NOAA's National Marine Fisheries Service
Endangered Species Act Section 7 Consultation

Biological Opinion

Agency: Permits, Conservation, and Education Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service

Activity Considered: The Proposal to Issue Permit No. 14586 to Jeanette Wyneken of Florida Atlantic University for Research on Abundance and Distribution of Marine Mammals and Sea Turtles in the Straits of Florida

Consultation Conducted by: Endangered Species Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service

Approved by: [Signature]

Date: NOV 10 2010

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1531 et seq.) requires each federal agency to insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency's action “may affect” listed species or designated critical habitat, that agency is required to consult formally with either NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the listed resources that may be affected. Federal agencies are exempt from this requirement if they have concluded that an action “may affect”, but is “unlikely to adversely affect” listed species or designated critical habitat, and NMFS and/or USFWS concur with that conclusion (50 CFR 402.14[b]).

For the actions described in this document, the action agency is NMFS’ Office of Protected Resources – Permits, Conservation, and Education Division. The consulting agency is NMFS’ Office of Protected Resources – Endangered Species Division. This document represents NMFS’ Biological Opinion (Opinion) of the effects of the proposed research activities on threatened and endangered species and designated critical habitat in accordance with section 7 of the ESA. This Opinion is based on information submitted by NMFS’ Office of Protected Resources – Permits, Conservation, and Education Division, published and unpublished scientific information on the biology and ecology of the listed species affected, and other relevant sources of information.
CONSULTATION HISTORY

On May 18, 2010, NMFS’ Office of Protected Resources – Permits, Conservation, and Education Division requested consultation with NMFS’ Office of Protected Resources – Endangered Species Division on a proposed action to issue scientific research permit No. 14586 to Jeanette Wyneken of Florida Atlantic University to perform aerial and vessel surveys in the Straits of Florida. The permits would be valid for five years from the date of issuance. The initiation package included the permit applications from the respective applicants, discussion of the effects of the research on the target species, and drafts of the proposed permits.

Upon reviewing the initiation package, NMFS’ Office of Protected Resources – Endangered Species division requested additional information regarding the level of effort expected by the survey team. Upon receiving the additional information, NMFS’ Office of Protected Resources – Endangered Species Division initiated formal consultation on June 8th, 2010.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

NMFS’ Office of Protected Resources – Permits, Conservation and Education Division proposes to issue a permit to Jeanette Wyneken of Florida Atlantic University for harassment of marine mammals (including listed whales) and sea turtles in the Straits of Florida during aerial and vessel abundance surveys, pursuant to section 104 of the Marine Mammal Protection Act of 1972, as amended (MMPA) (16 U.S.C. 1361 et seq.) and section 10(a)(1)(A) of the ESA. These actions may result in “takes” of listed cetaceans including fin (Balaenoptera physalus), humpback (Megaptera novaeangliae), sperm (Physeter macrocephalus), and North Atlantic right whales (Eubalaena glacialis) as well as listed sea turtles including leatherback (Dermochelys coriacea), loggerhead (Caretta caretta), green (Chelonia mydas), hawksbill (Eretmochelys imbricata), and Kemp’s ridley sea turtles (Lepidochelys kempii). This ESA Section 7 consultation considers the effects of the proposed research studies on endangered and threatened species and designated critical habitat.

The proposed permit would not authorize any lethal “take” of listed species but would authorize “take” resulting from short-term harassment of listed species during aerial and vessel surveys. The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. However, the MMPA defines harassment as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal population in the wild or has the potential to disturb a marine mammal or marine mammal population in the wild by causing disruption of

1 The ESA defines “take” as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct
behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering” [16 U.S.C. 1362(18)(A)]. The latter portion of this definition (that is, “...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering”) is almost identical to the U.S. Fish and Wildlife Service’s regulatory definition of “harass” pursuant to the ESA. For this Opinion, “harassment” is defined similarly as 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.

The research activities proposed in permit No. 14586 for Jeanette Wyneken include aerial and vessel surveys along pre-determined transects to document abundances of cetaceans and sea turtles in the Florida Straits from Jacksonville to Miami and west to the Bahamas. Aerial surveys would be conducted following the transect line methodology presented by Buckland et al. (2001). Surveys would be taken once a month during all months of the year using a Cessna 337 high-wing aircraft. Altitude would be maintained at 150 meters (m) (or 500 feet [ft]) with a ground speed of approximately 75-100 knots. Two types of transects would be flown: (1) Transects will be flown perpendicular to the coast (east-west) starting as far south as Ft. Lauderdale and as far north as West Palm Beach, Florida and will travel across the Florida Straits to the Bahamas, and (2) one transect will be flown north from West Palm Beach to Jacksonville and one transect will be flown south from Jacksonville to West Palm Beach within the main currents of the Gulf Stream. Observers would identify all species observed as well as species size when possible in accordance with survey methods presented by Henwood and Epperly (1999). Aerial surveys would be continuous and researchers would not break transect to approach any targeted species.

Vessel surveys would also be conducted following the transect line methodology presented by Buckland et al. (2001). The surveys would take place at a speed of 9 kilometers/hour (km/hr) and would be conducted once a month during all months of the year using COET 33 ft survey vessel. Just as with the aerial surveys, transect lines would occur perpendicular to the coast (east-west) and would encompass both near-shore and off-shore areas starting as far south as Ft. Lauderdale and as far north as Jupiter, and would travel across the Florida Straits to the Bahamas. Three trained observers would be positioned on the vessel to identify targeted sea turtle and marine mammal species. Researchers would not break from transect to approach any targeted species observed. If an animal is sighted along the transect line, researchers would break transect to avoid or minimize any interaction or harassment to the species.

The objective of the research is to collect information on the spatial and temporal distribution of sea turtle and marine mammal species occurring in the Straits of Florida. The research would provide information on the abundance of sea turtles and marine mammals in the area prior to the deployment of a national off-shore laboratory that will serve as a testing site for ocean energy technology. The research will assist in future planning efforts in order to avoid important migration routes or areas where listed species are highly concentrated throughout the year. Table 1 below lists the proposed “take” of
listed species to be authorized in Wyneken’s permit as a result of the proposed research activities.

Table 1. Research Activities and Proposed Takes of Listed Species for Permit No. 14586 – Jeanette Wyneken

<table>
<thead>
<tr>
<th>SPECIES (LIFE STAGE)</th>
<th>ACTIVITY</th>
<th>INDIVIDUALS PROPOSED TO BE TAKEN ANNUALLY</th>
<th>INDIVIDUALS PROPOSED TO BE TAKEN OVER FIVE YEAR DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>275</td>
<td>1,375</td>
</tr>
<tr>
<td>Green Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>75</td>
<td>375</td>
</tr>
<tr>
<td>Hawksbill Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>35</td>
<td>175</td>
</tr>
<tr>
<td>Hawksbill Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>Kemp’s Ridley Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>35</td>
<td>175</td>
</tr>
<tr>
<td>Kemp’s Ridley Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>Leatherback Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>275</td>
<td>1,375</td>
</tr>
<tr>
<td>Leatherback Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>75</td>
<td>375</td>
</tr>
<tr>
<td>Loggerhead Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>700</td>
<td>3,500</td>
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<tr>
<td>Loggerhead Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>200</td>
<td>1,000</td>
</tr>
<tr>
<td>Unidentified Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>550</td>
<td>2,750</td>
</tr>
<tr>
<td>Unidentified Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>150</td>
<td>750</td>
</tr>
<tr>
<td>North Atlantic Right Whale (All)</td>
<td>Aerial Survey; Vessel Survey; Count/Survey</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Species (All)</td>
<td>Survey Methods</td>
<td>Count/Survey</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>Fin Whale</td>
<td>Aerial Survey; Vessel Survey; Count/Survey</td>
<td>10 50</td>
<td></td>
</tr>
<tr>
<td>Sperm Whale</td>
<td>Aerial Survey; Vessel Survey; Count/Survey</td>
<td>10 50</td>
<td></td>
</tr>
<tr>
<td>Humpback Whale</td>
<td>Aerial Survey; Vessel Survey; Count/Survey</td>
<td>10 50</td>
<td></td>
</tr>
</tbody>
</table>

**Mitigation Measures**

The following section summarizes the mitigation measures associated with Permit No. 14586 to mitigate effects to targeted and any non-targeted protected species during research activities. More detailed information may be found in the associated permit and Environmental Assessment document. The following conditions are included in Jeanette Wyneken’s proposed permit:

1. In the event a serious injury or mortality of a protected species occurs, the Researchers must suspend permitted activities and contact the Chief, NMFS Permits, Conservation, and Education Division by phone within two business days. Researchers must also submit a written incident report. The Permits Division may grant authorization to resume permitted activities based on review of the incident report and in consideration of the Terms and Conditions of the permit.

2. If authorized take\(^2\) is exceeded, the Researchers must cease all permitted activities and notify the Chief, NMFS Permits, Conservation, and Education Division by phone as soon as possible but not later than two business days. Researchers must also submit a written incident report within two weeks of the incident. The incident report must include a complete description of the events and identification of steps that will be taken to reduce the potential for additional exceedance of authorized take.

3. Any “approach”\(^3\) of a cetacean constitutes a take by harassment and must be counted and reported.

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\(^2\) The permit does not allow for unintentional serious injury and mortality caused by the presence or actions of researchers. This includes, but is not limited to; deaths of dependent young by starvation following research-related death of a lactating female; deaths resulting from infections related to sampling procedures; and deaths or injuries sustained by animals during capture or handling, or while attempting to avoid researchers or escape capture. Note that for marine mammals, a serious injury is defined by regulation as any injury that will likely result in mortality.

\(^3\) An "approach" is defined as a continuous sequence of maneuvers (episode) involving a vessel or researcher's body in the water, including drifting, directed toward a cetacean or group of cetaceans closer than 100 yards for large whales, or 50 yards for smaller cetaceans.
4. During aerial surveys, any cetacean or sea turtle observed below 1,000 ft should be counted and reported as a take.

5. No individual animal may be taken more than 3 times in one day.

6. Aerial surveys must be flown at an altitude of 500 ft or higher.

7. To minimize disturbance: If an animal shows a response to the presence of the aircraft, the aircraft must leave the vicinity and either resume searching or continue on the line-transect survey.

8. The permit does not authorize takes of any protected species not identified in Appendix 1 of the permit, including those species under the jurisdiction of the USFWS (e.g. manatees). Should other protected species be encountered during the research activities authorized under the permit, researchers must exercise caution and remain at a safe distance from the animal(s) to avoid take, including harassment.

9. Individuals conducting permitted activities must possess qualifications commensurate with their roles and responsibilities.

10. Persons who require state or Federal licenses to conduct activities authorized under the permit (e.g. veterinarians, pilots) must be duly licensed when undertaking such activities.

11. The Permit holder must submit annual reports to the Chief, NMFS Permits, Conservation, and Education Division and a final report must be submitted within 180 days after expiration of the permit, or, if the research concludes prior to permit expiration, within 180 days of completion of the research.

12. Research results must be published or otherwise made available to the scientific community in a reasonable period of time.

13. The Permit Holder must provide written notification of planned field work to the appropriate Assistant Regional Administrator(s) for Protected Resources. Such notification must be made at least two weeks prior to initiation of a field trip/season and must include the locations of the intended field study and/or survey routes, estimated dates of research, and number and roles of participants.

14. To the maximum extent practicable, the Permit Holder must coordinate permitted activities with activities of other Permit Holders conducting the same or similar activities on the same species, in the same locations, or at the same times of year to avoid unnecessary disturbance of animals.

In addition to adhering to the permit conditions, the researchers will minimize and avoid any interaction with protected species occurring along the transect line by breaking
transect to avoid an oncoming animal. Trained observers will be on board during vessel surveys to spot any listed species occurring along the path of the vessel. Also, aerial surveys will not approach any listed species spotted along the survey tract.

**APPROACH TO THE ASSESSMENT**

NMFS approaches its section 7 analyses of agency actions through a series of steps. The first step identifies those aspects of proposed actions that are likely to have direct and indirect physical, chemical, and biotic effects on listed species or on the physical, chemical, and biotic environment of an action area. As part of this step, we identify the spatial extent of these direct and indirect effects, including changes in that spatial extent over time. The result of this step includes defining the *Action Area* for the consultation. The second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *Exposure Analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action’s effects and the populations or subpopulations those individuals represent. Once we identify which listed resources are likely to be exposed to an action’s effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure (these represent our *Response Analyses*).

The final steps of our analyses establishes the risks those responses pose to listed resources (these represent our *Risk Analyses*). Our jeopardy determinations must be based on an action’s effects on the continued existence of threatened or endangered species as those “species” have been listed, which can include true biological species, subspecies, or *Distinct Population Segments* (DPSs) of species. The continued existence of these “species” depends on the fate of the populations that comprise them. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them – populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

Our risk analyses reflect these relationships between listed species, the populations that comprise that species, and the individuals that comprise those populations. Our risk analyses begin by identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action’s effects. Our analyses then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population-level risks to the species those populations comprise.

We measure risks to listed individuals using the individuals’ “fitness,” or the individual’s growth, survival, annual reproductive success, and lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual’s probable lethal, sub-lethal, or behavioral responses to an action’s effect on the environment (which we identify during our *Response Analyses*) are likely to have consequences for the individual’s fitness.
When individual listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions are likely to reduce the abundance, reproduction, or growth rates (or increase the variance in these measures) of the populations those individuals represent (see Stearns, 1992). Reductions in at least one of these variables (or one of the variables we derive from them) is a necessary condition for reductions in a population’s viability, which is itself a necessary condition for reductions in a species’ viability. As a result, when listed plants or animals exposed to an action’s effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). As a result, if we conclude that listed plants or animals are not likely to experience reductions in their fitness, we would conclude our assessment.

Although reductions in fitness of individuals is a necessary condition for reductions in a population’s viability, reducing the fitness of individuals in a population is not always sufficient to reduce the viability of the population(s) those individuals represent. Therefore, if we conclude that listed plants or animals are likely to experience reductions in their fitness, we determine whether those fitness reductions are likely to reduce the viability of the populations the individuals represent (measured using changes in the populations’ abundance, reproduction, spatial structure and connectivity, growth rates, variance in these measures, or measures of extinction risk). In this step of our analyses, we use the population’s base condition (established in the Environmental Baseline and Status of the Species sections) as our point of reference. If we conclude that reductions in the fitness of individuals are not likely to reduce the viability of the populations those individuals represent, we would conclude our assessment.

Reducing the viability of a population is not always sufficient to reduce the viability of the species those populations comprise. Therefore, in the final step of our analyses, we determine if reductions in a population’s viability are likely to reduce the viability of the species those populations comprise using changes in a species’ reproduction, numbers, distribution, estimates of extinction risk, or probability of being conserved. In this step of our analyses, we use the species’ status (established in the Status of the Species section) as our point of reference. Our final jeopardy determinations are based on whether threatened or endangered species are likely to experience reductions in their viability and whether such reductions are likely to be appreciable.

To conduct these analyses, we rely on all of the evidence available to us. This evidence might consist of monitoring reports submitted by past and present permit holders, reports from NMFS Science Centers, reports prepared by State or Tribal natural resource agencies, reports from non-governmental organizations involved in marine conservation issues, the information provided by the Permits, Conservation and Education Division when it initiates formal consultation, and the general scientific literature. 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 Minerals Management Service, U.S. Coast Guard and U.S. Navy whose operations extend into the marine environment.

During each consultation, we conduct electronic searches of the general scientific literature using *American Fisheries Society*, *Google Scholar*, *ScienceDirect*, *BioOne*, *Conference Papers Index*, *JSTOR*, and *Aquatic Sciences and Fisheries Abstracts* search engines. We supplement these searches with electronic searches of doctoral dissertations and master’s theses. These searches specifically try to identify data or other information that supports a particular conclusion (for example, a study that suggests whales will exhibit a particular response to aerial or vessel surveys) as well as data that does not support that conclusion.

We rank the results of these searches based on the quality of their study design, sample sizes, level of scrutiny prior to and during publication, and study results. Carefully designed field experiments (for example, experiments that control potentially confounding variables) are rated higher than field experiments that are not designed to control those variables. Carefully designed field experiments are generally ranked higher than computer simulations. Studies that produce large sample sizes with small variances are generally ranked higher than studies with small sample sizes or large variances. Finally, in keeping with the direction from the U.S. Congress to provide the “benefit of the doubt” to threatened and endangered species [House of Representatives Conference Report No. 697, 96th Congress, Second Session, 12 (1979)], when data are equivocal, or in the face of substantial uncertainty, our decisions are designed to avoid the risks associated with incorrectly concluding an action has no adverse effect on a listed species when, in fact, such adverse effects are likely (i.e. avoiding Type II error).

**ACTION AREA**

The action area is defined in 50 CFR 402.2 as “all areas to be affected directly or indirectly by the Federal Action and not merely the immediate area involved in the action.” Jeanette Wynekan’s permit would authorize research in the Florida Straits including north-south transects from Jacksonville to Miami, Florida, and east-west transects from Miami and Ft. Lauderdale, Florida, west to the Bahamas. The effects of the proposed action extend throughout the Florida straits west to the Bahamas; therefore, the action area considered in this Opinion includes nearshore and offshore waters off the east coast of Florida west to the Bahamas.

**STATUS OF THE SPECIES**

NMFS’ Office of Protected Resources – Endangered Species Division has determined that the following listed resources provided protection under the ESA occur within the action area and may be affected by proposed action:
<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Listing Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue whale</td>
<td><em>Balaenoptera musculus</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Fin whale</td>
<td><em>Balaenoptera physalus</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Humpback whale</td>
<td><em>Megaptera novaeangliae</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>North Atlantic right whale</td>
<td><em>Eubalaena glacialis</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Sei whale</td>
<td><em>Balaenoptera borealis</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Sperm whale</td>
<td><em>Physeter macrocephalus</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Green sea turtle</td>
<td><em>Chelonia mydas</em></td>
<td>Endangered ⁴</td>
</tr>
<tr>
<td>Hawksbill sea turtle</td>
<td><em>Eretmochelys imbricata</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Kemp’s ridley sea turtle</td>
<td><em>Lepidochelys kempii</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Leatherback sea turtle</td>
<td><em>Dermochelys coriacea</em></td>
<td>Endangered</td>
</tr>
<tr>
<td>Loggerhead sea turtle</td>
<td><em>Caretta caretta</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Elkhorn Coral</td>
<td><em>Acropora palmata</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Staghorn Coral</td>
<td><em>Acropora cervicornis</em></td>
<td>Threatened</td>
</tr>
<tr>
<td>Johnson’s Seagrass</td>
<td><em>Halophila johnsonii</em></td>
<td>Threatened</td>
</tr>
</tbody>
</table>

**North Atlantic Right Whale Critical Habitat**
**Elkhorn Coral Critical Habitat**
**Staghorn Coral Critical Habitat**
**Johnson’s Seagrass Critical Habitat**

**Listed Resources Not Likely to be Adversely Affected**
Endangered blue and sei whales occur in the range of the proposed action and could be subject to disturbance and boat strikes from the proposed activities. However, these species are typically located further offshore in deeper waters than the areas targeted by the proposed research and would be highly unlikely to be encountered during aerial or vessel surveys performed by the research applicants. The research vessel would also transit at slow speeds and would have trained observers onboard to spot any oncoming whale so that the research team could maneuver around the animal if it were to occur during transit or along the actual transect lines. These species are highly unlikely to be exposed to the effects of the proposed action and any potential threats are discountable. Therefore, the proposed action is not likely to adversely affect blue or sei whales and these species will not be considered further in this Opinion.

