before receiving visual stimuli. As such, exploring the acoustic effects of the proposed project provides a reasonable and conservative estimate of the magnitude of disturbance caused by the general presence of a manmade, industrial structure in the marine environment, as well as effects of sound on sea turtle behavior.

Effects of sound exposure on marine organisms can be characterized by the following range of physical and behavioral responses (Richardson 1995):

1. Non-auditory physiological effects – Effects of sound exposure on tissues in non-auditory systems either through direct exposure or as a consequence of changes in behavior, e.g., stress.
2. Behavioral reactions – Range from brief startle responses, to changes or interruptions in feeding, diving, or respiratory patterns, to cessation of vocalizations, to temporary or permanent displacement from habitat.
3. Masking – Reduction in ability to detect communication or other relevant sound signals due to elevated levels of background noise.
4. Temporary threshold shift – Temporary, fully recoverable reduction in hearing sensitivity caused by exposure to sound.
5. Permanent threshold shift – Permanent, irreversible reduction in hearing sensitivity due to damage or injury to ear structures caused by prolonged exposure to sound or temporary exposure to very intense sound.

Currently, there are no NMFS established criteria for injury or behavioral disturbance or harassment for sea turtles. The hearing capabilities of sea turtles are poorly known and there is little available information on the effects of noise on sea turtles. Some studies have demonstrated that sea turtles have fairly limited capacity to detect sound, although all results are based on a limited number of individuals under questionable experimental conditions and must be interpreted cautiously. Most recently, McCauley et al. (2000a; 2000b) noted that decibel levels of 166 dB re 1μPa were required before any behavioral reaction (e.g., increased swimming speed) was observed, and decibel levels above 175 dB re 1μPa elicited avoidance behavior of sea turtles. The study done by McCauley et al. (2000a; 2000b), as well as other studies done to date, used impulsive sources of noise (e.g., air gun arrays) to ascertain the underwater noise levels that produce behavioral modifications in sea turtles. As no studies have been done to assess the effects of continuous sound sources on sea turtles, McCauley et al. (2000a; 2000b) serves as the best available information on the levels of underwater noise that may produce a startle, avoidance, and/or other behavioral or physiological response in sea turtles. Based on this and the best available information, we believe any sea turtles exposed to underwater sound greater than 165 dB re 1μPa may experience behavioral disturbance/modification (e.g., movements away from the action area).

While there is some data suggesting noise levels from exposure to underwater explosives might result in injury to sea turtles, no such information is available for pile driving; however, studies on the effects of explosions on sea turtles recommend that an empirically-based safety range developed by Young (1991) and Keevin and Hempen (1997) be used for guidance in estimating possible injury thresholds for sea turtles. Using the safety range formulas developed by Young (1991), and Keevin and Hempen (1997), and converting back to sound pressure levels using the "Ross Formula," SVT Engineering Consultants (Bennett 2010) calculated a value of 222 dB re 1μPa peak as a conservative estimate of the underwater noise levels that may cause injury to sea turtles during pile driving operations. The study by SVT Engineering Consultants (Bennett 2010) however, did not provide an estimated RMS value of underwater noise levels that may result in injury to sea turtles. As the sea turtle behavioral thresholds noted above are measured using the RMS of the sound source, to be consistent, we estimated the RMS value from the estimated peak level of underwater noise associated with possible sea turtle injury (i.e., 222 dB re 1μPa peak). The RMS of a sound source is approximately 15 dB lower than the peak level of underwater noise for that sound source (developed by J. Stadler and D. Woodbury for NMFS pile driving calculations; see http://www.dot.ca.gov/hq/env/bio/fisheries_bioacoustics.htm). Based on this information, we have estimated an RMS value for injury of 207 dB re 1μPa. This value, like the peak value estimated by SVT Engineering Consultants (Bennett 2010), is a conservative estimate of the level of underwater noise, resulting from pile driving, that may cause injury to sea turtles. Based on this, we believe that underwater noise levels at or above 207 dB re 1μPa have the potential to injure sea turtles. As such, the best estimate we can establish for behavioral response of sea turtles to pile driving sound is 166 dB re: 1μPa and, for potential injury, 207 dB re: 1μPa.

6.5.2.1 Stress

Direct evidence of anthropogenic sound causing stress is lacking in sea turtles. However, we expect sea turtles to generally avoid high-intensity exposure to pile driving or HRG sources audible to sea turtles in a fashion similar to predator avoidance. As predators generally induce a stress response in their prey (Dwyer 2004; Lopez and Martin 2001; Mateo 2007), we assume that sea turtles experience a stress response to pile driving or HRG sources audible to sea turtles when they exhibit behavioral avoidance or when they are exposed to sound levels apparently sufficient to initiate an avoidance response (166 dB re 1 μPa). We expect breeding adult females may experience a lower stress response, as female loggerhead, hawksbill, and green sea turtles appear to have a physiological mechanism to reduce or eliminate hormonal response to stress (predator attack, high temperature, and capture) in order to maintain reproductive capacity at least during their breeding season; a mechanism apparently not shared with males (Jessop 2001; Jessop et al. 2000; Jessop et al. 2004). Individuals may experience a stress response at levels lower than 166 dB re 1 μPa, but data are lacking to evaluate this possibility. Therefore, we follow the best available evidence identifying a behavioral response as the point at which we also expect a significant stress response.

It is possible that an animal's prior exposure to pile driving or HRG sources audible to individuals influences its future response. We have little information available to us as to what response individuals would have to future exposures to pile driving or HRG sources audible to individuals compared to prior experience. If prior exposure produces a learned response, then this subsequent learned response would likely be similar to or less than prior responses to other stressors (Andre and Jurado 1997; André et al. 1997; Gordon et al. 2006). We do not believe sensitization would occur based upon the lack of severe responses previously observed in sea turtles exposed to pile driving or HRG sources audible to individuals that would be expected to produce a more intense, frequent, and/or earlier response to subsequent exposures.

6.5.2.2 Pile driving

In order to minimize the effects of pile driving on ESA-listed species, BOEM will require Southern Company to implement several mitigation measures. The most significant of these measures requires that no pile driving occur if any whales or sea turtles are present within an observer-monitored region of 1,000 m of the pile to be driven. Outside the 1,000 m exclusion zone, noise levels are anticipated to be below well below levels believed to be potentially injurious. Once pile-driving equipment is turned on, should a sea turtle or marine mammal be detected within the exclusion zone, pile driving will be halted or delayed until the exclusion zone is clear of marine mammals and sea turtles for at least 60 minutes (Ballorain et al. 2013; Brill et al. 1995; Byles 1988; Eckert et al. 1989; Eckert et al. 1996; Harvey et al. 2006; Hazel et al. 2009; I-Jiunn 2009; López-Mendilaharsu et al. 2009; Mendonca and Pritchard 1986; Renaud 1995a; Renaud and Carpenter 1994; Sakamoto et al. 1990; Southwood et al. 1999; Spotila 2004a). Based on this, it is extremely unlikely that a sea turtle will be present within 1,000 m of any pile being driven if noise is sufficient to cause injury (due to the close proximity that turtles would need to be in) or severe behavioral or physiological harm (due to the expectation that the motivation to leave the area due to discomfort will be greater than any motivation to remain in the immediate vicinity).

As explained above, the best available information indicates that sea turtles will respond behaviorally to impulsive noises greater than 165 dB re 1 μPa and will likely actively avoid areas ensonified to this level. It is reasonable to assume that sea turtles, on hearing the sound produced during pile driving, would either not approach the source or would move around it/away from it once the proximity/motivation to avoid uncomfortable sound levels is reached. When considering the potential for behavioral effects, we need to consider the geographic and temporal scope of any impacted area. For this analysis, we consider the area where noise levels greater than 165 dB re 1 μPa will be experienced and the duration of time that those underwater noise levels could be experienced. Behavioral responses could range from a startle with immediate resumption of normal behaviors to complete avoidance of the immediate area for a period of hours while pile driving is operational and could also include changes in diving patterns or changes in foraging behavior.

Sea turtles are present in the action area during the warmer spring, summer, and fall months which coincide with the period that pile driving could generally occur. Sea turtles in the area could be migrating, resting or foraging. We expect sea turtles within 1,000 m of the piles being driven (up to three piles over three days) are expected to temporarily stop these behaviors and make evasive movements (changes in diving or swimming patterns) until they are outside the area where noise is elevated above 165 dB re 1uPa. Given that the piles will be installed in an open ocean environment with no impediments to movement, we do not expect any instances where a sea turtle would be unable to avoid the sound source.

Sea turtles migrating through the area when pile driving occurs are expected to adjust their course to avoid areas louder than 165 dB re 1uPa. The turtle may experience physiological stress during this avoidance behavior but this stressed state would end minutes or hours after having swum away from the immediate area. Similarly, any disruption or delay in foraging or resting would be temporary and persist only as long as it took the sea turtle to swim away from the noisy area, or less considering foraging opportunities in surrounding areas. Resting or foraging could resume once the sea turtle left the immediate area, or in the pile-driving area with a few hours once pile driving is done for the day. If engaged in migration, this is expected to continue with the avoidance representing a minor disruption to the migratory path.

Sea turtles may avoid or be temporarily excluded from the area with disturbing levels of sound for the duration of pile driving operations (i.e., eight hours a day), the area from which an individual is being excluded is not essential to any turtle and the behaviors that would have been carried out in the area can be carried out elsewhere with only minor, short term costs to the individuals affected. All behavioral responses to a disturbance, such as those described above, will have an energetic or metabolic consequence to the individual reacting to the disturbance (e.g., adjustments in migratory movements or foraging). We believe short-term interruptions of normal behavior are likely to have little effect on the overall health, reproduction, and energy balance of an individual or population. As the disturbance will occur for only eight hours a day, over a period of three days, sea turtles are not expected to be exposed to chronic levels of underwater noise and thus, chronic levels of disturbance that significantly impair essential behavior patterns. Thus, although there will be a temporary energetic consequence to any sea turtle disturbed by impact pile driving noise, due to the temporary nature of the disturbance, the additional energy expended is not likely to clearly impair essential life functions (i.e., foraging, migrations, nesting) or impair the health, survivability, or reproduction of an individual.

6.5.2.3 HRG surveys

Pages 222-255 of the 2013 NMFS programmatic biological opinion on BOEM Atlantic G&G activities detail responses sea turtles are generally expected to exhibit in response to HRG acoustic sources as well as the vessels hosting these systems (NMFS 2013c). Some additional information is available for these marine protected species since the time this consultation was completed. Regarding sonar systems, we expect that systems used will produce harmonic components in a frequency range above and below the center frequency similar to other commercial sonars (Deng et al. 2014).