Critical habitat for the North Atlantic right whale exists within the north and south aerial survey trackline. However, no vessel surveys are proposed within the southeast calving grounds for the North Atlantic right whale and aerial survey methods as proposed by the applicant are not expected to affect habitat conditions suitable for calving success. Therefore, the proposed actions is not likely to adversely affect critical habitat for the North Atlantic right whale and this resource will not be considered further in this Opinion.

⁴ Green sea turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. Due to difficulties in distinguishing between individuals from the Florida breeding population from other populations, green sea turtles are considered endangered wherever they occur in U.S. waters.
Two listed invertebrate species (Elkhorn and Staghorn coral), one listed plant species (Johnson’s seagrass), and each of their respective critical habitat occur within the action area and could be therefore be subject to physical disturbance or from unexpected contaminant or fuel spill pollution from the research vessel. However, because the research is directed offshore and because the vessel used would transit to and from designated port areas, the researchers are not expected to impact the sediment or bottom habitat for coral or Johnson’s seagrass. Also, the research team has experience performing similar types of surveys and would be expected to take all proper precautions to avoid a contaminant spill and to take the necessary steps to address a spill that occurs to minimize or avoid disturbance to listed species and critical habitat occurring in nearshore waters. Listed corals and Johnson’s seagrass as well as their respective critical habitats are highly unlikely to be exposed to effects from the proposed action and any potential threats are discountable. Therefore, the proposed action is not likely to adversely affect Elkhorn coral, Staghorn coral, Johnson’s seagrass, or their respective critical habitat and these listed resources will not be considered further in this Opinion.

Listed Resources Likely to be Adversely Affected
The sections below provide information on the status of listed resources likely to be adversely affected by the proposed action. The biology and ecology of these species as well as their global status and trends are described below, and inform the effects analysis for this Opinion.

**Loggerhead Sea Turtle**

*Species Description, Distribution, and Population Structure*

Adult and subadult loggerhead sea turtles (*Caretta caretta*) are characterized as having a light yellow plastron and a reddish brown carapace covered by non-overlapping scutes that meet along seam lines. They typically have 11 or 12 pairs of marginal scutes, five pairs of costals, five vertebrals, and a nuchal (precentral) scute that is in contact with the first pair of costal scutes. Hatchlings lack the reddish tinge and vary from light to dark brown dorsally. Both pairs of appendages are dark brown and have distinct white margins. Hatchling mean body mass is about 20 g and mean straight carapace length is about 45 mm (Dodd, 1988).

The loggerhead sea turtle inhabits continental shelf and estuarine environments and occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd, 1988). The majority of loggerhead nesting occurs at the western rims of the Atlantic and Indian Oceans concentrated in the north and south temperate zones and subtropics (NRC, 1990).

In the western North Atlantic, the majority of loggerhead nesting is concentrated along the coasts of the United States from southern Virginia to Alabama. Additional nesting beaches are found along the northern and western Gulf of Mexico, eastern Yucatán Peninsula, at Cay Sal Bank in the eastern Bahamas (Addison and Morford, 1996; Addison, 1997), off the southwestern coast of Cuba (Gavilan, 2001), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands. In the eastern Atlantic, the largest nesting population of loggerheads is in the Cape Verde
Islands (Abella et al., 2007; Delgado et al., 2008), with some nesting also occurring along the West African coast (Freté 2001). From a global perspective, the southeastern U.S. nesting aggregation is critical to the survival of this species as it second in size only to the nesting aggregations in the Arabian Sea off Oman. In addition, shelf waters along the Florida west coast, the Bahamas, Cuba, and the Yucatán Peninsula have been identified as important resident areas for adult female loggerheads that nest in Florida (Foley et al., 2008).

Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea. Little is known about the distribution of adult males who are seasonally abundant near nesting beaches although aerial surveys suggest that loggerheads in U.S. waters are distributed as a whole in the following proportions: 54 percent in the southeast U.S. Atlantic, 29 percent in the northeast U.S. Atlantic, 12 percent in the eastern Gulf of Mexico, and 5 percent in the western Gulf of Mexico (Turtle Expert Working Group [TEWG], 1998). Shallow water habitats with large expanses of open ocean access, such as Florida Bay, provide year-round resident foraging areas for significant numbers of male and female adult loggerheads while juveniles are also found in enclosed, shallow water estuarine environments not frequented by adults (Epperly et al., 1995a). Further offshore, adults primarily inhabit continental shelf waters, from New England south to Florida, the Caribbean, and Gulf of Mexico (Schroeder et al., 2003). Benthic, immature loggerheads foraging in northeastern U.S. waters are known to migrate southward in the fall as water temperatures cool and then migrate back northward in spring (Epperly et al., 1995a; Keinath, 1993; Morreale and Sandora, 1998; Shoop and Kenney, 1992).

Currently, there are 9 distinct population segments (DPS) of loggerhead sea turtles proposed to be listed under the ESA divided geographically: South Atlantic Ocean DPS, Southeast Indian Ocean DPS, Mediterranean Sea DPS, North Indian Ocean DPS, North Pacific Ocean DPS, Northeast Atlantic Ocean DPS, Northwest Atlantic Ocean DPS, South Pacific Ocean DPS, and Southeast Indo-Pacific Ocean DPS.

**Life History Information**

Loggerhead sea turtles reach sexual maturity between 20 and 38 years of age, although this varies widely among populations (Frazer and Ehrhart, 1985; NMFS, 2001). The annual mating season for loggerhead sea turtles occurs from late March to early June, and eggs are laid throughout the summer months. Female loggerheads deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins, 1984) and have an average remigration interval of 3.7 years (Tucker, 2010). Mean clutch size varies from 100 to 126 eggs for nests occurring along the southeastern U.S. coast (Dodd, 1988).

Loggerheads originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for a period as long as 7-12 years (Bolten et al., 1998). Stranding records indicate that when immature loggerheads reach 40-60 cm straight carapace length, they then travel to coastal inshore waters of the

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5 A distinct population segment, is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or distinct population segments of vertebrate species.
continental shelf throughout the U.S. Atlantic and Gulf of Mexico (Witzell, 2002). Recent studies, however, have suggested that not all loggerhead sea turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic juveniles, followed by permanent settlement into benthic environments (Laurent et al., 1998; Bolten, 2003). These studies suggest some turtles may either remain in the pelagic habitat in the North Atlantic longer than hypothesized or move back and forth between pelagic and coastal habitats interchangeably (Witzell, 2002).

As post-hatchlings, loggerheads hatched on U.S. beaches migrate offshore and become associated with Sargassum habitats, driftlines, and other convergence zones (Carr, 1986; Witherington, 2002). Juveniles are omnivorous and forage on crabs, mollusks, jellyfish and vegetation at or near the surface (Dodd, 1988). Sub-adult and adult loggerheads are primarily found in coastal waters and prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

Listing Status
The loggerhead sea turtle was listed as threatened under the ESA in 1978 throughout its range. At the time of this consultation, 9 separate loggerhead sea turtle DPS’ are proposed for listing under the ESA with 2 proposed as endangered (South Atlantic Ocean and Southwest Indian Ocean) and 7 proposed as threatened (Mediterranean Sea, North Indian Ocean, North Pacific Ocean, Northeast Atlantic Ocean, Northwest Atlantic Ocean, South Pacific Ocean, and Southeast Indo-Pacific Ocean). Critical habitat has not been designated for the loggerhead sea turtle.

Status and Trends
The most recent reviews show that only two loggerhead nesting aggregations have greater than 10,000 females nesting per year: Peninsular Florida in the United States and Masirah Island, Oman (Baldwin et al., 2003; Ehrhart et al., 2003; Kamezaki et al., 2003, Limpus and Limpus, 2003; Margaritoulis et al., 2003). Current data reports declines of 26 percent over a recent 20 year period (1989-2008) with a 41 percent decline since 1998 alone (NMFS and USFWS, 2009). The status of the Oman nesting beaches has not been evaluated recently; however, these beaches are located in regions vulnerable to extremely disruptive events (e.g. political upheavals, wars, and catastrophic oil spills), thus resulting in increased risk to loggerhead nesting success in these areas (Meylan et al., 1995). At present, there are no reliable estimates of population size of loggerheads in the pelagic and oceanic environments as studies tend to focus on known nesting populations or are too localized to reveal any reliable large scale estimates (Bjorndal and Bolten, 2000). Heppell et al. (2003) showed that the growth of loggerhead sea turtle populations were particularly sensitive to changes in annual survival of both juvenile and adult sea turtles, and Crouse (1999) concluded that relatively small changes in annual survival rates of both juvenile and adult loggerhead sea turtles will adversely affect large segments of the total loggerhead sea turtle population, thereby increasing their risk of extinction.

Loggerhead sea turtles face numerous natural and anthropogenic threats that help shape its status and affect the ability of the species to recover. As many of the threats affecting loggerheads are either the same or similar in nature to threats affecting other listed sea
turtle species, many of the threats identified in this section below are discussed in a
general sense for all listed sea turtles rather than solely for loggerheads. Threats specific
to a particular species are then discussed in the corresponding status sections where
appropriate.

Sea turtles have been impacted historically by domestic and international fishery
operations that often capture, injure, and even kill sea turtles at various life stages. In the
U.S., the bottom trawl, sink gillnets, hook and line gear, and bottom longline managed in
the Northeast Multispecies Fishery are known to capture sea turtles during normal fishery
operations (Watson et al., 2004; Epperly et al., 1995a; Lewison et al., 2003, Lewison et
al., 2004; Richards, 2007) while the lines used for pot gear for the U.S. Lobster and Red
Crab fisheries can cause entanglement resulting in injury to flippers, drowning, or
increased vulnerability to boat collisions (Lutcavage et al., 1997). In addition, various
trawl, gillnet, longline, and hook gears used for the Monkfish, Spiny Dogfish, Summer
Flounder, Scup, Black Sea Bass, and Atlantic Highly Migratory Species fisheries
managed in the U.S. impact sea turtles at various degrees. The Southeast U.S. Shrimp
Fishery (which uses otter trawl gear) has historically been one of the largest fishery
threats to sea turtles (Murray, 2006), and continues to interact with (and kill) large
numbers of turtles each year. Although loggerhead sea turtles are most vulnerable to
pelagic longlines during their immature life history stage, there is some evidence that
benthic juveniles may also be captured, injured, or killed by pelagic fisheries as well
(Lewison et al., 2004) (refer to the Environmental Baseline section of this Opinion for
further information regarding federal and state managed fisheries affecting sea turtles in
the action area).

In addition to domestic fisheries, sea turtles are subject to direct as well as incidental
capture in numerous foreign fisheries, further exacerbating the ability of sea turtles to
survive and recover on a more global scale. For example, pelagic, immature loggerhead
sea turtles circumnavigating the Atlantic are exposed to international longline fisheries
including the Azorean, Spanish, and various other fleets (Aguilar et al., 1995; Bolten et
al., 1994; Crouse, 1999). Bottom set lines in the coastal waters of Madeira, Portugal, are
reported to take an estimated 500 pelagic immature loggerheads each year (Dellinger and
Encamacao, 2000) and gillnet fishing is known to occur in many foreign waters,
including (but not limited to) the northwest Atlantic, western Mediterranean, South
America, West Africa, Central America, and the Caribbean. Shrimp trawl fisheries are
also occurring off the shores of numerous foreign countries and pose a significant threat
to sea turtles similar to the impacts seen in U.S. waters. In addition to the reported takes,
there are many unreported takes or incomplete records by foreign fleets, making it
difficult to characterize the total impact that international fishing pressure is having on
listed sea turtles. Nevertheless, international fisheries represent a continuing threat to sea
turtle survival and recovery throughout their respective ranges.

There are also many non-fishery impacts affecting the status of sea turtle species, both in
the marine and terrestrial environment. In nearshore waters of the U.S., the construction
and maintenance of Federal navigation channels has been identified as a source of sea
turtle mortality. Hopper dredges, which are frequently used in ocean bar channels and
sometimes in harbor channels and offshore borrow areas, move relatively rapidly and can entrain and kill sea turtles (NMFS, 1997a). Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants. Other neashore threats include harassment and/or injury resulting from private and commercial vessel operations, military detonations and training exercises, and scientific research activities.

Coastal development can deter or interfere with nesting, affect nesting success, and degrade nesting habitats for sea turtles. Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Lutcavage et al., 1997; Bouchard et al., 1998). 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 females and may evoke a change in the natural behaviors of both adults and hatchlings (Ackerman, 1997; Witherington et al., 2003; Witherington et al., 2007). In addition, coastal development is usually accompanied by artificial lighting which has been known to alter the behavior of nesting adults (Witherington, 1992) and is often fatal to emerging hatchlings that are drawn away from the water (Witherington and Bjorndal, 1991). Predation by various land predators is a threat to developing nests and emerging hatchlings. Additionally, direct harvest of eggs and adults from beaches in foreign countries continues to be a problem for various sea turtle species throughout their ranges (NMFS and USFWS, 2009).

Sea turtles in the Gulf of Mexico are located in an area of high-density offshore oil extraction with chronic, low-level spills and occasional massive spills (such as the current Deep Horizon oil spill, Ixtoc I oil well blowout and fire in the Bay of Campeche in 1979, and the explosion and destruction of a loaded supertanker, the Mega Borg, near Galveston in 1990). Oil spills can impact sea turtles and other wildlife directly through three primary pathways: ingestion – when animals swallow oil particles directly or consume prey items that have been exposed to oil, absorption – when animals come into direct contact with oil, and inhalation – when animals breath volatile organics released from oil or from “dispersants” applied by response teams in an effort to increase the rate of degradation of the oil in seawater. Several aspects of sea turtle biology and behavior place them at particular risk, including the lack of avoidance behavior, indiscriminate feeding in convergence zones, and large pre-dive inhalations (Milton et al., 2003). When large quantities of oil enter a body of water, chronic effects such as cancer, and direct mortality of wildlife becomes more likely (Lutcavage et al., 1997). Oil spills in the vicinity of nesting beaches just prior to or during the nesting season could place nesting females, incubating egg clutches, and hatchlings at significant risk (Fritts and McGehee, 1982; Lutcavage et al., 1997; Witherington, 1999). Continuous low-level exposure to oil in the form of tarballs, slicks, or elevated background concentrations also challenge animals facing other natural and anthropogenic stresses. Types of trauma can include skin irritation, altering of the immune system, reproductive or developmental damage, and liver disease (Keller et al., 2004; Keller et al., 2006). In addition, chronic exposure may impair a turtle’s overall fitness so that it is less able to withstand other stressors throughout the species life history (Milton et al., 2003).
The earlier life stages are usually at greater risk from an oil spill than adults since they usually spend a greater portion of their time at the sea surface, thereby increasing their risk of exposure to floating oil slicks (Lutcavage et al., 1995). Most reports of oiled hatchlings originate from convergence zones where currents meet to form collection points for material at or near the surface of the water. For example, 65 of 103 post-hatchling loggerhead sea turtles in convergence zones off Florida’s east coast were found with tar in the mouth, esophagus, or stomach (Loehefener et al., 1989). Thirty-four percent of post-hatchlings captured in Sargassum off the Florida coast had tar in the mouth or esophagus and more than 50 percent had tar caked in their jaws (Witherington, 1994). Tarballs in a turtle’s gut are likely to have a variety of effects – starvation from gut blockage, decreased absorption efficiency, absorption of toxins, effects of general intestinal blockage (such as local necrosis or ulceration), interference with fat metabolism, and buoyancy problems caused by the buildup of fermentation gases (floating prevents turtles from feeding and increases their vulnerability to predators and boats), among others. Also, trapped oil can kill the seagrass beds that turtles feed upon. Lutz and Lutcavage (1989) reported hatchlings found with their beaks and esophagi blocked with tarballs, apparently dying of starvation.

Frazier (1980) suggested that olfactory impairment from chemical contamination could represent a substantial indirect effect in sea turtles, since a keen sense of smell apparently plays an important role in navigation and orientation. A related problem is the possibility that an oil spill impacting nesting beaches may affect the locational imprinting of hatchlings, and thus impair their ability to return to their natal beaches to breed and nest (Milton et al., 2003).

Oil cleanup activities, such as the use of dispersants, may also be harmful to sea turtles although such impacts are difficult to predict in the absence of direct testing. While inhaling petroleum vapors can irritate turtles’ lungs, dispersants can interfere with lung function through their surfactant (detergent) effect. Dispersant components absorbed through the lungs or gut may affect multiple organ systems and interfere with digestion, respiration, excretion, and/or salt-gland function which can be similar to effects deriving from the oil itself (Hoff and Shigenaka, 2003). Other oil cleanup activities such as the use of earth-moving equipment on beaches can dissuade females from nesting and destroy nests while the use of containment booms has the possibly of entraping young hatchlings (Witherington, 1999). At the time of this consultation, NMFS has reported that 52 loggerhead sea turtles have been found dead in the vicinity of the Deep Horizon spill although the cause of death is not immediately certain for all carcasses recovered (NMFS, 2010a). More research will need to be done to determine the short and long term effects that oil spills such as the Deep Horizon oil spill in the Gulf of Mexico has on loggerhead and other sea turtle populations in the years to come.

**Green Sea Turtle**

*Species Description, Distribution, and Population Structure*

Green sea turtles (*Chelonia mydas*) have a smooth carapace with four pairs of lateral (or costal) scutes and a single pair of elongated prefrontal scales between the eyes. They
typically have a black dorsal surface and a white ventral surface although the carapace of green sea turtles in the Atlantic Ocean has been known to change in color from solid black to a variety of shades of grey, green, brown and black in starburst or irregular patterns (Lagueux, 2001).