The several sonars operate at frequencies outside the hearing bandwidths of sea turtles (i.e., between 100-2,000 Hz for sea turtles; Bartol et al. 1999a; Lenhardt et al. 1994; Ridgeway et al. 1969). However, three systems do operate at frequencies that sea turtles may hear (boomers, sparkers, and chirp depth sounders) and may ensonify individual sea turtles at intensities and frequencies sufficient to cause a response. Sea turtle avoidance of these sources is likely, but some turtles may not avoid the source vessel and may be exposed at levels of concern. Based on available information on captive turtles, avoidance may begin at received levels above 165 dB re 1 μPa. For those turtles that might be exposed to HRG sound sources at levels above 165 dB re 1 μPa during the proposed activities, we expect this could result in a stress response that rises to the level of harassment. However, numerous exposures are unlikely, due to the nature of the sound sources moving with the vessel, having highly-directionalized, narrow-beam, low-duty cycle characteristics and cause no more than temporary behavioral responses.

6.5.2.4 Meteorological tower and buoy installation/decommissioning

Meterological tower construction will potentially expose sea turtles to banging of metal parts, welding activities, and operation of cranes and other machinery. We have no information to support that sea turtles will respond in a way that would result in meaningful behavioral changes, alter time or energy budgets, or result in other responses that can have fitness consequences.

Meteorological tower decommissioning involves in-water noise related to removal of the tower. This noise is not anticipated to be any louder than the impacts already assessed under the pile driving and construction. The potential noise impacts from decommissioning would be temporary, lasting only for the duration of the tower removal. Decommissioning activities will be prohibited November 1 through April 30. Some sea turtles may be exposed to installation/decommissioning activities. As with tower construction, noises could include metal parts banging together, welding activities, as well as crane and machinery operations. We have no information to support that sea turtles will respond in a way that would result in meaningful behavioral changes, alter time or energy budgets, or result in other responses that can have fitness consequences.

6.6 Risk Analysis

During meteorological tower construction, noise generated by pile driving may be audible to sea turtles, although the noise would be different in character depending upon whether it was from vibratory or impact pile driving. Noise from pile driving could cause some sea turtles to move away from or avoid the construction area. Currently, the biological consequences of hearing loss or behavioral responses for individual sea turtles are not known, and little information exists regarding short-term and long-term impacts to sea turtle populations. Avoidance of ensonified areas could disrupt foraging and migration or result in the expenditure of additional energy that will have otherwise not occurred. These impacts will be temporary and will not result in population-level effects. Large numbers of individuals are not expected to be exposed to pile driving noise due to the short-term duration of the activity and the limited spatial scale of construction within the action area. Also, mitigation measures are expected to further reduce the exposure of sea turtles to construction-related acoustics by requiring a 60-minute observation period before pile driving begins, a 1,000 m exclusion zone during pile driving, and a soft start procedure to allow animals to leave the area prior to harassing levels of sound. Sea turtle dive durations range from 5 to 40 minutes, depending on the species, with a maximum duration of 45 to 66 minutes, depending on the species (Ballorain et al. 2013; Brill et al. 1995; Byles 1988; Eckert et al. 1989; Eckert et al. 1996; Harvey et al. 2006; Hazel et al. 2009; I-Jiunn 2009; López-Mendilaharsu et al. 2009; Mendonca and Pritchard 1986; Renaud 1995a; Renaud and Carpenter 1994; Sakamoto et al. 1990; Southwood et al. 1999; Spotila 2004a). Based on this information, it is reasonable to expect that monitoring the exclusion zone for at least 60 minutes will allow protected species observers to detect any sea turtle within the exclusion zone prior to the start of construction activities. McCauley et al. (2000a; 2000b) reported that source levels of 166 dB re 1 μPa were required to evoke behavioral reactions from captive sea turtles. According to available information on sea turtle behavioral response to intense pulsed sounds (i.e., impact pile driving), sea turtles are likely to actively avoid disturbing levels of sound (McCauley et al. 2000a; McCauley et al. 2000b; O'Hara and Wilcox 1990). While avoidance may aid in reducing exposure to disturbing sounds, it may also result in the alteration of normal behaviors such as migration and foraging. However, these alterations are expected to be localized and temporary, lasting only the duration of pile installation (impact or vibratory for a maximum of four to eight hours per day over three days for each tower).

ESA-listed sea turtles are expected to return to areas previously avoided due to sound levels following the cessation of pile driving activities. As pile driving will occur for approximately four to eight hours a day, for three days it is likely that sea turtles will be excluded from the area with disturbing levels of sound for only this period each day, or for a maximum of three days. Should sea turtles be present and feeding or resting in an area where pile driving occurred, it is expected that they could find alternative forage and resting locations elsewhere within the action area. Additionally, should ESA-listed sea turtles be migrating through the region, it is expected that they will avoid disturbing noises, thereby decreasing the potential for impacts from the pile driving noise. The avoidance of the area due to sound will therefore affect individuals; however, it is expected that these effects will be temporary and localized. It is expected that foraging, migrating, or resting individuals will be only minimally impacted, and no injury or impairment of an individual's ability to complete essential behavioral functions is expected.

Based on this analysis, we have determined that any changes in behavior resulting from exposure to increased underwater noise associated with pile driving, constructing or decommissioning the meteorological tower, deploying buoys, maintaining any of this equipment, or undertaking HRG surveys may temporarily disrupt behaviors including resting, foraging, and migrating of some sea turtles but the individual's ability to carry out these behaviors will resume as soon as the animal swims out of the noisy area or the pile driving ceases. Therefore, any impairment will be temporary and limited to a short-term stress response and temporary shift in energy expenditures from the pre-disturbance behavior to evasive movements. Because of the short term nature of this disturbance, no sea turtles will be precluded or significantly impaired from completing any normal behaviors such as resting, foraging or migrating and we do not expect the fitness of any individuals to be affected. Additionally, while there will be a short term increase in energy expenditure, this is not expected to have any detectable effect on any present or future effect on growth, reproduction, or general health. Based on the above analyses, although on an individual level, we expect temporary adjustments in individual behaviors, we do not expect the exposure to the proposed noise sources or vessel activities to result in injury or death by impairing essential behavioral patterns for individual sea turtles. No population level effects are likely.

6.7 Cumulative Effects

"Cumulative effects" are 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 of the ESA.

We expect that those aspects described in the *Environmental Baseline* and *Status of ESA-listed and Proposed Resources* will continue to impact ESA-listed resources into the foreseeable future. We expect climate change, habitat degradation, dredging, oil and gas activities, military activities, vessel traffic, entrapment and entanglement, wind energy projects, entrainment in power plants, ship-strikes, pollution, scientific research, and harvests to continue into the future. Movement towards bycatch reduction and greater foreign protections of sea turtles are generally occurring throughout the Atlantic Ocean, which may aid in abating the downward trajectory of many sea turtle populations considered in this consultation.

6.8 Integration and Synthesis

The *Integration and Synthesis* section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the *Effects of the Action on ESA-Listed Species and Critical Habitat* (Section 4) to the

Environmental Baseline (Section 5) and the *Cumulative Effects* (Section 6.5) to formulate the agency's biological and conference Opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of ESA-listed and proposed species in the wild by reducing its numbers, reproduction, or distribution. This assessment is made in full consideration of the *Status of ESA-Listed and Proposed Species* (Section 4).

As explained in the *Overview of NMFS' Assessment Framework* (Section 3), risks to listed individuals are measured using changes to an individual's "fitness" – i.e., the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When ESA-listed animals, or animals proposed to be listed, exposed to an action's effects are not expected to experience reductions in fitness, we do not expect the action to have adverse consequences on the viability of the population(s) those individuals represent or the species those populations comprise (Anderson 2000; Brandon 1978; Mills and Beatty 1979; Stearns 1992). As a result, if the assessment indicates that ESA-listed or proposed animals are not likely to experience reductions in their fitness, we conclude our assessment. If possible reductions in individuals' fitness are likely to occur, the assessment considers the risk posed to population(s) to which those individuals belong, and then to the species those population(s) represent.

The *Status of ESA-Listed and Proposed Species* discussion describes how listed sea turtles range-wide have been adversely affected by human-induced factors such as commercial fisheries, direct harvest of sea turtles, and modification or degradation of the sea turtle's terrestrial and aquatic habitat. Effects occurring in terrestrial habitats have generally resulted in the loss of eggs or hatchling sea turtles, or nesting females, while those occurring in aquatic habitat have caused the mortality of juvenile, subadult and adult sea turtles through ingestion of debris or pollution. Similarly, the actions discussed in the *Environmental Baseline*, as well as the continuation of these actions as those considered under *Cumulative effects* all pose the potential to result in take of sea turtle species that resulted in stress or possible mortality.

The following discussions summarize the probable risks the proposed actions pose to ESA listed sea turtles, and sea turtles proposed to be listed, that are likely to be exposed. These discussions integrate the exposure profiles presented previously with the results of our response analyses for each of the actions considered in this Opinion.

ESA-listed turtles that are expected to occur within the action area include green sea turtles, Kemp's ridley sea turtles, leatherback sea turtles, and loggerhead sea turtles, which are either listed as threatened or endangered (the North Atlantic DPS of green sea turtles is proposed to be listed as threatened). The *Status of Listed Resources* section found that most sea turtle populations have undergone significant to severe reduction by human harvesting of both eggs and turtles, as well as severe bycatch pressure in worldwide fishing industries. As previously mentioned, the Cumulative Effects section identified actions in the *Environmental Baseline* to generally continue for the foreseeable future.

From the *Effects Analysis*, we expect that three green (proposed North Atlantic DPS or currently listed endangered entity), six Kemp's ridley, six leatherback, and 39 loggerhead sea turtles could experience exposure to pile driving and be harassed by these sounds, all of these stemming from the three-day pile driving event. These sounds may induce a temporary increase in stress levels, swimming patterns, and movement out of the action area. Population sizes are not available to calculate the subset of all population affected, as "population" proxies, if available, are based upon adult female nesters. However, those that are available suggest a very small proportion of each population would be affected. We expect transient responses that do not affect the fitness of any one individual. Although some sea turtles may be exposed to chirp echo sounder, sparker, or boomer systems, we do not expect anything more than temporary behavioral responses and a mild stress response (if any response at all) from exposed individuals. We do not expect vessel sound or ship strikes to negatively impact sea turtles. We do not expect impairment of breeding or local nesting activities as a result of the proposed action. We do not anticipate any indirect effects from the proposed actions to influence sea turtles. Overall, we do not expect any individual sea turtle to undergo a fitness consequence. Based upon these findings, we do not expect population or species-level consequences.

7 CONCLUSION

After reviewing the current status of the ESA-listed species, the *Environmental Baseline* within the action area, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects, it is NMFS' Opinion that the proposed action is not likely to jeopardize the continued existence of or recovery of green (currently listed or proposed North Atlantic DPS), Kemp's ridley, leatherback, or loggerhead sea turtles. No critical habitat is expected to be affected by the proposed activities.

8 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. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Section 7(b)(4) and Section 7(o)(2) 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.