Green sea turtles are distributed circumglobally, mainly in waters between the northern and southern 20° C isotherms (Hirth, 1971) and nesting occurs in more than 80 countries worldwide (Hirth, 1997). The two largest nesting populations are found at Tortuguero, on the Caribbean coast of Costa Rica, and Raine Island, on the Great Barrier Reef in Australia. The complete nesting range of green sea turtles within the southeastern U.S. includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina as well as the U.S. Virgin Islands (U.S.V.I.) and Puerto Rico (NMFS and USFWS, 1991). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard through Broward counties. Regular nesting is also known to occur on St Croix, U.S.V.I., and on Vieques, Culebra, Mona, and the main island of Puerto Rico (Dow et al., 2007). For more information on green sea turtle nesting in other ocean basins, refer to the 1991 Recovery Plan for the Atlantic Green Turtle (NMFS and USFWS, 1991) or the 2007 Green Sea Turtle 5-Year Review (NMFS and USFWS, 2007a).

Green sea turtles use mid-Atlantic and northern areas of the western Atlantic coast as important summer developmental habitat. They are found in estuarine and coastal waters as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds (Musick and Limpus, 1997). Like loggerheads, green turtles that use northern waters during the summer must return to warmer waters when water temperatures drop, or face the risk of cold stunning. Cold stunning of green sea turtles may occur in southern areas as well (i.e., Indian River, Florida), as these natural mortality events are dependent on water temperatures and not solely on geographical location.

In U.S. Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore waters from Texas to Massachusetts. Important feeding areas in Florida include the Indian River Lagoon System, the Florida Keys, Florida Bay, Homosassa, Crystal River, Cedar Key, St. Joseph Bay, and the Atlantic Ocean off Florida from Brevard through Broward counties (Wershoven and Wershoven, 1992; Guseman and Ehrhart, 1992). Additional important foraging areas in the western Atlantic include the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean coast of Panama, scattered areas along Colombia and Brazil (Hirth, 1971), and the northwestern coast of the Yucatan Peninsula. Adults of both sexes are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs (Hays et al., 2001).

The genetic substructure of the green sea turtle regional subpopulations shows distinctive mitochondrial DNA properties for each nesting rookery (Bowen et al., 1992) although turtles from separate nesting origins are commonly found mixed together on foraging grounds.
Life History Information
Scientists estimate green turtles reach sexual maturity anywhere between 20 and 50 years, at which time females begin returning to their natal beaches (i.e., the same beaches where they were born) every 2-4 years to lay eggs (Balazs, 1982; Frazer and Ehrhart, 1985), while males may mate every year (Balazs, 1983). Adult females migrate from foraging areas to mainland or island nesting beaches and may travel hundreds or thousands of kilometers each way.

Green sea turtle mating occurs in the waters off the nesting beaches. The nesting season varies depending on location. In the southeastern U.S., females generally nest between June and September, while peak nesting occurs in June and July (Witherington and Ehrhart, 1989). During the nesting season, females nest at approximately two-week intervals, laying an average of 3-4 clutches (Johnson and Ehrhart, 1996). Mean clutch size is highly variable among populations, but averages 110-115 eggs. In Florida, green sea turtle nests contain an average of 136 eggs (Witherington and Ehrhart, 1989), which will incubate for approximately two months before hatching.

After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years, feeding close to the surface on a variety of pelagic plants and animals associated with drift lines of algae and other debris. Once the juveniles reach a certain age/size range, they leave the pelagic habitat and travel to nearshore foraging grounds. As adults, they feed almost exclusively on sea grasses and algae in shallow bays, lagoons, and reefs (Rebel, 1974).

Listing Status
The green sea turtle was listed as threatened under the ESA in 1978 except for the Florida and Pacific coast of Mexico breeding populations which were listed as endangered. Critical habitat for the green sea turtle has been designated for the waters surrounding Isla Culebra, Puerto Rico, and its associated keys.

Status and Trends
The principal cause of the historical, worldwide decline of the green sea turtle was long-term harvest of eggs and adults on nesting beaches and juveniles and adults on feeding grounds. Seminoff (2004) estimated that analyses of subpopulation changes at 32 Index Sites distributed globally showed a 48 to 67 percent decline in the number of mature females nesting annually over the previous three generations. Of the 23 threatened nesting concentrations analyzed by NMFS and USFWS (2007a) for which estimates of current trends was possible, 10 nesting populations appeared to be increasing, 9 appeared to be stable, and 4 appeared to be decreasing. The review did mention that despite some increasing trends in global numbers, these estimates should be viewed cautiously since trend data was only available for about half of the total sites examined. According to the review, the poorest regions in terms of nesting included sites in Southeast Asia, the eastern Indian Ocean, and central Atlantic Ocean (NMFS and USFWS, 2007a).
In the western Atlantic, several major nesting assemblages have been identified and studied over time to monitor trends (Bass et al., 2006; Bowen et al., 1992). The largest known nesting assemblage in the western Atlantic, at Tortuguero, Costa Rica, has shown a long-term increasing trend since monitoring began in 1971, with an annual average of 17,402–37,290 nesting females seen each year (Troëng and Rankin, 2005). The estimated number of emergences was reported to be under 20,000 in 1971 and over 40,000 in 1996 with a high estimate of over 100,000 emergences reported in 1995 (Bjorndal et al., 1999). In the continental United States, green turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida and present estimates range from 200-1,100 females nesting annually. Occasional nesting has also been documented along the Gulf coast of Florida as well as the beaches on the Florida Panhandle (Meylan et al., 1994; Weishampel et al., 2003). While there appears to be an increasing trend in green sea turtle nesting in the southeast U.S., these numbers only reflect one segment of the population (nesting females) and should be taken with caution. There are no reliable estimates of the total number of green sea turtles inhabiting foraging areas within the southeast United States; however, localized information is available for a few sites. Green turtles were once abundant enough in the shallow bays and lagoons of the Gulf to support a commercial fishery, which landed over one million pounds of green sea turtles in 1890 (Doughty, 1984). However, Doughty reported that by the year 1902, a significant decline in the fishery was observed. A long-term in-water monitoring study in the Indian River Lagoon of Florida has tracked the populations of juvenile green turtles in a foraging environment and noted significant increases in catch-per-unit effort (more than doubling) between the years 1983-1985 and 1988-1990. An extreme, short-term increase in catch per unit effort of around 300 percent was reported for the years 1995-1996 (Ehrhart et al., 1996). Catches of benthic immature turtles at the St. Lucie Nuclear Power Plant intake canal, which acts as a passive turtle collector on Florida’s east coast, have also been increasing since 1992 (Martin and Ernst, 2000). It is likely that green sea turtles foraging in the region come from multiple genetic stocks.

Currently, anthropogenic impacts to the green sea turtle are similar to those facing other sea turtle species including interactions with domestic and international fisheries, destruction of nesting and foraging habitat, ship strikes and other vessel interactions, and threats from oil spills and other forms of pollution (refer to the loggerhead sea turtle status and trends section above for more information on these threats).

Green turtles depend on shallow foraging grounds with sufficient benthic vegetation. Therefore, direct destruction of foraging areas due to dredging, boat anchorage, deposition of spoil, and siltation may have considerable effects on the distribution of foraging green turtles (Coston-Clements and Hoss, 1983; Williams, 1988). Eutrophication, heavy metals, radioactive elements, and hydrocarbons all may reduce the extent, quality, and productivity of foraging grounds (Frazier, 1980; McKenzie et al., 1999; Storelli and Marcotrigiano, 2003). Various types of marine debris such as plastics, oil, and tar tends to collect on pelagic drift lines that young green turtles inhabit (Carr, 1987; Moore et al., 2001) and can lead to death through injection (Balazs, 1985; Bjorndal et al., 1994). Another major threat from man-made debris is the entanglement

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of turtles in discarded monofilament fishing line and abandoned netting (Balazs, 1985). Just as with loggerhead sea turtles, nesting and foraging green sea turtles are subjected to the effects from past and present oil spills occurring in the Gulf of Mexico and other regions. At the time of this consultation, NMFS has reported 24 confirmed mortalities of green sea turtles located in the vicinity of the Deep Horizon oil spill (NMFS, 2010a).

Fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle’s body, has been found to infect green sea turtles, most commonly juveniles (Williams et al., 1994). The occurrence of fibropapilloma tumors may result in impaired foraging, breathing, or swimming ability possibly leading to death in some cases making it a serious threat to the survival and recovery of the species.

**Hawksbill Sea Turtle**

*Species Description, Distribution, and Population Structure*

Hawksbill sea turtles (*Eretmochelys imbricata*) are small to medium-sized (45 to 68 kg on average) although nesting females are known to weigh up to 80 kg in the Caribbean (Pritchard et al., 1983). The carapace is usually serrated and has a "tortoiseshell" coloring, ranging from dark to golden brown, with streaks of orange, red, and/or black. The plastron of a hawksbill turtle is typically yellow. The head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. The shape of the mouth allows the hawksbill turtle to reach into holes and crevices of coral reefs to find sponges, their primary food source as adults, and other invertebrates. The shells of hatchlings are 42 mm long and are mostly brown and somewhat heart-shaped (Hillis and Mackay, 1989; van Dam and Sarti, 1989; Eckert, 1995).

Hawksbill turtles are circumtropical, usually occurring between latitudes 30° N and 30° S in the Atlantic, Pacific, and Indian Oceans. Hawksbills are widely distributed throughout the Caribbean Sea and western Atlantic Ocean, regularly occurring in southern Florida and the Gulf of Mexico (especially Texas), in the Greater and Lesser Antilles, and along the Central American mainland south to Brazil (Groombridge and Luxmoore, 1989; NMFS and USFWS, 1998). Within the U.S., hawksbills are most common in Puerto Rico and U.S. Virgin Islands but are also seen in the Gulf of Mexico and along the U.S. east coast of Florida where the warm Gulf Stream current passes close to shore (Lund, 1985; Meylan and Donnelly, 1999). Besides Florida, Texas is the only other state where hawksbills are sighted with any regularity in the continental U.S. (Plotkin and Amos, 1988; Plotkin and Amos, 1990; Amos, 1989).

Hawksbill sea turtles nest on insular and sandy beaches throughout the tropics and subtropics. Nesting occurs in at least 70 countries, although much of it now only occurs at low densities (NMFS and USFWS, 2007b). The most significant nesting within the U.S. occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and Buck Island, respectively. Although nesting within the continental U.S. is typically rare, it can occur along the southeast coast of Florida and the Florida Keys. In addition to nesting beaches in the U.S. Caribbean, the largest hawksbill nesting population in the Western Atlantic occurs in the Yucatán Peninsula of Mexico, where several thousand nests are recorded annually in the states of Campeche, Yucatán, and Quintana Roo.
In the U.S. Pacific, hawksbills nest on main island beaches in Hawaii, primarily along the east coast of the island. Hawksbill nesting has also been documented in American Samoa and Guam.

Substantial efforts have been made to determine the nesting population origins of hawksbill sea turtles assembled in foraging grounds, and genetic research has shown that hawksbills of multiple nesting origins commonly mix in foraging areas (Bowen et al., 1996). Adult hawksbill turtles are capable of migrating long distances between nesting beaches and foraging areas, which are comparable to migrations of green and loggerhead turtles. In the Atlantic, a female hawksbill sea turtle tagged at Buck Island Reef National Monument in the U.S. Virgin Islands traveled 1,160 miles (1,866 km) to the Miskito Cays in Nicaragua (Spotila, 2004).

**Life History Information**

Although the age at which hawksbills reach sexual maturity is unknown, the best available estimates suggest maturity takes at least 20 years with some estimates suggesting as long as 38 years (Limpus and Miller, 2000). Males are typically mature at around 69 cm in length while females are typically mature at around 75 cm in length (Limpus, 1992; Eckert, 1992). Female hawksbills return to their natal beaches every 2-3 years to nest (Witzell 1983; Van Dam et al., 1991) and generally lay 3-5 nests per season (Richardson et al., 1999). Compared with other sea turtles, clutch size for hawksbills can be quite high (up to 250 eggs per clutch) (Hirth, 1980).

Hawksbills may undertake developmental migrations (migrations as immatures) and reproductive migrations that involve travel over hundreds or thousands of kilometers (Meylan, 1999a). Post-hatchlings (oceanic stage juveniles) are believed to occupy the "pelagic" environment, taking shelter in floating algal mats and drift lines of flotsam and jetsam in the Atlantic and Pacific oceans (Musick and Limpus, 1997) before recruiting to more neritic, coastal foraging grounds. In the Caribbean, hawksbills are known to exclusively feed on sponges (Meylan, 1988; van Dam and Diez, 1997) although at times they have been seen foraging on other food items, notably corallimorphs and zooanthids (van Dam and Diez, 1997; Mayor et al., 1998; Leon and Diez, 2000).

Reproductive females undertake periodic (usually non-annual) migrations to their natal beach to nest and exhibit a high degree of fidelity to their nest sites. Movements of reproductive males are less certain, but are presumed to involve migrations to the nesting beach or to courtship stations along the migratory corridor. Hawksbills show a high fidelity to their foraging areas as well (van Dam and Diez, 1998). Foraging sites are typically areas associated with coral reefs although hawksbills are also found around rocky outcrops and high energy shoals which are optimum sites for sponge growth. They can also inhabit seagrass pastures in mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent (Bjorndal, 1997; van Dam and Diez, 1998).
**Listing Status**
The hawksbill sea turtle was listed as endangered under the ESA in 1970 and is also considered Critically Endangered by the IUCN (Mortimer and Donnelly, 2008). Critical habitat was designated in 1998 for hawksbill turtles in coastal waters surrounding Mona and Monito Islands, Puerto Rico.

**Status and Trends**
Hawksbills are solitary nesters and, thus, determining population trends or estimates on nesting beaches is difficult. Only five regional nesting populations remain (Seychelles, Mexico, Indonesia, and two in Australia) (Meylan and Donnelly, 1999) and most populations are declining, depleted, and/or remnants of larger aggregations (NMFS and USFWS, 2007b). The largest nesting population of hawksbills appears to occur in Australia where approximately 2,000 hawksbills nest off the northwest coast and about 6,000 to 8,000 nest off the Great Barrier Reef each year (Spotila, 2004). Additionally, about 2,000 hawksbills nest each year in Indonesia and 1,000 nest in the Republic of Seychelles (Spotila, 2004). In the U.S., about 500-1,000 hawksbill nests are laid on Mona Island, Puerto Rico (Diez and van Dam, 2006) and another 100-150 nests on Buck Island Reef National Monument off St. Croix in the U.S. Virgin Islands (Meylan, 1999b). There are currently no reliable estimates of population abundance and trends for non-nesting hawksbills at the time of this consultation.

The historical decline of the species is primarily attributed to centuries of exploitation for the beautifully patterned shell which made it a highly attractive species to target (Parsons, 1972). The fact that reproductive females exhibit a high fidelity for nest sites and the tendency of hawksbills to nest at regular intervals within a season made them an easy target for capture on nesting beaches. The continuing demand for the hawksbill's shell as well as other products (leather, oil, perfume, and cosmetics) represents an ongoing threat to recovery of the species. The British Virgin Islands, Cayman Islands, Cuba, Haiti, and the Turks and Caicos Islands (U.K.) all permit some form of legal take of hawksbill turtles. In the northern Caribbean, hawksbills continue to be harvested for their shells, which are often carved into hair clips, combs, jewelry, and other trinkets (Marquez, 1990; Stapleton and Stapleton, 2006). Additionally, hawksbills are harvested for their eggs and meat while whole stuffed turtles are sold as curios in the tourist trade. Also, hawksbill sea turtle products are openly available in the Dominican Republic and Jamaica despite a prohibition on harvesting hawksbills and their eggs (Fleming, 2001). While the international trade in the shell of this species is prohibited between those countries that have signed the Convention on International Trade in Endangered Species (CITES), illegal trade is still occurring and remains a threat.

Although hawksbills are currently subject to the same suite of threats on both nesting beaches and in the marine environment that affect other sea turtles (e.g. interaction with fishing gear, coastal construction, oil spills etc.), they are particularly sensitive to losses of coral reef communities. As stated earlier, coral reefs represent important resting and foraging habitat for hawksbill sea turtles who typically feed on sponge communities that are in association with the coral. Coral reefs are vulnerable to destruction and degradation caused by human activities (e.g. nutrient pollution, sedimentation,
contaminant spills, vessel groundings and anchoring, recreational uses, etc.) and are also 
highly sensitive to the effects of climate change (e.g. higher incidences of disease and 
coral bleaching) (Wilkinson, 2004; Crabbe, 2008). Continued loss of coral reef 
communities will limit the ability of hawksbill sea turtles to forage and represents a major 
threat to recovery.

Throughout the Atlantic and Gulf of Mexico, hawksbill sea turtles also face harassment 
in many forms including recreational use of beaches, beach erosion and replenishment, 
and effects of directed research activities. In addition, beach front lights appear to pose a 
serious problem for hatchling hawksbill turtles in U.S. coastal areas (USFWS, 1999). 
Just as with other sea turtles, nesting and foraging hawksbill sea turtles are subjected to 
the effects from past and present oil spills occurring in the Gulf of Mexico and other 
regions (see loggerhead sea turtle status section for more information). At the time of 
this consultation, no confirmed deaths of hawksbill sea turtles have been recorded in the 
vicinity of the Deep Horizon spill site, although this does not mean that no mortality has 
occurred (NMFS, 2010a).

In addition to anthropogenic threats, hawksbill turtles are also threatened by natural 
causes including hurricanes (NMFS and USFWS, 2007b) and predation by exotic species 
(e.g. fire ants, raccoons and opossums) that occur on nesting beaches (USFWS, 1999).

Kemp’s Ridley Sea Turtle

Species Description, Distribution, and Population Structure

The Kemp’s ridley sea turtle (Lepidochelys kempii) is among the smallest of all extant sea 
turtles with adults generally weighing less than 45 kg and having a carapace length of around 65 cm. Adults have an almost circular carapace with a grayish green color while 
the plastron is often pale yellow. There are two pairs of prefrontal scales on the head, 
five vertebral scutes, and five pairs of costal scutes. In the bridge adjoining the plastron 
to the carapace, there are four scutes, each of which is perforated by a pore. Hatchlings 
are usually grayish-black in color and weigh between 15-20 g.

This species has a very restricted range relative to other sea turtle species with most 
adults occurring in the Gulf of Mexico in shallow near shore waters, although adult-sized 
individuals sometimes are found on the eastern seaboard of the United States as well. 
Nesting is essentially limited to the beaches of the western Gulf of Mexico, primarily in 
the Mexican state of Tamaulipas, although in recent years nests have also been recorded 
in Florida and the Carolinas (Meylan et al., 1995). Kemp’s ridleys nest in daytime 
aggregations known as arribadas, primarily at Rancho Nuevo, a stretch of beach in 
Mexico. Most of the population of adult females nests in this single locality (Pritchard, 
1969).

Atlantic juveniles/subadults travel northward with vernal warming to feed in the 
productive, coastal waters of Georgia through New England, returning southward with 
the onset of winter to escape the cold (Lutcavage and Musick, 1985; Henwood and 
Ogren, 1987; Ogren, 1989). Upon leaving Chesapeake Bay in autumn, juvenile ridleys 
migrate down the coast, passing Cape Hatteras in December and January (Musick and
Limpus, 1997). These larger juveniles are joined there by juveniles of the same size from North Carolina sounds and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp’s ridleys outside of the Gulf of Mexico (Musick and Limpus, 1997; Epperly et al., 1995b; Epperly et al., 1995c).

**Life History Information**

Kemp’s ridley sea turtles reach sexual maturity at 7-15 years of age. While some turtles nest annually, the weighted mean remigration rate is approximately two years. Nesting generally occurs from April to July and females lay approximately 2.5 nests per season with each nest containing approximately 100 eggs (Marquez, 1994).

Studies have shown that the time spent in the post-hatchling pelagic stage can vary from 1-4 years time, while the benthic immature stage typically lasts approximately 7-9 years (Schmid and Witzell, 1997). Little is known of the movements of the post-hatching, planktonic stage within the Gulf of Mexico although the turtles during this stage are assumed to associate with floating seaweed (e.g. *Sargassum* spp.) where they would presumably feed on the available sargassum and associated infauna or other epipelagic species found in the Gulf of Mexico. As stated earlier, juveniles are known to migrate northward and southward up the eastern U.S. coast where they frequently forage in submerged aquatic grass beds (Musick and Limpus, 1997). Adult Kemp’s ridleys primarily occupy neritic habitats, typically containing muddy or sandy bottoms where prey can be found.

In the post-pelagic stages, Kemp’s ridley sea turtles are largely cancrivorous (crab eating), with a preference for portunid crabs (Bjorndal, 1997). Stomach contents of Kemp's ridleys along the lower Texas coast consisted of a predominance of nearshore crabs and mollusks, as well as fish, shrimp and other foods considered to be bycatch discards from the shrimping industry (Shaver, 1991).

**Listing Status**

The Kemp’s ridley sea turtle was listed as endangered under the ESA on December 2, 1970. This species is also protected by CITES and is listed as “critically endangered” under the IUCN Red List of Threatened Species (IUCN, 1996). No critical habitat has been designated for the species.

**Status and Trends**

Of the seven extant species of sea turtles of the world, the Kemp's ridley has declined to the lowest population level. When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand, 1963). By the early 1970s, the world population estimate of mature female Kemp's ridleys had reduced to 2,500-5,000 individuals and this trend continued through the mid-1980s. The severe decline in the Kemp’s ridley population in the past appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions (e.g. the U.S. shrimp trawl fishery). From the 1940’s through the early 1960’s, nests from Rancho Nuevo, Mexico were heavily
exploited but beach protection in 1966 helped to curtail this activity (NMFS and USFWS, 1992). Between the years of 1978 and 1991 only 200 Kemp’s ridleys nested annually.

More recent nesting data suggested that the population may have been showing signs of recovery as the number of nests grew from a low of 702 nests in 1985, to 1,940 nests in 1995, to over 20,000 nests in 2009 (NMFS and USFWS, 2010). However, preliminary nesting data for 2010 indicate a dramatic drop in the number of nests (Conant, pers. comm. 2010) and recent impacts to foraging and nesting habitat as a result of the Deep Horizon oil spill in the Gulf of Mexico may further affect nesting success, although future monitoring data will need to confirm this. According to the preliminary data available from NMFS at the time of this consultation, there are 426 confirmed deaths of Kemp’s ridley sea turtles in the vicinity of the Deep Horizon oil spill site and this number is considered a conservative one (NMFS, 2010a). While the cause of death is not certain for many of the carcasses recovered, these numbers represent the highest total mortality by far of any of the extant sea turtle species occurring in the Gulf since the blowout first occurred. It is expected that the acute and chronic events of the Deep Horizon oil spill as well as other historical spills will continue to threaten the survival and recovery of the Kemp’s ridley sea turtle for years to come (see the status and trends section for the loggerhead sea turtle for more information on oil spill effects to sea turtles).

In addition to effects from oil spills, other anthropogenic impacts to the Kemp’s ridley population are similar to those facing other sea turtle species including interactions with fishing gear, marine pollution, foraging habitat destruction, and threats at nesting beaches. Strandings events observed over the years illustrate the vulnerability of Kemp's ridley turtles to the impacts of human activities in nearshore Gulf of Mexico waters (TEWG, 1998).

**Leatherback Sea Turtle**

*Species Description, Distribution, and Population Structure*

The leatherback (*Dermochelys coriacea*) is the largest sea turtle and the largest living reptile in the world. Mature males and females can reach lengths of over 2 m and weigh close to 900 kg (or 2000 lbs). The leatherback is the only sea turtle that lacks a hard, bony shell. A leatherback's carapace is approximately 4 cm thick and consists of a leathery, oil-saturated connective tissue overlaying loosely interlocking dermal bones. The ridged carapace and large flippers are characteristics that make the leatherback uniquely equipped for long distance foraging migrations. Leatherbacks lack the crushing chewing plates characteristic of sea turtles that feed on hard-bodied prey (Pritchard, 1971). Instead, they have pointed tooth-like cusps and sharp edged jaws that are perfectly adapted for a diet of soft-bodied pelagic (open ocean) prey, such as jellyfish and salps. A leatherback's mouth and throat also have backward-pointing spines that help retain such gelatinous prey.

The leatherback sea turtle ranges farther than any other sea turtle species, exhibiting broad thermal tolerances (NMFS and USFWS, 1995). They forage in temperate and subpolar regions between latitudes 71º N and 47º S in all oceans and undergo extensive migrations to and from their tropical nesting beaches. In the Atlantic Ocean, leatherbacks
have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (NMFS-SEFSC, 2001). Female leatherbacks nest from the southeastern United States to southern Brazil in the western Atlantic and from Mauritania to Angola in the eastern Atlantic. The most significant nesting beaches in the Atlantic, and perhaps in the world, are located in French Guiana and Suriname (NMFS-SEFSC, 2001).

Previous genetic analyses of leatherbacks using only mitochondrial DNA (mtDNA) suggested that within the Atlantic basin there were at least three genetically distinct nesting populations: the St. Croix nesting population (U.S. Virgin Islands), the mainland nesting Caribbean population (Florida, Costa Rica, Suriname/French Guiana), and the Trinidad nesting population (Dutton et al., 1999). Further genetic analyses using microsatellite markers along with the mtDNA 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, 2007). General differences in migration patterns and foraging grounds may occur between the seven nesting assemblages, although data to support this is limited in most cases.

*Life History Information*

Leatherbacks are a long-lived sea turtle species, with some individuals reaching 30 years of age or older. Past estimates showed that they reached sexual maturity faster than most other sea turtle species as Rhodin (1985) reported maturity for leatherbacks occurring at 3-6 years of age while Zug and Parham (1996) reported maturity occurring at 13-14 years of age. More recent research using sophisticated methods of analyzing leatherback ossicles has cast doubt on the previously accepted age to maturity figures, with leatherbacks in the western North Atlantic possibly not reaching sexual maturity until as late as 29 years of age (Avens and Goshe, 2007).

Female leatherbacks lay up to 10 nests during the nesting season (March through July in the U.S.) at 2-3 year intervals. They produce 100 eggs or more in each clutch and, thus, can produce 700 eggs or more per nesting season (Schultz, 1975). However, a significant portion (up to approximately 30 percent) of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. After 60-65 days, leatherback hatchlings with white striping along the ridges of their backs and on the margins of the flippers emerge from the nest. Leatherback hatchlings are approximately 50-77 cm in length, with fore flippers as long as their bodies, and weigh approximately 40-50 g.

Although leatherbacks forage in coastal waters, they appear to remain primarily pelagic through all life stages (Heppell et al., 2003). Eckert (1999) found that leatherback juveniles remain in waters warmer than 26ºC until they exceed 100 cm in length. 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). Leatherbacks are known to be deep divers, with recorded
depths in excess of a half mile (Eckert et al., 1989), but may also come into shallow waters to locate prey items.

**Listing Status**
The leatherback sea turtle was listed as endangered under the ESA throughout its range on June 2, 1970. Critical habitat was designated in 1998 in coastal waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands. In 2009, NMFS proposed to revise the critical habitat to include additional areas off of the U.S. west coast; although these areas have not been formally designated at the time of this consultation.

**Status and Trends**
Estimates of total population size for Atlantic leatherbacks are difficult to ascertain due to the inconsistent nature of the available nesting data. In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard, 1982). The most recent population estimate for leatherback sea turtles from the North Atlantic breeding groups is in the range of 34,000-90,000 adult individuals (20,000-56,000 of which are adult females) (TEWG, 2007). The TEWG (2007) also reported that nesting populations appear to be increasing for Trinidad, Suriname, Guyana, and Puerto Rico while other colonies in the Caribbean, Costa Rica, Nicaragua, and Honduras may be stable or slightly declining. In contrast, the TEWG reports that the colonies in the South China Sea and East Pacific have undergone catastrophic collapse. However, it should also be noted that these trends are for nesting females only and should be taken with caution as this represents only one segment of the total leatherback population.

The Florida stock nests primarily along the east coast of Florida. This stock appears to have grown from under 100 nests per year in the 1980s (Meylan et al., 1995) to over 1,000 nests per year on average in the first decade of the 21st century (Florida Fish and Wildlife Conservation Commission [FWC], 2009). Using data from the index nesting beach surveys, the TEWG (2007) estimated a significant annual nesting growth rate of 1.17 percent between 1989 and 2005 for the Florida nesting stock.

Currently, anthropogenic impacts to the leatherback population are similar to those facing other sea turtle species including interactions with fishery gear, marine pollution, destruction of foraging habitat, and threats to nesting beaches (see loggerhead status and trends section for more information on these threats). Of all the extant sea turtle species, however, leatherbacks seem to be the most vulnerable to entanglement in fishing gear, especially gillnets, pot/trap lines, and trawl gear used in various fisheries around the world. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, their method of locomotion, and/or perhaps their attraction to the lightsticks used to attract target species in longline fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine and many other stranded individuals exhibited evidence of prior entanglement (Dwyer et al., 2002). For many years, the use of turtle excluder devices (TEDs) required for use in many U.S. fisheries were less effective at excluding the larger leatherback sea turtles compared to the the smaller, hard-shelled turtle species. However,
recent modifications to the design of TEDs are now required and should help reduce the amount of leatherback deaths that result from net capture. Zug and Parham (1996) point out that a combination of the loss of long-lived adults in fishery-related mortalities and a lack of recruitment from intense egg harvesting in some areas has caused a sharp decline in leatherback sea turtle populations and represents a significant threat to survival and recovery of the species worldwide.

Leatherback sea turtles may be also be more susceptible to marine debris ingestion than other sea turtle species due to their predominantly pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding and migratory purposes (Lutcavage et al., 1997; Shoop and Kenney, 1992). Investigations of the stomach contents of leatherback sea turtles revealed that a substantial percentage (44 percent of the 16 cases examined) contained some form of plastic debris (Mrosovsky, 1981). The presence of plastic in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and forms of debris such a plastic bags (Mrosovsky et al., 2009). Balazs (1985) speculated that the object might resemble a food item by its shape, color, size or even movement as it drifts about, and induce a feeding response in leatherbacks. Just as with other sea turtles, nesting and foraging leatherback sea turtles are subjected to the effects from past and present oil spills occurring in the Gulf of Mexico and other regions (see loggerhead sea turtle status section for more information). At the time of this consultation, no confirmed deaths of leatherbacks have been recorded in the vicinity of the Deep Horizon spill site, although this does not mean that no mortality has occurred (NMFS, 2010a). In addition to direct contact, ingestion of oil-contaminated prey items represents a particular threat to leatherbacks emanating from the Deep Horizon spill in the Gulf of Mexico and this may continue to be a threat to recovery in the years ahead.

Global climate change is likely to influence the distribution and abundance of jellyfish, the primary prey item of leatherbacks (NMFS and USFWS, 2007c). Several studies have shown leatherback distribution is influenced by jellyfish abundance (e.g., Houghton et al., 2006; Witt et al., 2006; Witt et al., 2007); however, more studies need to be done to monitor how changes to prey items affect distribution and foraging success of leatherbacks so that population-level effects can be determined.

**North Atlantic Right Whale**

*Species Description, Distribution, and Population Structure*

The North Atlantic Right Whale (*Eubalaena glacialis*) is one of the most endangered of the large baleen whales. Some defining characteristics include a stocky body, large head, strongly bowed margin of the lower lip, callosities (raised patches of roughened skin) on the head region, and a lack of a dorsal fin. Right whales occur in sub-polar to temperate waters with a migratory pattern of high latitudes in the warmer seasons and lower latitudes in the winter seasons (Perry et al., 1999). All North Atlantic right whales compose a single population and no subpopulation has been identified. The western North Atlantic region has six major habitats or congregation areas: coastal waters of the southeastern U.S., the Great South Channel, Georges Bank/Gulf of Maine, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Scotian Shelf (Winn et al., 1986).
Nichols et al. (2008) notes that right whale distribution in the western North Atlantic has shown some year-to-year variation in space and time, likely resulting from patchy prey distribution. While right whales have been documented in the eastern North Atlantic, reported sightings are very rare (Best et al., 2001a).

North Atlantic right whales exhibit extensive migratory patterns, traveling from foraging areas along the eastern seaboard of the U.S. and Canada to calving areas off the coasts of Georgia and Florida in late fall/early winter and then back again in late spring/early summer. While cow-calf pairs are regularly seen in the southeastern calving grounds during the winter, the whereabouts of much of the population during the winter months remains unknown (Waring et al., 2009). Knowlton et al. (1992) reported several long distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland. In addition, Mate et al. (1997) reported radio-tagged whales making extensive excursions moving from the Gulf of Maine into deeper waters off the continental shelf. These long range movements indicate evidence of extended ranges for some North Atlantic right whale individuals and perhaps the existence of additional habitat areas important to the species which have not yet been identified.

Based on the lack of data, precise distribution and migration patterns of the eastern North Atlantic right whale population are largely unknown. The 1998 IWC Workshop on the Comprehensive Assessment of Right Whales agreed that only animals found in the western North Atlantic can be considered a functioning extant unit based on current sightings information.

**Life History Information**

Female right whales usually reach sexual maturity between 7 and 10 years of age (Best and Kishino, 1998; Hamilton et al., 1998). In the western North Atlantic, calving takes place between December and March in shallow, coastal waters. Gestation lasts from 357 to 396 days in southern right whales, and is likely similar in the North Atlantic species (Best, 1994). Weaning seems to be variable, but has been reported to be 8-17 months in duration (Hamilton et al., 1995). An analysis of the age structure suggests that the population contains a smaller proportion of juvenile whales than expected (Hamilton et al., 1998; Best et al., 2001b) which may reflect lowered recruitment and/or high juvenile mortality.

The calving interval for North Atlantic right whales is between 2 and 7 years (Knowlton et al., 1994; Best et al., 2001b; Burnell, 2001; Cooke et al., 2001). From 1980 to 1992, the average calving interval for females was 3.67 years (Knowlton et al., 1994); however, from 1990-1998 that interval increased to 5.8 years (Kraus et al., 2001), effectively lowering the reproductive rate of the western North Atlantic right whale population. Possible causes for the depressed reproductive rate include low genetic diversity, loss of habitat, food limitation and contaminants, biotoxins, and disease. Interestingly, calving data from 2001-2005 showed a dramatic increase in North Atlantic right whale calving (23 calves per year) indicating that the calving interval may have since decreased in this population (Kraus et al., 2005).
Right whales fast during the winter and feed during the summer, although some may opportunistically feed during periods of migration. They rely on dense patches of copepods (largely of the genus *Calanus* and *Pseudocalanus*) found in highly variable and spatially unpredictable locations in the Bay of Fundy, Roseway Basin, Cape Cod Bay, the Great South Channel, and other areas off the northern U.S. and Canadian coastlines (Wishner et al., 1988; Murison and Gaskin, 1989; Mayo and Marx, 1990; Baumgartner et al., 2003; Baumgartner and Mate, 2003). Although right whales feed on copepod aggregations at the surface (Mayo and Marx, 1990), they more commonly dive below the surface to exploit areas of high prey density (Kenney et al., 1995; Baumgartner et al., 2003; Baumgartner and Mate, 2003). Mothers and calves have been known to spend prolonged periods of time at the surface compared to other foraging individuals (Baumgartner and Mate, 2003).

Evidence indicates that the North Atlantic right whales, like other baleen whales, are able to hear at least low frequency sounds (less than 1 kHz) based on the morphology of its auditory apparatus (Ketten, 1997) suggesting that the auditory system of this species is more sensitive to low frequency sounds than that of smaller toothed whales (Ketten, 1997). Parks et al. (2007) reported the hearing range of North Atlantic right whales to be from 10 Hz to 22 kHz and vocalizations are expected to fall within this range as well (Richardson et al., 1995).

**Listing Status**
The North Atlantic right whale was originally listed as endangered under the precursor to the ESA and under the ESA since its inception in 1973 (35 FR 8495). The original listing included both the North Atlantic and the North Pacific populations. Following a comprehensive status review, NMFS concluded that these two populations consisted of two distinct species. On December 27, 2006 (71 FR 77704 and 71 FR 77694), NMFS published two proposed rules to list these species separately. The final rule published on March 6, 2008 (73 FR 12024). The North Atlantic right whale is also protected by CITES and the MMPA. Critical habitat was designated for right whales on June 3, 1994 under the original northern right whale listing. The critical habitat for feeding cover portions of the Great South Channel, Cape Cod Bay, and Stellwagen Bank. The critical habitat for calving occurs along the coasts of Georgia and northeastern Florida.