8.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent, of such incidental “taking” on the species (50 CFR § 402.14(i)(1)(i)). The amount of “take” represents the number of individuals that are expected to be “taken” by actions while the extent of “take” or “the extent of land or marine area that may be affected by an action” may be used if we cannot assign numerical limits for animals that could be incidentally “taken” during the course of an action (51 FR 19953).

The NMFS anticipates the proposed meteorological tower and buoy construction, deployment, and maintenance along Georgia is likely to result in the incidental “take” of ESA-listed species by harassment. The proposed action is expected to “take” by harassment three green, six Kemp’s ridley, six leatherback, and 39 Northwest Atlantic DPS loggerhead sea turtles by exposing individuals to received pile driving sound levels greater than 165 dB re 1 μPa for sea turtles. These estimates are based on the best available information of densities in the area to be ensonified above 165 dB re 1 μPa. This incidental “take” would result primarily from exposure to acoustic energy during pile driving operations and would be in the form of harassment, and is not expected to result in the death or injury of any individuals that are exposed. These takes could occur to hatchling, juvenile, subadult, or adult sea turtle life stages. No additional sea turtle “take” is anticipated from construction, deployment, maintenance, or decommissioning activities associated with the meteorological tower or buoys.

We expect that sea turtles can only perceive sound from a subset of the HRG sources (boomer, sparker, and chirp sub-bottom profiler) due to expected or known sea turtle hearing frequency ranges and frequency parameters of the HRG systems to be employed. The three systems that do operate at frequencies that sea turtles may hear may ensonify individual sea turtles at intensities and frequencies sufficient to cause “take” by harassment. Sea turtle exposure to HRG sources in the 2013 NMFS programmatic biological opinion on BOEM Atlantic G&G activities was not quantitatively undertaken due to lack of dive and density estimates. Although density estimates are available here, dive estimates remain unknown and, therefore, models developed for marine mammals for the 2013 NMFS programmatic biological opinion on BOEM Atlantic G&G activities and the BOEM programmatic environmental impact statement cannot be used. In addition, we remain unable to estimate propagation distances and exposure intensity levels because information regarding which, how much, and where specific HRG sources will be used is not known. Therefore, although we expect that green, Kemp's ridley, leatherback, and loggerhead sea turtles will be exposed to HRG survey systems in the action area, we cannot reliably quantify the anticipated amount of take of sea turtles during HRG surveys. "Take" of these species will have been exceeded if the monitoring program associated with HRG survey activities detects any individuals of these species that have been harmed, injured, or killed as a result of exposure to HRG transmissions, or if survey effort (in number of hours; 450) is exceeded. These takes could occur to hatchling, juvenile, subadult, or adult sea turtle life stages.

No incidental "take" of cetaceans is anticipated from the proposed action due to HRG activities proposed. However, if "take" to cetaceans is documented, its authorization is addressed by the 2013 NMFS programmatic biological opinion on BOEM G&G activities in the Atlantic.

During this consultation, NMFS issued a proposed rule to revise the listings of green sea turtles. NMFS proposed eight threatened DPSs and three endangered DPSs. Green turtles in the action area would be part of the proposed threatened North Atlantic DPS. If the proposed rulemaking becomes effective and if the proposed listings are finalized as proposed and as assessed in this Opinion, incidental "take" estimates for the range-wide threatened green sea turtle species will become null and void and the incidental "take" estimate for this species would be assigned to the North Atlantic DPS. In order for the ITS to take effect for the North Atlantic DPS of green sea turtles, BOEM must request of NMFS that the findings of the conference opinion be verified. If NMFS confirms the findings remain correct, NMFS will respond to BOEM that the findings are still true and that the incidental take for the proposed North Atlantic green sea turtle DPS is in effect.

Harassment of green, Kemp's ridley, leatherback, and loggerhead sea turtles at levels below 166 dB re 1 μPa, is not expected. Any incidental "take" of green, Kemp's ridley, leatherback, or loggerhead sea turtles is restricted to the permitted action as proposed. If the actual incidental "take" exceeds the predicted level or type, BOEM must reinitiate consultation. This includes decommissioning activities which require additional authorization by BOEM if the activities are not consistent, particularly more impactful, than what has been described in the *Description of the Proposed Action*. All anticipated "takes" would be "takes by harassment," as described previously, involving temporary changes in behavior.

8.2 Effects of the Take

In this Opinion, NMFS determined that the amount or extent of anticipated "take," coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

8.3 Reasonable and Prudent Measures

The measures described below are nondiscretionary, and must be undertaken by BOEM so that they become binding conditions for the exemption in Section 7(o)(2) to apply. Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with Section 7(a)(2) of the ESA and the proposed action may incidentally "take" individuals of ESA-listed species, NMFS will issue a statement that specifies the impact of any incidental "taking" of endangered or threatened species. To minimize such impacts, reasonable and prudent measures, and term and conditions to implement the measures, must be provided. Only incidental "take" resulting from the agency actions and any specified reasonable and prudent measures and terms and conditions identified in the ITS are exempt from the "taking" prohibition of Section 9(a), pursuant to Section 7(o) of the ESA.

NMFS believes the reasonable and prudent measure described below is necessary and appropriate to minimize the amount of incidental "take" of sea turtles resulting from the proposed actions. This measure is non-discretionary and must be a binding condition of BOEM and NMFS' authorization for the exemption in Section 7(o)(2) to apply. If BOEM or NMFS fail to ensure compliance with this term and conditions and its implementing terms and conditions, the protective coverage of Section 7(o)(2) may lapse.

- The Southern Company must implement and monitor the effectiveness of mitigation measures incorporated as part of the proposed authorization of the incidental "taking" of green, Kemp's ridley, leatherback, and loggerhead sea turtles.