**Status and Trends**
Historically, North Atlantic right whales were greatly affected by commercial whaling activities. An estimate of pre-exploitation population size of North Atlantic right whales is not available; however, Reeves and Mitchell (1987) and Reeves et al. (1992) concluded that there were at least hundreds to over a 1,000 right whale individuals, respectively, in the western North Atlantic in the 1600’s with the greatest rate of population decline occurring in the 1700’s. These studies were based on incomplete whaling data and should be viewed with caution. Back calculations using the present population size and growth rate suggest that the population may have numbered fewer than 100 individuals by 1935 when the IWC extended protection to right whales (Hain, 1975; Reeves et al., 1992); however, this estimate should also be viewed with caution since little is known about the population dynamics of right whales in the years since whaling began.
In 1992, the western North Atlantic right whale population was estimated to be 295 individuals and an updated analysis gives a minimum population size of 345 individuals for 2005 based on the most recent reviews of the photo-id recapture database (Waring et al., 2009). The population growth rate reported for the period 1986-1992 by Knowlton et al. (1994) was 2.5 percent (CV=0.12) suggesting that the stock was showing signs of recovery. However, work by Caswell et al. (1999) suggested that the crude survival probability declined from about 0.99 in the early 1980’s to about 0.94 in the late 1990’s. The authors also determined that if the mortality rate is not slowed and reproduction not improved, extinction could occur within 100 years from the time of the study. Additional work conducted in 1999 showed that survival had indeed declined in the 1990’s particularly for adult females (Best et al., 2001b; Clapham, 2002). The most recent stock assessment for the species reported a mean growth rate of 1.8 percent for the period 1990-2005, giving evidence that annual growth in the population remains extremely low (Waring et al. 2009). The number of right whales in the eastern North Atlantic Ocean is probably much smaller, although there is insufficient data available to make an estimation of the size of this population.

Mortalities due to fishing gear and ship strikes have been a cause for concern and threaten to accelerate the declining trend in growth rates in this population (NMFS, 2005). There were 24 confirmed reports of North Atlantic right whales being entangled in fishing gear between 2004 and 2008 off the Atlantic coast of the U.S. and Maritime Provinces of Canada, with 3 whales dying of their wounds and one additional whale sustaining serious injuries (Glass et al., 2010). For ship strikes, there were 17 confirmed reports with 8 whales dying of their wounds and 2 additional whales sustaining serious injuries (Glass et al., 2010). Deaths of females, in particular, are especially threatening the ability of the population recover. For instance, in 2005, mortalities included six adult females, three of which were carrying near-term fetuses and four of which were just starting to bear calves, thereby representing a lost reproductive potential of as many as 21 individuals (Kraus et al., 2005).

Levels of chromium reported in right whale blubber samples are sufficient to be mutagenic and may be affecting recovery of the species along with exposure to other contaminants in the marine environment (Chen et al., 2009; Wise et al., 2009). Annual mortality rate, and calculations based on demographic data through 1999 indicate that this mortality rate increase could reduce population growth by approximately 10 percent per year (Fujiwara and Caswell, 2001, Kraus et al., 2005).

Concerns also exist for changes in climate and its effect on the ability of North Atlantic right whales to recover in future years (Greene et al., 2003). Specifically, the variations in oceanography resulting from current shifts and water temperatures may significantly affect the occurrence of the North Atlantic right whale’s primary prey resource (i.e. copepod crustaceans). To adapt, North Atlantic right whales may have to shift their distribution to reflect changes in prey distribution, pursue other prey types, or face prey shortage. Changes in calving intervals with sea surface temperature have already been documented for southern right whales (Leaper et al., 2006); however there is insufficient
data to know the effects that current climate-related trends are having on the North Atlantic right whale population.

**Humpback Whale**

**Species Description, Distribution, and Population Structure**

Humpback whales (*Megaptera novaengliae*) are large baleen whales known for their long pectoral fins (up to 15 ft in length) and complex whale songs. Humpback whales occur throughout the world’s oceans and are generally found over continental shelves, shelf breaks, and around oceanic islands (Balcomb and Nichols, 1978; Whitehead, 1987). Humpback whales exhibit seasonal migrations between warmer temperate and tropical waters in winter and cooler waters of high prey productivity in summer (Gendron and Urban, 1993), although the seasonal distributions of this species have yet to be fully understood (Reeves et al., 2004). Humpback whales have the longest known migratory movements of any mammal, with one-way distances up to 8,461 km (Rasmussen et al., 2007). They usually migrate through deep, pelagic waters before settling in shallower, coastal waters at each end of the migration route (Winn and Reichley, 1985).

In the North Atlantic, humpback whales summer in six different regions: off the eastern coast of the United States, the Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and northern Norway (Katona and Beard, 1990; Christensen et al., 1992a; Palsbøll et al., 1997; Perry et al., 1999). These regions represent relatively discrete subpopulations (Clapham and Mayo, 1987). In the fall and winter, humpback whales from all feeding areas migrate to calving and mating grounds in the Caribbean, where mixing among subpopulations occurs (Katona and Beard, 1990; Clapham et al., 1993; Palsbøll et al., 1997; Stevick et al., 1998; Bérubé et al., 2004). In addition, there are reports of humpback whales in winter off Greenland, Norway, Newfoundland, the southern Gulf of Maine, Bermuda, and also in the eastern North Atlantic off the Cape Verde Islands (Katona et al., 1990; NMFS, 2006a). The species uses U.S. mid-Atlantic and U.S. southern waters as a migratory pathway and apparently as a feeding area, at least for juveniles (Wiley et al., 1995; Barco et al., 2002).

Humpback whales also occur in the North Pacific and Southern Hemisphere. In the North Pacific, the species is found off the Hawaiian Islands, from Mexico north to the Gulf of Alaska and Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and Sea of Okhotsk (Nemoto, 1957; Tomilin, 1957; Johnson and Wolman, 1984 as cited in NMFS, 1991; NMFS, 1991). Humpback whales that occur off Central America and Mexico in the winter and spring migrate to the coast of California north to British Columbia in summer and fall (Steiger et al., 1991). Although the Pacific coast of Central America is not considered a major wintering area for this species, humpback whales are reported off the west coast of Panama as well as Costa Rica (Steiger et al., 1991). In Asia, humpbacks have been observed in the vicinity of Taiwan, the Ogasawara Islands, and the Northern Mariana Islands (NMFS, 1991). Humpback whales are also found in the Arabian Sea in the northern Indian Ocean (Mikhalev, 1997; Perry et al., 1999). In the Southern Hemisphere, humpback whales occur during winter along the tropical and western sides of continents, along eastern coastlines, and around islands (Perry et al., 1999). During the austral summer, the species occurs in South Georgia, the
South Shetlands, and along the west and east coasts of Africa, Australia, and South America (Dawbin, 1966 as cited in Perry et al., 1999; Best et al., 1998).

In the past, humpback whales in the North Atlantic were treated as a single population for management purposes (Waring et al., 1999). However, humpback whales in the Gulf of Maine were subsequently recognized by NMFS as a separate feeding aggregation based upon the strong fidelity of individual whales to this region (Palsbøll et al., 2001 as cited in Waring et al., 2009). In 2002, the IWC acknowledged the evidence for treating the Gulf of Maine as a separate management unit (IWC, 2002 as cited in Waring et al., 2009).

In the North Pacific, NMFS recognizes three stocks of humpback whales for management purposes under the MMPA: the western North Pacific, central North Pacific, and eastern North Pacific stocks. The IWC considers there to be one North Pacific management stock, and no clear consensus exists on population structure for the species in this ocean (Calambokidis et al., 2001). In the Southern Hemisphere, Donovan (1991) reported four groupings of humpback whales found in IWC Areas II through IV; however, migration of the species between oceans is noted (e.g., between the Indian Ocean and South Atlantic, based on genetic data) (Pomilla and Rosenbaum, 2005). Relatively recent data compiled by the IWC on breeding stocks suggests multiple groupings of humpback whales (Bannister, 2005) but how such aggregations translate into individual biological populations remains uncertain.

**Life History Information**

Sexual maturity in humpback whales is reached between 5 and 11 years of age (Clapham, 1992; Gabriele et al., 2007). Humpback whale reproductive activities occur primarily in winter and gestation takes about 11 months (Winn and Reichley,, 1985), followed by a nursing period of up to 12 months (Baraff and Weinrich, 1993). Calving primarily occurs in the shallow coastal waters of continental shelves and some oceanic islands (Perry et al., 1999). The calving interval is likely 2-3 years (Clapham and Mayo, 1987), although there is some evidence of calving occurring in consecutive years (Glockner-Ferrari and Ferrari, 1985; Clapham and Mayo, 1987; 1990; Weinrich et al., 1993). During the breeding season, humpback whales form small unstable groups (Clapham, 1996), and males sing long, complex songs directed toward females and other males. Males compete for mates and are polygamous (Clapham, 1996).

Although largely solitary, humpback whales often cooperate during feeding activities (Elena et al., 2002). They exhibit a wide range of foraging behaviors, and feed on a range of prey types including small schooling fishes, euphausiids, and other large zooplankton (Nemoto, 1957; Nemoto, 1959; Nemoto, 1970; Krieger and Wing, 1984; 1986). Since a majority of humpback whale prey is found above 300 m (or 984 ft), most dives are relatively shallow (approximately 60-170 m) (Hamilton et al., 1997). Dives usually range between 2-5 min, but can last as long as 20 min (Dolphin, 1987). Feeding groups can be stable for long periods of times, and there is good evidence of some territoriality on both feeding (Clapham, 1996) and wintering grounds (Tyack, 1981).
Humpback whale vocalization is much better understood than hearing sensitivity, although like other baleen whales, evidence indicates the species can hear at least low frequency sounds (less than 1 kHz) based on the morphology of its hearing apparatus suggesting that the auditory system of the species is more sensitive to low frequency sounds than that of smaller toothed whales (Ketten, 1997). Houser et al. (2001) reported the hearing range of humpback whales to be in the range of 700 Hz to 10 kHz. In terms of vocalization, different calls by humpback whales have been associated with different functions including feeding, breeding, and other social calls. Humpback whales are reported to be less vocal when found on their high-latitude feeding grounds in summer compared with their lower-latitude winter ranges (Richardson et al., 1995). Au (2000) compiled information on humpback whale vocalizations and reported sounds to include grunts in the frequency range of 25-1,900 Hz, pulses in the frequency range of 25-89 Hz, and songs with components ranging from 30-8,000 Hz.

Listing Status
Humpback whales have been listed as endangered under the ESA since 1973. The IWC first protected humpback whales in the North Pacific in 1965, and this species is also protected by CITES and the MMPA. Humpback whales are also listed as “vulnerable” under the IUCN Red List of threatened species (IUCN, 2005a).

Status and Trends
Historically, humpback whale populations worldwide were greatly affected by commercial whaling activities. Based on mitochondrial DNA analysis, Roman and Palumbi (2003) estimated pre-exploitation populations of humpback whales to be as many as 1,000,000 worldwide with 240,000 occurring in the North Atlantic alone. Between 1805 and 1909, American whalers harvested between 14,164-18,212 humpback whales in the North Atlantic while the Pacific kill was estimated to be about 28,000 (Best, 1987 as cited in NMFS, 1991). Records also show that from the late 1880’s to the mid-1970’s, whaling operations took 1,397 humpback whales off eastern Canada and 522 off West Greenland in the western North Atlantic (Kapel, 1979; Mitchell, 1974), 1,579 in the eastern North Atlantic and Arctic Oceans (Perry et al., 1999), nearly 30,000 in the Pacific Ocean (Perry et al., 1999), and over 68,000 in the Southern Ocean (Bonner, 1982).

Current estimates for the North Atlantic humpback whale population include the estimates by Palsbøll et al. (1997) of 4,894 males and 2,804 females, based on genetic tagging data. However, some authors believe this combined total of 7,698 whales to be an underestimate of the true population size (Clapham et al., 1995; Palsbøll et al., 1997). Several researchers report an increasing trend in abundance for the North Atlantic population, and an independent increase in numbers of individuals sighted within the Gulf of Maine feeding aggregation (Katona and Beard, 1990; Barlow and Clapham, 1997; Smith et al., 1999; Waring et al., 2009). Stevick et al., (2003) estimated that approximately 11,570 animals existed in 1993 with an estimated rate of increase of 3.1 percent per year. Assuming that this rate of increase has remained constant, the estimated 2010 population size for North Atlantic humpback whales would be around 19,473
individuals, a number still significantly lower than Roman and Palumbi’s (2003) pre-exploitation estimate of 240,000 individuals.

In the 1980s, North Pacific humpback whale population estimates ranged from 1,407 to nearly 2,100 (Darling and Morowitz, 1986; Baker and Herman, 1987); however, by the mid-1990s, the population was estimated to have risen to around 6,000 (Calambokidis et al., 1997). Between 2004 and 2006, a comprehensive assessment of the population of humpback whales in the North Pacific identified 7,971 unique individuals from photographic records (Calambokidis et al., 2008). Based on the results of that effort, Calambokidis et al. (2008) estimated that the current population of humpback whales in the North Pacific Ocean consisted of about 18,300 adult individuals. Rice (1978a) estimated pre-exploitation numbers of humpback whales in the North Pacific to be around 15,000; however, this data has been shown to be statistically unreliable.

In the Southern Hemisphere, the IWC estimated the humpback whale population at 19,851 individuals extrapolated from survey data of whales south of the 60°S latitude (IWC, 1996) although this estimate has been shown to be statistically unreliable and should be taken with caution (Perry et al., 1999). Nevertheless, these estimates are far lower than the pre-exploitation abundances reported by Gambell (1976) who estimated the humpback whale numbers in the Southern Ocean to be as high as 100,000 individuals.

At present, there are several stressors affecting humpback whales globally, although the significance of any effects emanating from these individual stressors remains uncertain. Entanglement in commercial fishing gear continues to be a problem as there were 81 confirmed reports of humpback whales being entangled in fishing gear between 2004 and 2008 off the Atlantic coast of the U.S. and Maritime Provinces of Canada, with 5 whales dying of their wounds and an additional 11 sustaining serious injuries (Glass et al., 2010). Mortality from ship strikes is also a threat to recovery. Along the Pacific coast, a humpback whale is known to be killed about every other year by ship strikes (Barlow et al., 1997). Along the Atlantic coast of the U.S. and Canada between 2004 and 2008, there were 14 confirmed reports of humpback whales being struck by vessels with 8 whales dying of their wounds (Glass et al., 2010).

Organochlorines, including PCB and DDT, have been identified from humpback whale blubber samples (Gauthier et al., 1997). These contaminants are transferred to young through the placenta, leaving newborns with contaminant loads equal to that of mothers before bioaccumulating additional contaminants during life and passing the additional burden to the next generation (Metcalfe et al., 2004).

The current IWC quota for subsistence harvest of western North Atlantic humpback whales is 20 total individuals over the seasons 2008-2012, to be caught by the Bequians of St. Vincent and the Grenadines. Japan has conducted its scientific whaling program JARPA II (Japanese Whale Research Program under a Special Permit in the Antarctic) with anticipated harvests of 50 humpback whales from the D and E management stocks each year (Nishiwaki et al., 2006). Other current threats affecting humpback whale recovery include effects of ocean noise as well as disturbance from whale watching and
other scientific research activities occurring within and outside of the action area considered in this Opinion.

**Fin Whale**

*Species Description, Distribution, and Population Structure*

Fin whales (*Balaenoptera physalus*) are the second largest baleen whale by length, and are long-bodied and slender, with a prominent dorsal fin set about two-thirds of the way back on the body. They are dark gray dorsally and white ventrally, but the pigmentation pattern is often complex. Distinctive features of pigmentation, along with dorsal fin shapes and body scars, are useful for photo-identification (Agler et al., 1993).

Fin whales are widely distributed throughout the world’s oceans; however, they tend to avoid tropical and pack ice waters with the high-latitude limit of their range set by ice and the lower-latitude limit by warmer tropical waters approximately 15°C (Sergeant, 1977). They also are less concentrated in nearshore environments while appearing to favor deeper waters. Fin whales can be found singly or in pairs, but can also form larger groupings of more than 3 individuals, particularly while feeding. Balcomb (1987) noted that fin whales commonly travel in herds, often widely dispersed, ranging from 6 to more than 100 individuals. They have also been reported grouped with other balaenopterid whale species at times (Corkeron et al., 1999; Shirihai, 2002). Most fin whales in the northern hemisphere migrate seasonally from the Arctic in summer to lower latitudes in the winter to breed. However, the locations of these breeding grounds are not known and their migration patterns are less predictable than for similar species such as humpback whales (Perry et al., 1999).

In the North Atlantic, fin whales are ubiquitous during the summer; however, they winter in the western Atlantic from from the edge of the sea ice south to the Gulf of Mexico and in the eastern Atlantic from southern Norway to the Bay of Biscay with some whales also migrating into the Mediterranean Sea (Gambell, 1985). A general migration in the fall from the Labrador and Newfoundland region, south past Bermuda, and into the West Indies has also been theorized (Clark, 1995). Fin whales are also endemic to the Mediterranean Sea, where (at least in the western Mediterranean), individuals tend to aggregate during summer and disperse in winter over large spatial scales (Cotte et al., 2009).

Fin whales also occur in the North Pacific and Southern Hemisphere. In the North Pacific in summer, fin whales are found in the Chukchi Sea, the Sea of Okhotsk, waters of the Aleutian Islands and the Gulf of Alaska south to California (Gambell, 1985). Rice (1974) suggested that Northern Pacific fin whales may winter off of southern California; however, further research is needed to confirm this (Forney et al., 2000). Fin whales have been also observed feeding in Hawaiian waters in mid-May (Shallenberger, 1981; Balcomb, 1987).

The population structure of fin whales has long been uncertain. In the North Atlantic, fin whale population structure is unknown, although the existence of subpopulations has been suggested. A genetic study conducted by Bérubé et al. (1998) provided support for
the existence of subpopulations in the North Atlantic and Mediterranean, with limited gene flow among them. The genetic data are consistent with the idea that different subpopulations use the same feeding grounds (Waring et al., 2009). The IWC has designated 7 distinct management stocks in the North Atlantic: (1) the British Isles-Spain and Portugal stock, (2) the West Norway-Faroe Islands stock, (3) the North Norway stock, (4) the East Greenland-Iceland stock, (5) the West Greenland stock, (6) the Newfoundland-Labrador stock, and (7) the Nova Scotia stock (Donovan, 1991). The IWC Scientific Committee has also recognized evidence of a separate population in the Mediterranean (IWC, 2006). In U.S. waters of the western North Atlantic, NMFS recognizes one stock of fin whales for management purposes under the MMPA (Perry et al., 1999; Waring et al., 2004). However, whether current management stock boundaries define biologically isolated units remains uncertain (Waring et al., 2009). There is a need for improved understanding of the genetic differences among and between populations to determine stock structure which is a prerequisite for assessing abundance and trends (NMFS, 2010b).

Life History Information
The life expectancy of fin whales is thought to be between 70 and 80 years (Kjeld et al., 2006). Fin whales become sexually mature between 5 and 15 years of age (Gambell, 1985; COSEWIC, 2005) and have a calving interval of 2-3 years (Agler et al., 1993). Gestation lasts about 12 months and nursing occurs for 6-11 months (Perry et al., 1999). Calving and mating activities occur in late fall and winter (Mackintosh and Wheeler, 1929; Nishiwaki, 1952; Tomilin, 1957) although specific breeding areas remain unknown. Little is known of the group behavior or composition during the reproductive season; however, a staged seasonal migration has been suggested, with pregnant females migrating in advance of other sex or age classes and immature whales migrating last (COSEWIC, 2005; NMFS, 2006a). Agler (1993) reported that the gross annual reproductive rate of fin whales in the Gulf of Maine was around 8 percent during the 1980s.

Fin whales feed on euphausiids and large copepods in addition to schooling fish (Nemoto, 1970; Kawamura, 1982; Watkins et al., 1984) although their diet varies seasonally and geographically (Watkins et al., 1984; Shirihai, 2002). Competition may occur with other baleen whales or other consumers of these prey types (Nemoto, 1970; Kawamura, 1980), although Payne et al. (1990) concluded that fin whales are less stressed by fluctuations in prey availability than humpback whales due to their greater ability to exploit patchy prey aggregations. The amount of time fin whales spend diving varies from a tens of seconds to over an hour (Watkins et al., 1981; Gambell, 1985; Hain et al., 1992; Croll et al., 2001a).

Evidence indicates that the species, like other baleen whales, is able to hear at least low frequencies (less than 1 kHz) based on the morphology of its auditory apparatus (Ketten, 1997) and vocalizes in the low frequency range. Richardson et al. (1995) reported the most common sound produced by fin whales is a one-sound vocalization at around 20-Hz, occurring in short series of pulses in spring, summer, and fall, and in repeated
stereotyped patterns in winter. The source depth of calling fin whales has been reported
to be about 50 m (Watkins et al., 1987).

Listing Status
Fin whales have been listed as endangered under the ESA since 1973 and are also
protected in the U.S. under the MMPA. The IWC began regulating commercial whaling
of fin whales starting in 1969 and by 1976, the species was fully protected (Allen, 1980).
The species is also protected by CITES and is listed as endangered on the IUCN Red List
of Threatened Species (IUCN, 2005b).

Status and Trends
Historically, fin whale populations worldwide were severely affected by commercial
whaling in the 20th century in the North Atlantic, North Pacific, and Southern oceans
estimates and estimated the global population of fin whales in 1991 to be about 119,000
individuals, which represented about a quarter of his estimated pre-exploitation
abundance of 464,000 individuals.

Sergeant (1977) estimated that prior to commercial exploitation, there may have been as
many as 30,000 to 50,000 fin whale individuals in the North Atlantic. Currently, no
reliable population estimates exist for the entire North Atlantic; however, estimates do
exist for portions of the North Atlantic. For the year’s 1996-2001, the IWC’s best
estimate for the population of fin whales in the central and northeastern Atlantic was
30,000 individuals. Braham (1991) estimated the western North Atlantic to contain
between 3,590 and 6,300 individuals while Hain et al. (1992) estimated that there were
approximately 5,000 fin whales in the western North Atlantic Ocean based on a 1978-
1982 survey. The most recent abundance estimate for the western North Atlantic stock
was 2,269 individuals (Waring et al., 2009).

In the North Pacific, there may have been as many as 42,000-45,000 fin whales prior to
commercial exploitation; however, it's estimated that this population reduced to between
13,620 and 18,630 by the early 1970's (Ohsumi and Wada, 1974). Moore et al. (2000)
conducted surveys for whales in the central Bering Sea in 1999 and estimated the fin
whale population to be approximately 4,951 individuals. Results from ship surveys
performed off the coasts of Washington, Oregon, and California in the years 1996 and
2001 estimated the fin whale population at 3,279 individuals (Barlow and Taylor, 2001)
while results of a 2005 ship survey in the same region estimated the fin whale population
at 3,281 individuals (Forney, 2007). Based on the available information, it is feasible that
the North Pacific population as a whole has failed to increase significantly over the past
30 years.

In the Southern Hemisphere, there may have been as many as 400,000 fin whales prior to
exploitation by whaling vessels; however it's estimated this population may have reduced
to 85,200 fin whales by the late 1970's (IWC, 1979). A joint Conservation of Antarctic
Marine Living Resources/IWC survey In the Scotia Sea and Antarctic Peninsula during
the austral summer of 2000 (January-February) resulted in a more recent abundance
estimate of 4,672 individuals in the Southern Hemisphere (Hedley et al., 2001; Reilly et al., 2004).

At present, several factors may be affecting fin whales globally, although the significance of any effects to populations remains largely unknown. As is the case with other large whale species, entanglement in commercial fishing gear and mortality from ship strikes continue to affect the species’ ability to recover in the western North Atlantic. There were 14 confirmed reports of fin whales being entangled in fishing gear between 2004 and 2008 off the Atlantic coast of the U.S. and Maritime Provinces of Canada, with 3 whales dying of their wounds and an additional 3 sustaining serious injuries (Glass et al., 2010). For ship strikes, there were 13 confirmed reports of fin whales being struck by vessels with 10 dying of their wounds (Glass et al., 2010).

Organochlorines, including PCB, DDT, and DDE have been identified from fin whale blubber samples with females containing lower burdens than males. This is likely due to mobilization of contaminants during pregnancy and lactation (Aguilar and Borrell, 1988; Gauthier et al., 1997). Contaminant levels increase steadily with age until sexual maturity, at which time levels begin to drop in females and continue to increase in males (Aguilar and Borrell, 1988).

Fin whales are still hunted in subsistence fisheries off West Greenland and are hunted by Japanese whalers in the Southern Ocean as part of Japan's JARPA II research program with anticipated harvests of 50 fin whales each year expected for the period 2007-2019 (Nishiwaki et al., 2006). Other current threats affecting fin whale recovery include effects of ocean noise as well as disturbance from whale watching and other scientific research activities.

Effects of current climate change trends also present potential threats to fin whales, particularly in the Mediterranean Sea, where fin whales appear to prey exclusively on northern krill. These krill occupy the southern extent of their range and increases in water temperature could result in their decline in the Mediterranean Sea thereby potentially affecting food availability for fin whales in this region (Gambaiani et al., 2009). However, there is insufficient data to know the effects that current climate-related trends are having on fin whale populations.

**Sperm Whale**

*Species Description, Distribution, and Population Structure*

Sperm whales are distributed in all of the world’s oceans from equatorial to polar waters. They have disproportionately large heads at one quarter to one third of their total body length (Rice, 1989) and a rod-shaped lower jaw with 20-26 pairs of well-developed teeth in the mandibles (NMFS, 2006b). Photographs of distinctive markings on the dorsal fins and flukes of sperm whales are used in studies of life history and behavior (Whitehead and Gordon, 1986; Whitehead, 1990).

Sperm whales are wide-ranging and highly migratory with mature males traveling as far as latitude 70° N in the North Atlantic and latitude 70° S in the Southern Ocean (Perry et
al., 1999; Reeves and Whitehead, 1997). They have a strong preference for waters deeper than 1,000 m (Reeves and Whitehead, 1997) and are rarely found in waters less than 300 m in depth (Clarke, 1956; Rice, 1998). Sperm whales are frequently found in locations of high productivity due to upwelling or steep underwater topography, such as continental slopes, seamounts, or canyon features (Jaquet and Whitehead, 1996; Jaquet et al., 1996). In winter, sperm whales generally migrate closer to equatorial waters (Kasuya and Miyashita, 1988; Waring et al., 1993) where adult males join females to breed.

In the western North Atlantic, sperm whales range from Greenland south into the Gulf of Mexico and the Caribbean (Romero et al., 2001; Wardle et al., 2001). Cold-core eddy features like those in the Gulf of Mexico, are highly attractive to sperm whales because of the large numbers of squid that are drawn to the high concentrations of plankton associated with these features (Biggs et al., 2000; Davis et al., 2000a; Davis et al., 2000b; Davis et al., 2000c; Wormuth et al., 2000) and aerial surveys confirm that sperm whales are indeed located in the northern Gulf of Mexico in all seasons (Mullin et al., Hansen et al., 1996). Their distribution follows a distinct seasonal cycle, with whales congregating east-northeast of Cape Hatteras in the winter and then shifting northward in spring when whales are found throughout the Mid-Atlantic Bight. Distribution extends further northward to areas north of Georges Bank and the Northeast Channel region in the summer before shifting to waters south of New England in the fall. In the eastern North Atlantic, mature male sperm whales have been recorded as far north as Spitsbergen (Øien, 1990) and more recent observations suggest that solitary and paired mature males predominantly occur in waters off Iceland, the Faroe Islands, and the Norwegian Sea (Gunnlaugsson and Sigurjónsson, 1990; Øien, 1990; Christensen et al., 1992a; Christensen et al., 1992b).

In the North Pacific, Sperm whales are distributed broadly and are found as far north as Cape Navarin in summer, and south of latitude 40°N in the winter (Gosho et al., 1984; Miyashita et al., 1995 as cited in Carretta et al., 2005). They are found year-round in waters off California and Hawaii (Shallenberger, 1981; Dohl et al., 1983; Barlow, 1995; Forney et al., 1995; Mobley Jr. et al., 2000), and in waters off the northwestern U.S. in every season except winter (Green et al., 1992). The distribution of prey likely determines movements of female and immature male groups in the Pacific and, although not random, movements are usually difficult to anticipate and are likely associated with feeding success, perception of the environment, and memory of optimal foraging areas (Whitehead et al., 2008). Movements of several hundred miles are common (i.e. between the Galapagos Islands and the Pacific coastal Americas) and appear to be group or clan specific.

There is no clear understanding of the global population structure of sperm whales (Dufault et al., 1999). Recent ocean-wide genetic studies indicate low, but statistically significant, genetic diversity with no clear geographic structure but strong differentiation between social groups (Lyrholm et al., 1996; Lyrholm and Gyllensten, 1998; Lyrholm et al., 1999). Genetic studies indicate that adult sperm whales travel over large distances and that males are known to breed in ocean basins separate from the ones in which they were born (Whitehead, 2003). Sperm whale populations also appear to be structured
socially, at the level of the clan, rather than geographically (Whitehead, 2003; Whitehead et al., 2008). The IWC currently recognizes four sperm whale stocks: North Atlantic, North Pacific, northern Indian Ocean, and Southern Hemisphere (Dufault et al., 1999; Reeves and Whitehead, 1997). NMFS recognizes five stocks under the MMPA: North Atlantic, northern Gulf of Mexico, North Pacific, Hawaiian, and California/Oregon/Washington stocks (Perry et al., 1999; NMFS, 2006b). All sperm whales of the Southern Hemisphere are treated as a single stock with nine divisions, although this designation has little biological basis and is more in line with whaling records (Donovan, 1991).

**Life History Information**

Sperm whale age distribution is unknown, but sperm whales are believed to live at least 60 years (Rice, 1978b). Female sperm whales become sexually mature at 9 years of age on average while males become sexually mature between 9 and 20 years of age (Kasuya, 1991). Even upon reaching sexual maturity, males often require an additional 10 years of growth before they are large enough in size to outcompete other males for breeding rights (Kasuya, 1991; Würsig et al., 2000). The gestation period is about 15 months and nursing lasts about 2-3 years (Waring et al., 2004). The calving interval for females is estimated to be every 4-6 years between the ages of 12 and 40 (Kasuya, 1991; Whitehead et al., 2008).

Stable, long-term associations among females form the core of sperm whale societies (Christal et al., 1998). Up to about a dozen females usually live in such groups, accompanied by their female and young male offspring. Young individuals are subject to alloparental care by members of either sex and may be suckled by non-maternal individuals (Gero et al., 2009). At around 6 years of age, male sperm whales start leaving their family groups and eventually live in male-dominated groups known as “bachelor schools” (Pinela et al., 2009) although cohesion amongst males tends to decline with age (Christal and Whitehead, 1997).

Sperm whales appear to feed regularly throughout the year (NMFS, 2006b), often consuming as much as 3-3.5 percent of their total body weight daily (Lockyer, 1981). A large proportion of a sperm whale’s diet consists of low-fat, ammoniacal, or luminescent squids (Clarke, 1980a; Martin and Clarke, 1986; Clarke, 1996). They forage on or near the bottom, often ingesting stones, sand, sponges, and other non-food items (Rice, 1989). While sperm whales feed primarily on large and medium-sized squids, the list of documented food items is fairly long and diverse. Additional prey items include other cephalopods, such as octopi, and medium- and large-sized demersal fishes, such as rays, sharks, and many teleosts (Berzin, 1972; Clarke, 1977; Clarke, 1980b; Rice, 1989; Angliss and Lodge, 2004). Surface waters with sharp horizontal gradients, such as along the Gulf Stream in the Atlantic act as temporary feeding areas for sperm whales while cold-core eddy features, such as in the Gulf of Mexico, are highly attractive because of the large numbers of squid that are drawn to the high concentrations of plankton associated with these features (Biggs et al., 2000; Davis et al., 2000a; Davis et al., 2000b; Davis et al., 2000c; Wormuth et al., 2000). It has been suggested that some mature males may not migrate to breeding grounds annually during winter, and instead may remain in
higher latitude feeding grounds for more than a year at a time (Whitehead and Arnbom, 1987)

Sperm whales are well known for their prolific diving behavior with some whales diving as deep as 3 km down at durations exceeding 2 hours (Clarke, 1976; Watkins et al., 1985; Watkins et al., 1993). Most dives, however, are generally shorter (25-45 min) and shallower (400-1,000 m) and are separated by 8-11 minutes of rest at the surface (Gordon, 1987; Papastavrou et al., 1989; Würsig et al., 2000; Jochens et al., 2006; Watwood et al., 2006). Differences in night and day diving patterns are not known for this species; however, like most diving air-breathers for which there are data (e.g. rorquals, fur seals, and chinstrap penguins), sperm whales probably make relatively shallow dives at night when prey species are located closer to the surface.

Sound production and reception by sperm whales are better understood than in most cetaceans. Sperm whales produce broad-band clicks in the frequency range of 100 Hz to 20 kHz that can be extremely loud for a biological source (200-236 dB re 1μPa), although lower source levels have also been suggested at around 171 dB re 1 μPa (Weilgart and Whitehead, 1993; Goold and Jones, 1995; Weilgart and Whitehead, 1997; Möhl et al., 2003). Most of the energy in sperm whale clicks, however, is concentrated at around 2-4 kHz and 10-16 kHz (Weilgart and Whitehead, 1993; Goold and Jones, 1995). These long, repeated clicks are usually associated with feeding and echolocation as well as during social behavior and intragroup interactions.

Our understanding of sperm whale hearing stems largely from the sounds they produce. The only direct measurement of hearing was from a young stranded individual from which auditory-evoked potentials were recorded (Carder and Ridgway, 1990). From this whale, responses support a hearing range of 2.5-60 kHz. However, behavioral responses of adult, free-ranging individuals also provide insight into hearing range; sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins and Schevill, 1975; Watkins et al., 1985). They also stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones, 1995). The large amounts of time they spend at depth as well as their use of lower frequency sounds suggests that sperm whales are likely to be sensitive to sounds in the low to mid frequency hearing range (Croll et al., 1999).

Listing Status
Sperm whales were listed as endangered in 1970 under the precursor to the ESA (35 FR 18319, December 2, 1970) and remained listed after passage of the ESA in 1973. They are also protected by CITES and the MMPA.

Status and Trends
Sperm whale abundance was historically impacted from commercial whaling operations. While past abundance estimates have largely relied on historic whaling data deemed unreliable by the IWC (Perry et al., 1999), Whitehead (2002a) used modern visual survey research and estimated that prior to commercial whaling, sperm whales may have
numbered around 1,110,000 individuals with the current population estimated to be significantly less at 300,000-450,000 individuals worldwide. Although his estimates are based on extrapolating surveyed areas to unsurveyed areas without a systematic survey design, the numbers reported by Whitehead (2002a) probably represent the most current and best available estimates of global sperm whale abundance at the time of this consultation.

From 1800 to 1900, the IWC estimated that nearly 250,000 sperm whales were killed by whalers, with another 700,000 harvested from 1910-1982. However, these are likely underestimates due to the extensive illegal harvests and inaccurate reporting by Soviet whaling fleets from 1947-1973 (Yablokov et al., 1998; Yablokov and Zemsky, 2000). Based on historic whaling data, the population of sperm whales in the entire North Atlantic was estimated to be around 190,000 individuals (Perry et al. 1999). According to the most recent stock assessment reports available from NMFS, the total number of sperm whales in the North Atlantic is unknown; however, the best available estimate is 4,804 individuals in the western North Atlantic (Waring et al., 2007) and 1,665 individuals in the northern Gulf of Mexico (Waring et al., 2009). In both cases, data is insufficient to determine population trends.

Rice (1989) estimated abundance of sperm whales in the North Pacific to be over a million individuals prior to exploitation and that the population had reduced to 930,000 individuals by the late 1970’s. Whitehead (2002a) estimated current abundance of sperm whales in the eastern tropical Pacific, eastern North Pacific, Hawaii, and western North Pacific to be 76,803 total individuals. In addition, the best available estimates according to NMFS stock assessment reports are 102,112 individuals in the North Pacific (Kato and Miyashita, 1998 as cited in Caretta et al. 2009), 7,082 individuals in Hawaiian waters (Barlow, 2003 as cited in Carretta et al., 2005), and 2,853 individuals for the California/Oregon/Washington stock (Barlow and Forney, 2007; Forney, 2007 as cited in Carretta et al., 2008). In all cases, data is insufficient to determine population trends.

Estimates of current and historical sperm whale abundance in the Southern Hemisphere are either unavailable or statistically unreliable (NMFS, 2006b). Perry et al. (1999) estimated that 20,000 individuals were harvested in the Southern Hemisphere from 1956-1976. Whitehead (2002b) estimated sperm whale abundance at 12,069 individuals south of 60° S. Since the IWC last did a formal assessment of sperm whales, new data indicate that the Southern Hemisphere contains at least some populations that extend into the Northern Hemisphere (NMFS, 2006b).

Although the IWC protected sperm whales from commercial harvest in 1981, Japanese whalers continued to hunt sperm whales in the North Pacific until 1988 (Reeves and Whitehead, 1997). In 2000, the Japanese Whaling Association announced plans to harvest 10 sperm whales in the Pacific Ocean for research. Sperm whales are also hunted for subsistence purposes by whalers from Lamalera, Indonesia, where a traditional whaling industry has been reported to kill up to 56 sperm whales per year. Although consequences of these harvests are unclear, the paucity of population data and uncertainty regarding the potential of the species to recover from historical whaling pressure means
that active whaling programs will continue to threaten the survival and recovery of the species in the near future. Also, the loss of sperm whales to illegal Soviet whaling in the 20th century likely continues to inhibit recovery due to the sizable loss of adult females and their calves during that time, leaving gaps in demographic and age structuring (Whitehead, 2003).