8.4 Terms and Conditions

To be exempt from the prohibitions of Section 9 of the ESA, BOEM must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures described above and outlines the mitigation, monitoring and reporting measures required by the Section 7 regulations (50 CFR 402.14(i)). These terms and conditions are non-discretionary. If BOEM fails to ensure compliance with these terms and conditions and their implementing reasonable and prudent measures, the protective coverage of section 7(o)(2) may lapse. Although take of North Atlantic right whales is not authorized as part of this ITS, the "take" (0) is minimized by several of the conditions articulated below.

To implement the Reasonable and Prudent Measures, BOEM shall ensure that:

8.4.1 Standard operating conditions for protected species regarding vessel strike avoidance

The BOEM has stated that the Southern Company must ensure all vessels conducting activity associated with the lease must comply with the vessel strike avoidance measures specified below except under extraordinary circumstances when the safety of the vessel or crew are in doubt or the safety of life at sea is in question.

1) The Southern Company must ensure that vessel operators and crews maintain a vigilant watch for cetaceans and sea turtles and slow down or stop their vessel to avoid striking protected species.
2) The Southern Company must ensure that all vessel operators comply with the 18.5 km/h or less, speed restrictions in any DMA or Seasonal Management Area. In addition, the Southern Company must ensure that all vessels 65 feet or larger operating from November 1 through April 30 operate at speeds of 18.5 km/h or less. Vessel operators may send a blank email to ne.rw.sightings@noaa.gov for an automatic response listing all current Seasonal Management Areas and DMA.
3) North Atlantic right whales
    a) The Southern Company must ensure all vessels maintain a separation distance of 500 m or greater from any sighted North Atlantic right whale and the Early Warning System, Sighting Advisory System, and Mandatory Ship Reporting System data notifying mariners of right whale presence must be monitored during transit and operations.
    b) The Southern Company must ensure that the following avoidance measures are taken if a vessel comes within 500 m of a right whale:
        i) Vessel operators must ensure that while underway, any vessel must steer a course away from the right whale(s) at 18.5 km/h or less until the minimum separation distance has been established (unless (ii) below applies).
        ii) If a North Atlantic right whale is sighted within 100 m of an underway vessel, the vessel operator must immediately reduce speed and promptly shift the engine to neutral. The vessel operator must not engage the engines until the right whale has moved beyond 100 m from the vessel, at which point the vessel operator must comply with 3(b)(i)
        iii) If a vessel is stationary, the vessel operator must not engage engines until the North Atlantic right whale has moved beyond 100 m, at which time the vessel operator must comply with 3(b)(i).
4) Non-delphinoid cetaceans other than the North Atlantic right whale
    a) The Southern Company must ensure all vessels maintain a separation distance of 100 m or greater from any sighted non-delphinoid cetacean.
    b) The Southern Company must ensure that the following avoidance measures are taken if a vessel comes within 100 m of a non-delphinoid cetacean:
        i) The Southern Company must ensure that when a non-delphinoid cetacean (other than a North Atlantic right whale) is sighted, the vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the non-delphinoid cetacean has moved beyond 100 m.
        ii) The Southern Company must ensure that if a vessel is stationary, the vessel must not engage engines until the non-delphinoid cetacean has moved beyond 100 m.
5) Delphinoid cetaceans

a) The Southern Company must ensure all vessels maintain a separation distance of 50 m or greater from any sighted delphinoid cetacean.
b) The Southern Company must ensure that the following avoidance measures are taken if the vessel comes within 50 m of a delphinoid cetacean:
   i) The Southern Company must ensure that any vessel underway remain parallel to a sighted delphinoid cetacean's course whenever possible, and avoid excessive speed or abrupt changes in direction. Course and speed may be adjusted once the delphinoid cetacean has moved beyond 50 m or the delphinoid cetacean has moved abeam of the underway vessel.
   ii) In addition, the Southern Company must ensure that the speed of any vessel underway is reduced to 18.5 km/h or less when pods (including mother/calf pairs) or large assemblages of delphinoid cetaceans are observed. The Southern Company must ensure that the vessel does not adjust course and speed until the delphinoid cetaceans have moved beyond 50 m or abeam of the underway vessel.

6) Sea turtles. The Southern Company must ensure all vessels maintain a separation distance of 50 m or greater from any sighted sea turtle.
7) The Southern Company must ensure that vessel operators are briefed to ensure they are familiar with the above requirements.

8.4.2 Marine debris measures

The BOEM will require the Southern Company to ensure that vessel operators, employees, and contractors engaged in activity conducted under the lease are briefed on marine trash and debris awareness elimination as described in the Bureau of Safety and Environmental Enforcement Notice to Applicants No. 2012-G01 (Marine Trash and Debris Awareness and Elimination). The BOEM will not require the Southern Company to undergo formal training or post placards, as described under this Notice to Applicants. Instead, the Southern Company must ensure that its employees and contractors are made aware of the environmental and socioeconomic impacts associated with marine trash and debris and their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into the marine environment. The above referenced Notice to Applicants provides information the Southern Company may use for this awareness training.

8.4.3 Geological and geophysical operating conditions

1. Visibility. The Southern Company must not conduct G&G surveys under the lease at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state) prevents visual monitoring of the exclusion zones for HRG surveys and geotechnical surveys as specified below. This requirement may be modified as specified below.