Based on stranding and entanglement data from 2001-2005, NMFS reported that one sperm whale was confirmed struck by a ship, while no strandings reported signs of interaction with fishery-related activities (Waring et al., 2007). While there is less of a direct link established between sperm whale strandings and fishery interactions than there is for other large whales in the western North Atlantic, the strandings data probably underestimates the extent of fishery-related mortality and serious injury and should be taken with caution. Seismic vessel operations in the Gulf of Mexico represent an ongoing threat due to noise disturbance and vessel interactions (Waring et al., 2009). Results from very limited studies of northern Gulf of Mexico sperm whale responses to seismic exploration indicate that sperm whales do not appear to exhibit horizontal avoidance of seismic survey activities and that there may be some decrease in foraging effort during exposure to full-array airgun firing (Jochens et al. 2006) making seismic survey activities an ongoing threat to recovery of the northern Gulf of Mexico stock. In U.S. Pacific waters, sperm whales are incidentally by gill nets (Caretta et al., 2008), and are also known to interact with longline fisheries in the Gulf of Alaska although entanglement is rarely recorded (Hill and DeMaster 1999; Rice 1989; Sigler et al. 2008).

Contaminant burdens have been identified in sperm whales, but vary widely in concentration based upon life history and geographic location, with northern hemisphere individuals generally carrying higher burdens (Evans et al. 2004). Contaminants include dieldrin, chlordane, DDT, DDE, PCBs, HCB and HCHs in a variety of body tissues (Aguilar 1983; Evans et al. 2004), as well as several heavy metals (Law et al. 1996). Females appear to bioaccumulate toxins at greater levels than males, which may be related to possible dietary differences between females who remain at relatively low latitudes compared to more migratory males (Aguilar 1983; Wise et al. 2009). Chromium levels from sperm whales skin samples worldwide have varied from undetectable to 122.6 μg Cr/g tissue, with the mean (8.8 μg Cr/g tissue) resembling levels found in human lung tissue with chromium-induced cancer (Wise et al. 2009).

The northern Gulf of Mexico sperm whale stock is located in an area of high-density offshore oil extraction with chronic, low-level spills and occasional massive spills (such as the current Deep Horizon oil spill, Ixtoc I oil well blowout and fire in the Bay of Campeche in 1979, and the explosion and destruction of a loaded supertanker, the Mega Borg, near Galveston in 1990). Oil spills can impact marine mammals through ingestion, absorption, and inhalation just as in sea turtles (see loggerhead sea turtle status and trends section) and effects may range from instant death to sub-lethal damage to mild irritation, depending on concentration and length of exposure (Geraci, 1990). Marine mammals may inhale toxic doses of petroleum vapor when at the surface in the vicinity of an oil spill (Geraci, 1990; Geraci and Williams, 1990) and may directly ingest oil or feed on contaminated prey below the surface. Few studies on oil spills have focused exclusively
on cetaceans; however, bottlenose dolphins (Smultea and Wursig, 1995) and gray whales (Kent et al., 1983 as cited in Moore and Clarke, 2002) have been observed swimming through oil slicks and sheens making it likely that sperm whales would be similarly exposed in the Gulf of Mexico as a result of the recent Deep Horizon oil spill event.

Experience gained during the Exxon Valdez spill indicates that large-scale spills can cause persistent negative effects on wildlife that can last for decades (Peterson et al., 2003). Matkin et al. (2008) utilized photo-identification methods to monitor two killer whale populations 5 years prior to and 16 years after the Exxon Valdez oil spill and noted that in both cases, the two populations had not recovered from pre-spill numbers. Current numbers available at the time of this consultation indicate there has been one confirmed sperm whale mortality in the vicinity of the Deep Horizon oil spill in the Gulf of Mexico (dead 25 ft sperm whale found 77 miles due south of the spill site), although the cause of that mortality is unknown (NMFS, 2010a). Although the extent of effects of past and present oil spills on sperm whale populations is uncertain, the persistent impacts observed for other species of marine mammals suggest that oil spills will continue to threaten the survival and recovery of sperm whales (specifically the northern Gulf of Mexico population) for years to come.

Climate change has the ability to affect habitat and food availability for sperm whales. There is some evidence from Pacific equatorial waters that sperm whale feeding success and, in turn, calf production rates are negatively affected by increases in sea surface temperature (Smith and Whitehead, 1993; Whitehead, 1997). While there is insufficient data to know the effects that climate-related trends have on sperm whale populations, evidence suggests that rising global temperatures may reduce the productivity of at least some sperm whale populations in the future (Whitehead, 1997) thereby potentially slowing down the ability of the species to recover.

ENVIRONMENTAL BASELINE

By regulation, environmental baselines for biological opinions include the past and present impacts of all state, federal 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 that are contemporaneous with the consultation in process (50 CFR §402.02).

The purpose of the Environmental Baseline section is to step down from the species level discussion in the Status of the Species section and establish the current and projected viability or fitness of individuals and populations within the action area so that the effects of the proposed research activities can be measured and assessed. The following sections summarize the natural phenomena as well as the anthropogenic activities that have affected and continue to affect listed listed sea turtles and cetaceans within the action area.
Natural Sources of Stress and Mortality

Predation and Interspecific Competition
Killer whales and large sharks are known to occasionally prey on very young or sick fin whales (Perry et al., 1999; Ford and Reeves, 2008) as well as sperm whales (Best et al., 1984; Jefferson and Baird, 1991; Pitman et al., 2001). Humpback whales have been known to be preyed upon in the eastern Pacific (Steiger et al., 2008); however, it is not known if humpback whales are currently affected in the North Atlantic. Large sharks and killer whales may conceivably prey on North Atlantic right whales as scars have been reported indicating evidence of attacks (Kraus, 1990; NMFS, 2005); however it is not known what impact these attacks have on right whale populations. In addition to threats from shark and killer whale attacks, several researchers have suggested the recovery of the North Atlantic right whale has been impeded by competition with other whales (most notably Sei whales) for copepod food resources in the western North Atlantic (Rice, 1974; Mitchell, 1975; Scarff, 1986).

Strandings are also a relatively common event for sperm whales in the southeastern U.S. and Gulf of Mexico, with one to dozens of individuals beaching themselves and dying during any single event. Although several hypotheses, such as navigation errors, illness, and anthropogenic stressors, have been proposed (Goold et al., 2002; Wright, 2005), direct widespread causes remain unclear.

Diseases, Parasites, and Biotoxins
Parasites and biotoxins from red-tide blooms are other potential causes of mortality of listed baleen whales in the action area (Perry et al., 1999). The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in humpback and fin whales and may be affecting recovery of these species (Lambertsen, 1992). The threat of mortality and debilitation of North Atlantic right whales from similar diseases and red tide events is currently unknown; however, given their low numbers, right whales are expected to have a lower resilience to disease-related stressors that could affect this species’ ability to recover. Calcivirus and papillomavirus are known pathogens of sperm whales (Smith and Latham, 1978; Lambertsen et al., 1987).

A disease known as fibropapilloma is a major threat to listed turtles in many areas of the world including the action area. The disease is characterized by tumorous growths, which can range in size from very small to extremely large, and are found both internally and externally. Large tumors can interfere with feeding and essential behaviors, and tumors on the eyes can cause permanent blindness (Foley et al., 2005). It was first described in green turtles in the Florida Keys in the 1930s. Since then it has been recorded in many green turtle populations around the world as well as other sea turtle species, such as loggerheads (Huerta et al., 2002). In Florida, many immature green turtles captured in the Indian River Lagoon are infected, and there are similar reports from other sites in Florida, including Florida Bay. More research needs to be done to determine the cause of the disease as well as the possibly long term effects to sea turtle populations.
Oceanographic Features and Climatic Variability

Naturally occurring climatic patterns, such as the Pacific Decadal Oscillation and the El Niño and La Niña events, as well as longer time-scale climate change and variability are identified as major causes of changing marine productivity and may therefore influence listed species’ prey abundance in the action area (Mantua et al., 1997; Francis et al., 1998; Beamish et al., 1999; Hare et al., 1999; Benson and Trites, 2002). For example, decade-scale climatic regime shifts have been related to changes in zooplankton in the North Atlantic (Fromentin and Planque, 1996) and decadal trends in the North Atlantic Oscillation (NAO) (Hurrell, 1995) can affect the position of the Gulf Stream (Taylor et al., 1998) and other circulation patterns in the North Atlantic that influence foraging behavior of listed whales and act as important migratory pathways for various life stages of sea turtles. However, gaps in information and the complexity of climatic interactions complicate the ability to predict the effects that climate variability may have to these species from year to year (Kintisch, 2006; Simmonds and Isaac, 2007).

Other possible effects of climatic variability for listed whales and sea turtles include the alteration of community composition and structure, changes to species abundance, increased susceptibility to disease and contaminants, and altered timing of breeding (MacLeod et al., 2005; Robinson et al., 2005; Kintisch, 2006; Learmonth et al., 2006; McMahon and Hays, 2006). Atmospheric warming creates habitat alteration which may change sex ratios and affect reproductive periodicity for nesting sea turtles. Climate variability may also increase hurricane activity leading to an increase in debris in nearshore and offshore waters, thereby resulting in increased entanglement, ingestion, or drowning as well as increased physical destruction of sea turtle nests.

Anthropogenic Sources of Stress and Mortality

Commercial Whaling

Large whale populations in the action area were historically impacted by commercial whaling. Humpback whales were one of the predominant species targeted by commercial whaling operations in the western North Atlantic between the early 1800’s and the early part of the 1900’s including areas off the U.S. southeastern coast where the proposed research activities are expected to occur (Stevick et al., 2003). American whalers alone harvested 14,164-18,212 humpbacks in the North Atlantic between 1805-1909 (Best, 1987 as cited in NMFS, 1991). Fin whales were also heavily affected, as over 48,000 fin whales were harvested between 1860 and 1970 in the North Atlantic alone (Braham, 1991). North Atlantic right whales were also historically impacted by commercial whaling with their greatest rates of population decline probably occurring in the 1700’s (Reeves and Mitchell, 1987; Reeves et al., 1992). Hunting in the 19th and early 20th centuries, largely by Norwegian whaling operations, are likely to have irreversibly damaged or extirpated this stock (Collett, 1909; Brown, 1976).

Prior exploitation may have altered the population structure and social cohesion of these species such that effects on abundance and recruitment may continue for years after harvesting ceased. Significantly lower numbers have resulted in a loss of genetic diversity that could affect the ability of the current populations to successfully reproduce in the future (e.g., decreased conceptions, increased abortions, increased neonate
mortality). Also, historical whaling pressure significantly lowered population numbers such that their ability to resist the effects of deleterious phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, is lowered thereby greatly affecting the ability of these species to recover to pre-exploitation levels.

**Habitat Degradation**

A number of human activities may be directly or indirectly affecting listed whale and sea turtle species in the action area through habitat degradation. Anthropogenic activities such as discharges from wastewater systems, dredging, ocean dumping and disposal, aquaculture, and additional impacts from coastal development are known to degrade coastal waters utilized by listed whales and sea turtles in the action area. The construction and maintenance of federal navigation channels has been identified as a source of sea turtle mortality as hopper dredges move relatively rapidly and can entrain and kill sea turtles located in the dredge area.

Multiple municipal, industrial and household sources as well as atmospheric transport introduce various pollutants such as pesticides, hydrocarbons, organochlorides (e.g. DDT and PCBs), and other pollutants that may cause adverse health effects to listed species in the action area (Iwata, 1993; Grant and Ross, 2002; Garrett, 2004; Hartwell, 2004). The accumulation of persistent pollutants through trophic transfer may cause mortality and sub-lethal effects to marine mammals (Waring et al, 2009), including immune system abnormalities, endocrine disruption and reproductive effects (Krahn et al., 2007). Due to their large amount of blubber, marine mammals readily accumulate lipid-soluble contaminants such as PCBs (O’Hara and Rice, 1996) and concentrations of organochlorides have been documented in blubber samples collected for the species targeted by the proposed research activities (Aguilar and Borrell, 1988; Gauthier et al., 1997; Metcalfe et al., 2004). Recent efforts have led to improvements in regional water quality in the action area, although the more persistent chemicals are still detected and are expected to endure for years (Mearns, 2001; Grant and Ross, 2002). Also, acute exposure to hydrocarbons from petroleum products released into the environment via oil spills and other discharges are known to cause behavioral changes in marine mammals (Grant and Ross, 2002) and may directly injure individuals through skin contact with oils (Geraci, 1990), inhalation at the water’s surface and ingesting compounds while feeding (Matkin and Saulitis, 1997). Hydrocarbons also have the potential to impact prey populations, and therefore may affect listed species indirectly by reducing food availability in the action area.

There are studies on organic contaminants and trace metal accumulation in green and leatherback sea turtles (Aguirre et al., 1994; Caurant et al., 1999; Corsolini et al., 2000) although omnivorous loggerhead turtles have been observed to have the highest organochlorine contaminant concentrations in sampled tissues (Storelli et al., 2008). It is thought that dietary preferences were likely to be the main differentiating factor among species. Decreasing lipid contaminant burdens with turtle size were observed in green turtles, most likely attributable to a change in diet with age. Sakai et al (1995) found the presence of metal residues occurring in loggerhead turtle organs and eggs. Storelli et al. (1998) analyzed tissues from twelve loggerhead sea turtles stranded along the Adriatic
Sea (Italy) and found that characteristically, mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals and porpoises (Law et al., 1991). Although these contaminant concentrations do not likely affect pelagic waters, the species of turtles analyzed in this biological opinion travel between near shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

Loss or degradation of nesting habitat resulting from erosion control through beach nourishment and armoring, beachfront development, artificial lighting, and non-native vegetation is a serious threat affecting nesting sea turtle adults as well as hatchlings in the action area. Although beach nourishment, or placing sand on beaches, may provide more sand, the quality of that sand, and hence the nesting beach, may be less suitable than pre-existing natural beaches. Sub-optimal nesting habitat may cause decreased nesting success, place an increased energy burden on nesting females, result in abnormal nest construction, and reduce the survivorship of eggs and hatchlings (Mann, 1977; Ackerman, 1980; Mortimer, 1990). Beach armoring (e.g., bulkheads, seawalls, soil retaining walls, rock revetments, sandbags, and geotextile tubes) can impede a turtle's access to upper regions of the beach/dune system, thereby limiting the amount of available nesting habitat (Mazaris et al., 2009). Impacts also can occur if structures are installed during the nesting season. For example, unmarked nests can be crushed or uncovered by heavy equipment, nesting turtles and hatchlings can get caught in construction debris or excavations, and hatchlings can get trapped in holes or crevices of exposed riprap and geotextile tubes. In many areas of the world, sand mining (removal of beach sand for upland construction) seriously reduce or degrade/destroy sea turtle nesting habitats or interfere with hatchling movement to sea (NMFS, 2003).

Artificial lighting on or near the beach adversely affects both nesting and hatchling sea turtles located in the action area. Specifically, artificial lighting may deter adult female turtles from emerging from the ocean to nest and can disorient or misorient emerging hatchlings away from the ocean (Ehrhart, 1983, Salmon and Witherington, 1995). Hatchlings have a tendency to orient toward the brightest direction, which on natural, undeveloped beaches is commonly toward the broad open horizon of the sea. However, on developed beaches, the brightest direction is often away from the ocean and toward lighted structures. Hatchlings unable to find the ocean, or delayed in reaching it, are likely to incur high mortality from dehydration, exhaustion, or predation (Peters and Verhoeven, 1994; Salmon and Witherington, 1995).

Habitat in the action area may also be degraded by various sources of marine debris such as plastics, glass, metal, polystyrene foam, rubber, and derelict fishing gear. Marine debris is introduced into the marine environment through ocean dumping, littering, or hydrologic transport of these materials from land-based sources. Listed whales may become entangled in marine debris or directly ingest it while feeding, potentially leading to digestive problems, injury, or even death. Sea turtles living in the pelagic (open ocean) environment commonly ingest or become entangled in marine debris (e.g., tar balls, plastic bags, plastic pellets, balloons, and ghost fishing gear) as they feed along oceanographic fronts, where debris and their natural food items converge (Bugoni et al.,
This is especially problematic for turtles that spend all or significant portions of their life cycle in the pelagic environment (e.g., leatherbacks, juvenile loggerheads, and juvenile green turtles). Turtles can become entangled in derelict gillnets, pound nets, and the lines associated with longline and trap/pot fishing gear. Turtles entangled in these types of fishing gear may drown and often suffer serious injuries to their flippers from constriction by the lines or ropes.

**Ocean Noise**

Increases in underwater sound generated from various man-made sources such as commercial shipping and recreational vessels, whale watch cruises, seismic exploration, offshore construction (e.g. for offshore wind farms), and sonars of various types have the potential to affect listed whales and sea turtles in the action area at various times throughout the year. Marine mammals use sound in the ocean environment to find prey, locate mates, rear young, navigate, and to avoid predators (Bradley and Stern, 2008). Underwater noise generated in the marine environment have the potential to increase stress levels, alter behavior, result in temporary or permanent hearing loss, and/or, in extreme cases, result in direct injury and even even death (Richardson et al., 1995; NRC 2003, 2005; Clark and Ellison, 2004; Nowacek et al., 2007; Southall et al., 2007; Wright et al., 2008). Acoustic impacts to sea turtles can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns (NMFS-SEFSC, 2001).

Commercial shipping traffic is a major source of low frequency anthropogenic noise in the action area (NRC, 2003). Although large vessels emit predominantly low frequency sound, studies report broadband noise from large cargo ships at levels exceeding 2 kHz, which may interfere with important biological functions of cetaceans (Holt, 2008). However, the primary concern of incidental shipping noise is not related to acute exposures, but rather to the general increase in continuous background ambient noise and the potential masking of marine animals’ communication systems, their ability to hear mating calls, and their ability to pick up acoustic environmental cues that animals use to navigate and/or sense their surroundings, including sounds that are used to detect predators (OSPAR, 2009).