2. Modification of visibility requirement. If the Southern Company intends to conduct G&G survey operations in support of plan submittal at night or when visual observation is otherwise impaired, the Southern Company must submit to BOEM an alternative monitoring plan

detailing the alternative monitoring methodology (e.g., active or passive acoustic monitoring technologies). The BOEM may decide to allow the Southern Company to conduct G&G surveys in support of plan submittal at night or when visual observation is otherwise impaired using the proposed alternative monitoring methodology.

3. Protected-species observer. The Southern Company must ensure that the exclusion zone for all G&G surveys performed under the lease are monitored by a NMFS-approved protected species observer. The Southern Company must provide to BOEM a list of observers and their résumés no later than forty-five (45) calendar days prior to the scheduled start of surveys performed in support of plan submittal. The résumés of any additional observers must be provided fifteen (15) calendar days prior to each observer's start date. The BOEM will send the observer information to NMFS for approval.

4. Optical device availability. The Southern Company must ensure that reticle binoculars and other suitable equipment are available to each observer to adequately perceive and monitor distant objects within the exclusion zone during surveys conducted under the lease.

8.4.4 High resolution geophysical survey requirements

The following requirements will apply to all HRG survey work actively using electromechanical survey equipment where one or more acoustic sound source is operating at frequencies below 200 kHz:

1. Establishment of exclusion zone. The Southern Company must ensure that a 200 m default exclusion zone for cetaceans and sea turtles will be monitored by a protected species observer around any active sound sources on a survey vessel actively using electromechanical survey equipment where one or more acoustic sound sources is operating at frequencies below 200 kHz. In the case of the North Atlantic right whale, the minimum separation distance of 500 m is in effect when the vessel is underway as described in the vessel-strike avoidance measures.

   If BOEM determines that the exclusion zone does not encompass the 180 dB radius calculated for the acoustic source having the highest source level, BOEM will consult with NMFS about additional requirements.

   The BOEM may authorize surveys having an exclusion zone larger than 200 m to encompass the 160 dB radius if the Southern Company can demonstrate the zone can be effectively monitored.

2. Field verification of exclusion zone. The Southern Company may choose to conduct field verification of the exclusion zone for specific HRG survey equipment operating below 200 kHz. The Southern Company must take acoustic measurements at a minimum of two reference locations and be sufficient to establish the following: source level (peak at 1 m) and distance to the 180, 160, and 150 dB re 1μPa (RMS) sound pressure level isopleths as well as the 187 dB re 1μPa cumulative sound exposure level. Sound measurements must be taken at the reference locations at two depths (i.e., a depth at mid-water and a depth at approximately 1

m above the seafloor). An infrared range finder may be used to determine distance from the sound source to the reference location.

3. Modification of exclusion zone. The Southern Company must use the field-verification method described above to modify the HRG survey exclusion zone for specific HRG survey equipment operating below 200 kHz. This modified exclusion zone may be greater than or less than the 200 m default exclusion zone depending on the results of the field tests. Any new exclusion zone radius must be based on the most conservative measurement (i.e., the largest safety zone configuration) of the target (160 dB or 180 dB) zone. This modified zone must be used for all subsequent use of field-verified equipment and may be periodically reevaluated based on the regular sound monitoring. The Southern Company must obtain BOEM approval of any new exclusion zone before it may be implemented.
4. Clearance of exclusion zone. The Southern Company must ensure that active acoustic sound sources must not be activated until the protected species observer has reported the exclusion zone clear of all cetaceans and sea turtles for 60 minutes.
5. Electromechanical survey equipment ramp-up. The Southern Company must ensure that when technically feasible a “ramp-up” of the electromechanical survey equipment occur at the start or re-start of HRG survey activities. A ramp-up would begin with the power of the smallest acoustic equipment for the HRG survey at its lowest power output. The power output would be gradually turned up and other acoustic sources added in a way such that the source level would increase in steps not exceeding 6 dB per 5-min period.
6. Shut down for non-delphinoid cetaceans and sea turtles. If a non-delphinoid cetacean or sea turtle is sighted at or within the exclusion zone, an immediate shutdown of the electromechanical survey equipment is required. The vessel operator must comply immediately with such a call by the observer. Any disagreement or discussion should occur only after shut-down. Subsequent restart of the electromechanical survey equipment must use the ramp-up provisions described above and may only occur following clearance of the exclusion zone of all cetaceans and sea turtles for 60 minutes.
7. Power down for delphinoid cetaceans. If a delphinoid cetacean or pinniped is sighted at or within the exclusion zone, the electromechanical survey equipment must be powered down to the lowest power output that is technically feasible. The vessel operator must comply immediately with such a call by the observer. Any disagreement or discussion should occur only after power-down. Subsequent power up of the electromechanical survey equipment must use the ramp up provisions described above and may occur after (1) the exclusion zone is clear of a delphinoid cetacean and/or pinniped or (2) a determination by the protected species observer after a minimum of 10 minutes of observation that the delphinoid cetacean and/or pinniped is approaching the vessel or towed equipment at a speed and vector that indicates voluntary approach to bow-ride or chase towed equipment. An incursion into the exclusion zone by a non-delphinoid cetacean or sea turtle during a power-down requires implementation of the shut-down procedures described above.

8. Pauses in electromechanical survey sound source. The Southern Company must ensure that if the electromechanical sound source shuts down for reasons other than encroachment into the exclusion zone by a non-delphinoid cetacean or sea turtle, including, but not limited to, mechanical or electronic failure, resulting in the cessation of the sound source for a period greater than 20 minutes, the Southern Company must restart the electromechanical survey equipment using the full ramp-up procedures and clearance of the exclusion zone of all cetaceans and sea turtles for 60 minutes. If the pause is less than 20 minutes the equipment may be re-started as soon as practicable at its operational level as long as visual surveys were continued diligently throughout the silent period and the exclusion zone remained clear of cetaceans and sea turtles. If visual surveys were not continued diligently during the pause of 20-minutes or less, the Southern Company must restart the electromechanical survey equipment using the full ramp-up procedures and clearance of the exclusion zone of all cetaceans and sea turtles for 60 minutes.
9. Dynamic management area shutdown. The Southern Company must ensure that vessels cease HRG survey activities within 24 hours of NMFS establishing a DMA in the Southern Company's HRG survey area. HRG surveys may resume in the affected area after the DMA has expired.

In addition to these conditions, HRG equipment sound sources (not including the vessel) will not operate sound sources with frequencies below 30 kHz in North Atlantic right whale critical habitat from November 1 through April 31.

8.4.5 Protected species reporting requirements

The Southern Company must ensure compliance with the following reporting requirements for site characterization activities performed under the lease and must use contact information provided by BOEM, to fulfill these requirements:

1. Reporting observed impacts to protected species. The observer must report any observations concerning impacts on ESA-listed sea turtles to BOEM and the NMFS within 48 hours.
2. Reporting injured or dead protected species.
    a. The Southern Company must ensure that sightings of any injured or dead protected species (e.g., sea turtles) are reported to NMFS Southeast Region's Stranding Hotline (877-433-8299 or current) within 24 hours of sighting, regardless of whether the injury or death is caused by a vessel. In addition, if the injury or death was caused by a collision with a project-related vessel, the Southern Company must ensure that the incident is immediately reported to BOEM and NMFS Southeast Region's Stranding Hotline (877-433-8299 or current). The Southern Company must report any injuries or mortalities using the Incident Report in Attachment B-1. If the Southern Company's activity is responsible for the injury or death, the Southern Company must ensure that the vessel assist in any salvage effort as requested by NMFS.
    b. The Southern Company must ensure that any collision with or injury to a manatee shall be reported immediately to the Florida Fish and Wildlife Conservation

Commission Hotline at 1-888-404-3922. Collision and/or injury should also be reported to the US Fish and Wildlife Service in Vero Beach (1-772-562-3909) and to the Florida Fish and Wildlife Conservation Commission at ImperiledSpecies@myFWC.com. The Southern Company must report any injuries or mortalities using the Incident Report in Attachment B-1.

3. Report information. The protected species observer must record all observations of protected species using standard marine mammal observer data collection protocols. The list of required data elements for these reports is provided in Attachment B-2.
4. HRG plan for field verification of the exclusion zone. The Southern Company must submit a plan for verifying the sound source levels of any electromechanical survey equipment operating at frequencies below 200 kHz to BOEM no later than 45 days prior to the commencement of the field verification activities. The BOEM may require that the Southern Company modify the plan to address any comments BOEM submits to the Southern Company on the contents of the plan in a manner deemed satisfactory to BOEM prior to the commencement of the field verification activities.
5. Report of activities and observations. The Southern Company must provide BOEM and the NMFS with a report within ninety (90) calendar days following the commencement of HRG and/or geotechnical exploration activities that includes a summary of the survey activities, all protected species observer reports, a summary of the survey activities and an estimate of the number of listed sea turtles observed or “taken” during these survey activities.
6. Final technical report for meteorological tower construction and meteorological buoy installation. The Southern Company must provide BOEM and NMFS a report within 120 days after completion of the pile-driving and construction activities. The report must include full documentation of methods and monitoring protocols, summaries of the data recorded during monitoring, estimates of the number of listed sea turtles that may have been taken during construction activities, and provide an interpretation of the results and effectiveness of all monitoring tasks. The report must also include acoustic monitoring results from any pile-driving activity conducted during the installation of a meteorological tower. Reports must be sent to:

Bureau of Ocean Energy Management
Environment Branch for Renewable Energy
Phone: 703-787-1340
Email: renewable_reporting@boem.gov

National Marine Fisheries Service
Southeast Regional Office, Protected Resources Division
Section 7 Coordinator
Phone: 727-824-5312
Email: incidental.take@noaa.gov

9 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, to help implement recovery plans, or develop information (50 CFR §402.02).

We suggest the following conservation recommendations, which would provide information for future consultations involving pile driving and the issuance of incidental harassment authorizations that may affect endangered or threatened sea turtles:

1. *Effects of pile driving noise on sea turtles.* BOEM should promote and fund research examining the potential effects of pile driving on ESA-listed sea turtle species.

In order for NMFS' Office of Protected Resources ESA Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their critical habitat, BOEM should notify the ESA Interagency Cooperation Division of any conservation recommendations they implement in their final action.

10 REINITIATION OF CONSULTATION

This concludes formal consultation and conference for BOEM on the issuance of a five-year lease to authorize the construction, maintenance, and decommissioning of a meteorological tower, buoys, and HRG surveys along Georgia. If the proposed listings of green turtle DPSs are finalized as proposed, BOEM may ask NMFS to confirm the conference opinion as a biological opinion through formal consultation. The request must be in writing. If NMFS reviews the proposed action and finds that there have been no significant change in the action as planned or in the information used during the conference, NMFS will confirm the conference opinion as the biological opinion on the project and no further Section 7 consultation will be necessary.

As 50 CFR §402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect ESA-listed species or critical habitat in a manner or to an extent not considered in this Opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the ESA-listed species or critical habitat that was not considered in this Opinion, or (4) a new species is ESA-listed or critical habitat designated that may be affected by the action.

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