Another concern of increased sound from shipping traffic and recreational vessels is the gradual habituation of listed whales to these types of sound sources. Habituation may increase the risk of vessel strikes since the whales do not actively avoid the acoustic noise generated by an oncoming vessel. A study looking at the use of acoustic tags and controlled exposure experiments with North Atlantic right whales resulted in five of six individual whales responding strongly (interrupted dive pattern and swimming rapidly to the surface) to the presence of an artificial alarm stimulus while ignoring the playbacks of vessel noise, citing evidence of habituation (Nowacek et al., 2004). Several investigators have suggested that vessel noise may have caused humpback whales to avoid or leave feeding or nursery areas (Juraz and Juraz, 1979; Glockner-Ferrari and Ferrari, 1985; 1990; Salden, 1988), while others have suggested humpback whales may become habituated to vessel traffic and its associated noise (e.g. Watkins, 1986). Croll et al. (2001b) examined exposure of fin whales to low frequency noise and found that whale
foraging activity continued after exposure, and there were no apparent responses of
whales to loud, low frequency noise sources; however, the authors acknowledged that
these results do not address the cumulative impact of this noise on fin whales over larger
spatial and time scales. Parks et al. (2010) measured upcalls from North Atlantic right
whales in the Bay of Fundy and observed noise-dependent amplitude modification of
calls under varying background underwater noise levels. The results suggest that
increased call amplitude may be an immediate short term response to moderate noise
levels, while frequency change may be more gradual. These studies show that increased
vessel traffic in the action area will continue to affect the ability of cetaceans to perceive
threats as well as to communicate with mates and other conspecifics within and near the
action area.

Source sound pressure levels vary widely between construction activities with drilling
operations being relatively low while pile-driving and the use of explosives comprising
very high source levels (OSPAR, 2009). While studies documenting the effects of
marine construction and industrial activities on cetaceans are limited, it’s expected that
given the comparatively low source levels, injuries from either dredging or drilling
operations are unlikely in marine mammals, except those located very close to the source
(Southall et al., 2007). Underwater explosions, on the other hand, have the ability to
permanently injure the auditory systems of marine mammals as Ketten et al. (1993)
reported injury in the ears of two humpback whales stranded after underwater explosions.
While noise generated from marine construction has the potential to affect individuals in
the action area, it is unknown how these activities affect these listed whales at the
population level. As more energy facilities are built in marine environments, studies will
need to be done to understand the full range of effects that such operations have on whale
population dynamics.

Commercial sonar systems are used on recreational and commercial vessels and may
affect listed whales in the action area (NRC, 2003). Sonar signals could affect several
vocal characteristics or behaviors of cetaceans; however the degree to which these
changes significantly affect cetaceans in the action area is unknown. Sonar is a lesser
contributor to the overall ocean noise budget than other sources of anthropogenic sound
(OSPAR, 2009). Also, the distribution of these sounds would be small because of their
short durations and the fact that the high frequencies of the signals attenuate quickly in
seawater (Richardson et al., 1995). Nevertheless, increased sonar emanating from
multiple sources may increase effects of masking and cause short-term behavioral effects
of cetaceans in the action area.

Seismic surveys using towed airguns also occur within the action area and are the
primary exploration technique for oil and gas deposits and for fault structure and other
geological hazards. Airguns generate intense low-frequency sound pressure waves
capable of penetrating the seafloor and are fired repetitively at intervals of 10-20 seconds
for extended periods (NRC, 2003). Most of the energy from the guns is directed
vertically downward, but significant sound emission also extends horizontally. Peak
sound pressure levels from airguns usually reach 235-240 dB at dominant frequencies of
5-300Hz (NRC, 2003). Most of the sound energy is at frequencies below 500Hz. Very
little data exists on the effects of seismic surveys on cetaceans beyond short-term
behavioral responses; however, where responses have been observed, it is not known whether these reactions were significant at the population level (OSPAR, 2009). In the United States, all seismic surveys for oil and gas exploration and most research activities involving the use of airguns with the potential to take marine mammals are covered by incidental harassment authorizations under the MMPA. NMFS also anticipates incidental takes of sea turtles from vessel strikes, noise, marine debris, and the use of explosives during seismic surveys and during removal of oil and gas structures.

In summary, listed whales and sea turtles occurring in the action area are regularly exposed to several sources of anthropogenic sound sources, the effects of which are not well understood. Short-term exposure to high-energy sound sources such as underwater explosions, pile driving and other marine construction have the potential to result in direct injury or even death to listed species located near the sound source while the effects of exposure to more moderate but generally increasing background sound levels from vessel traffic, seismic surveys, and sonar pings may increase the effects of masking in listed cetaceans as well as the long term-habitat quality in the action area. The latter has the potential to lead to more population level effects such as overall distribution and rates of reproduction although more work needs to be done to confirm this.

**U.S. Military Activities**

U.S. Navy vessel operations and ordinance detonations have and continue to adversely affect listed species in the action area. From early July through early August 2007, the U.S. Navy conducted a Composite Training Unit-Joint Task Force Exercise within and seaward of the Cherry Point and Jacksonville-Charleston Operating Areas located off South Carolina, North Carolina, Georgia, and Florida. These exercises employed between 340 and 355 hours of mid-frequency active sonar. The Navy reported that observers spotted a group of dolphins during these exercises. Active sonar usage was shut down in response to this sighting. However, the actual number of marine animals that might have been exposed to mid-frequency active sonar during that exercise, and their resulting responses, is unknown.

Past and ongoing U.S. Navy aerial bombing training in the ocean off the southeast U.S. coast, involving drops of live ordnance (e.g. 500 and 1,000 lb bombs) is estimated to have the potential to annually injure or kill listed sea turtles (NMFS, 1997b) as well as marine mammals. In August and September 2008, the U.S. Navy conducted a ship shock trial on the MESA VERDE in waters east of Jacksonville, Florida, using high blast explosives. Surveys conducted after these activities did not detect any dead or injured listed marine mammals. In addition, no marine mammal or sea turtle stranding has been attributed to the shock trial. However, the lack of direct observations of adverse responses to these activities does indicate that that no responses occurred as a result of these activities. NMFS and the U.S. Navy have been working cooperatively to establish a policy for monitoring and managing acoustic impacts from anthropogenic sound sources in the marine environment.

In June 2009, NMFS issued a biological opinion on the NMFS Office of Protected Resources – Permits, Conservation and Education Division’s proposal to promulgate
regulations that would authorize the U.S. Navy to “take” marine mammals incidental to continued training activities conducted within and adjacent to waters off the (a) Northeast coast of the United States, (b) the Virginia Capes Range Complex; (c) the Cherry Point Range Complex, and (d) and the Charleston-Jacksonville Range Complex over a five-year period. This biological opinion also evaluated the U.S. Navy’s proposal to establish a transit protection system at Naval Submarine Base Kings Bay, Georgia, to escort nuclear powered ballistic submarines during transit between the Naval Submarine Base and the dive/surface site. According to that biological opinion, NMFS expected these activities to harass listed marine mammals by exposing them to sound fields produced by underwater detonations or ship noise at received levels that would cause individual animals to change their behavior from activities that require lower energy expenditures to those that require higher energy expenditures.

Between January and August 2009, the U.S. Navy conducted three Composite Training Unit Exercises and one Southeastern Anti-Submarine Warfare Integrated Training Initiative. The U.S. Navy also conducted three Integrated Anti-Submarine Warfare courses in conjunction with three of the Composite Training Unit Exercises it conducted during this time. The total number of sonar hours that were associated with each of these exercises is classified and are thus not reported here; however, there exists the possibility that marine mammals could have been exposed to these exercises and may have undergone short-term behavioral reactions to the sonar exposure.

On 28 July 2009, NMFS issued a final biological opinion on the U.S. Navy’s proposal to place a network of underwater transducer devices and undersea cables in a 1,713 square kilometer area of the ocean about 93 km (or 50 nm) offshore of northeastern Florida beginning in 2012 or 2013 with operations scheduled to begin sometime in 2014 or 2015. The instrumented area, which would be called the Undersea Warfare Tracking Range, would be connected by cable to a facility that would be located on shore where the data collected would be used to evaluate the performance of participants in shallow water training exercises. NMFS concluded that 106 humpback whales and 47 North Atlantic right whales might be exposed to active sonar operations at received levels that might result in behavioral responses.

**Fishing Activities**

Entrapment and entanglement in fishing gear is a frequently documented source of human-caused mortality in listed sea turtles and large whale species located within and in the vicinity of the action area (NMFS-SEFSC, 2001; Dietrich et al., 2007). These entanglements also make listed species more vulnerable to additional dangers (e.g., predation and ship strikes) by restricting agility and swimming speed. There is concern that many sea turtles and marine mammals that die from entanglement in commercial fishing gear tend to sink rather than strand ashore thus making it difficult to accurately determine the extent of such mortalities.

Threatened and endangered sea turtles are adversely affected by several types of fishing gears used in the action area. Gillnet, longline, other types of hook-and-line gear, trawl gear, and pot fisheries have all been documented as interacting with sea turtles.
Available information suggests sea turtles can be captured in any of these gear types when the operation of the gear overlaps with the distribution of sea turtles. Formal ESA Section 7 consultations have been conducted on the following fisheries occurring in the vicinity of the action area that may affect listed sea turtle species: Atlantic mackerel, coastal migratory pelagics, dolphin-wahoo, South Atlantic snapper-grouper, commercial directed shark, scup/black sea bass fisheries, Atlantic highly migratory species (HMS) fishery, and South Atlantic spiny lobster. An Incidental Take Statement (ITS) has been issued for the take of sea turtles in each of the fisheries. Entanglements or entrapments of sea turtles have been recorded in one or more of these gear types including trawl, hook and line, pot/trap, dredge, and net gear. In addition, pelagic longline, pelagic driftnet, bottom longline, and/or purse seine gear have also been documented taking sea turtles for pelagic-based fisheries. Gillnets are the primary gear type used by commercial fishermen in the South Atlantic region for the coastal migratory pelagic fishery (NMFS, 2007) while the recreational sector uses hook-and-line gear. The hook-and-line effort is primarily trolling.

The Southeast shrimp trawl fishery affects more sea turtles than all other activities combined (NRC, 1990). Revisions to the TED regulations (68 FR 8456, February 21, 2003) requiring larger openings enhanced the TED effectiveness in reducing sea turtle mortality resulting from trawling. This determination was based, in part, on the opinion’s analysis that shows the revised TED regulations are expected to reduce shrimp trawl related mortality by 94 percent for loggerheads and 97 percent for leatherbacks. Interactions between sea turtles and the shrimp fishery may also be declining because of reductions of fishing effort unrelated to fisheries management actions. In recent years, low shrimp prices, rising fuel costs, competition with imported products, and the impacts of recent hurricanes in the Gulf of Mexico have all impacting the shrimp fleets; in some cases reducing fishing effort by as much as 50 percent for offshore waters of the Gulf of Mexico (GMFMC, 2007). Indirect effects of shrimp trawling on sea turtles would include the disturbance of the benthic habitat by the trawl gear. The effect bottom trawls have on the seabed is mainly a function of bottom type. In areas where repeated trawling occurs, fundamental shifts in the structure of the benthic community have been documented (Auster et al., 1996) which may affect the availability of prey items for foraging turtles.

Other fisheries operate under state jurisdiction, and some are unmanaged. While little is known about the level of take in fisheries that operate strictly in state waters many state permit holders also hold Federal licenses; therefore, ESA Section 7 consultations on Federal action in those fisheries address some state-water activity. NMFS is also actively participating in a cooperative effort with the Atlantic States Fisheries Management Commission to standardize and/or implement programs to collect information on level of effort and bycatch in state fisheries in Atlantic waters. When this information becomes available, it can be used to refine take reduction plan measures in state waters.

NMFS records show that from 1990-2007, there were 46 confirmed North Atlantic right whale entanglements with fishing gear, including whales in weirs, gillnets, and trailing line and buoys (Waring et al., 2009). In addition, of the 24 confirmed reports of North
Atlantic right whales being entangled in fishing gear between 2004 and 2008 off the Atlantic coast of the U.S. and Maritime Provinces of Canada, 3 whales died of their wounds with one additional whale sustaining serious injuries (Glass et al., 2010).

For humpback whales, at least 5 were killed and 14 more seriously injured in the Gulf of Maine due to fishery interactions during the period 1999-2003 (Waring et al., 2006). Recent records show that from 2004-2008 there were 5 humpback whales killed and an additional 11 sustaining serious injuries from entanglement (Glass et al., 2010). Robbins and Mattila (2001) studied entanglement-related scarring on 134 individual humpback whales in the Gulf of Maine and concluded that between 48 and 65 percent had experienced entanglements. The authors also found that female humpbacks showing evidence of prior entanglements produced significantly fewer calves, suggesting entanglement may significantly reduce reproductive success in humpback whales (Robbins and Mattila, 2001).

NMFS has no observer records of fin whales being killed or seriously injured in commercial fisheries observed from 1997 to 2001 in the U.S. North Atlantic (Waring et al., 2004). However, NMFS stranding and entanglement records during the same time period yield an average of 0.2 fin whale mortalities per year from fishery interactions or entanglements in U.S. Atlantic waters (Waring et al., 2004). In addition, recent records show were 14 confirmed reports of fin whales being entangled in fishing gear between 2004 and 2008 off the Atlantic coast of the U.S. and Maritime Provinces of Canada, with 3 whales dying of their wounds and an additional 3 sustaining serious injuries (Glass et al., 2010).

Marine mammals probably consume at least as much fish as is harvested by humans (Kenney et al., 1985) so competition with humans for prey is a potential concern for large whales located in the action area (especially for fin and humpback whales). Reductions in fish populations, whether natural or human-caused, may affect humpback and fin whale populations and their recovery by altering their distribution. North Atlantic right whales feed almost exclusively on copepods and therefore are not in direct competition with human fishing operations. However, reduced zooplankton abundance due to habitat degradation is a potential indirect threat to these species from various human activities.

Ship Strikes and Other Vessel Interactions
In addition to noise effects described earlier, vessels operating in the action area adversely affect listed whales and sea turtles through direct ship strikes and/or other physical and behavioral disturbance. Turtles swimming or feeding at or just beneath the surface of the water are vulnerable to boat and vessel strikes, potentially resulting in serious propeller injuries and even death (Hazel et al., 2007). Listed cetaceans are also very vulnerable to ship strikes based on their size, swimming speeds, and locations that overlap areas with high boat traffic. From 2000-2004, there were 42 confirmed ship strikes on large whales in the North Atlantic with 21 confirmed deaths (Cole et al., 2006). Fin whales were the most frequently struck whale, although North Atlantic right and humpback whales were also commonly struck (Laist et al., 2001). Recent records show that from 2004-2008, there were 17 confirmed reports of North Atlantic right whales
being struck with 8 whales dying of their wounds and 2 additional right whales whales sustaining serious injuries (Glass et al., 2010). Results for for that same period listed 14 reports of humpbacks getting struck (including 8 confirmed mortalities) and 13 reports of fin whales being struck (including 10 confirmed mortalities) (Glass et al., 2010). Deaths of females, in particular, are especially threatening the ability of the North Atlantic right whale population to recover. For instance, in 2005, mortalities included six adult females, three of which were carrying near-term fetuses and four of which were just starting to bear calves, thereby representing a lost reproductive potential of as many as 21 individuals (Kraus et al., 2005).

In the North Atlantic, NMFS has several programs in place to help reduce ship strikes to whales. One of these measures is the implementation of new rules that limit vessel traffic of ships greater than 65 feet to speeds of 10 knots or less in areas when right whales are known to congregate. Other programs include the modification of shipping lanes from areas of high right whale concentrations. Although these efforts are targeted primarily to help conserve North Atlantic right whales, they are also beneficial to other whales which inhabit the same waters and are subject to similar threats. Despite these measures, the threat of ship strikes is expected to continue in the action area as commercial shipping lanes continue to cross important breeding and feeding habitats and may actually increase in the future as whale populations recover and individuals populate new areas or areas where they were previously extirpated (Swingle et al., 1993; Wiley et al., 1995).

In addition to serious injury or direct mortality through ship strikes, listed whales have also been shown to respond to the general presence of vessels by exhibiting avoidance behaviors and signs of increased stress including tail slapping, rolling, diving, separation of mothers and young and abandonment of resting areas, among others (Kovacs and Innes, 1990; Kruse, 1991; Wells and Scott, 1997; Samuels and Gifford, 1998; Bejder et al., 1999; Colburn, 1999; Cope et al., 1999; Mann et al., 2000; Samuels et al., 2000; Boren et al., 2001; Constantine, 2001; Nowacek et al., 2001). Vessel avoidance may cause whale individuals in the action area to move away from important feeding areas or potential mates, both of which can affect the ability of the species to recover. Whale watching, a profitable and rapidly growing business with more than 9 million participants in 80 countries and territories, may increase these types of disturbance and negatively affect listed species in the action area (Hoyt, 2001).

**Scientific Research**

Large whales and sea turtles in the action area have been the subject of numerous scientific research activities (mostly non-lethal), as authorized by NMFS permits. Research activities for whales include close vessel and aircraft approaches, biopsy sampling, suction cup and implantable satellite tagging, the opportunistic collection of sloughed skin, and active acoustic experiments. Research activities for sea turtles range from photographing, weighing, and tagging sea turtles incidentally taken in fisheries, blood sampling, biopsy sampling, and performing laparoscopy on intentionally captured turtles. There are currently 16 active permits authorizing research on targeted whales and 26 active permits directed towards sea turtles targeted by the proposed action in the areas that include the southeastern U.S. The number of authorized takes varies widely.
depending on the research and species involved. Before any research permit is issued, the proposal must be reviewed under the permit regulations (i.e., must show a benefit to the species). In addition, since issuance of the permit is a federal activity, issuance of the permit by the NMFS must also be reviewed for compliance with section 7(a)(2) of the ESA to ensure that issuance of the permit does not result in jeopardy to the species. Authorized “takes” by harassment represent substantial research effort relative to species abundance in the action area with repeated disturbances of individuals likely to occur each year. However, all permits for sea turtles and marine mammals contain conditions requiring the permit holders to coordinate their activities with the NMFS regional offices and other permit holders and, to the extent possible, share data to avoid unnecessary duplication of research.

There is evidence that listed whales may be either sensitized by multiple approaches (Lundquist, 2007) which can increase their stress levels, and possibly exacerbate their reactions to biopsy sampling or tagging; however, whales have also been shown to become habituated to boats as a result of multiple approaches, possibly leading to a lesser reaction from other research activities performed on the whales as a result (Whitehead et al., 1990; Weinrich et al., 1991; Weinrich et al., 1992; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005; Richter et al., 2006). If whales are already in a stressful situation with a close approach, there is a good chance that the tagging or removal of the biopsy sample increases their stress response. It is clear that the approach itself may play a role in the extent to which a whale reacts to biopsying or tagging. Whales that are biopsied following a fast approach may respond more intensely to the impact of the dart than if approached slowly (Whitehead et al., 1990; Brown et al., 1991; Weinrich et al., 1991; 1992; Jahoda et al., 2003). When approaches are conducted slowly, the whales tend to exhibit minimal responses that are short-lived (Clapham and Mattila, 1993). Researchers operating in the action area are required to approach whales slowly using a converging course technique that should minimize the stress response of the whales according to the literature.

The fact that multiple permitted “takes” of listed whales and sea turtles is already permitted and is expected to continue to be permitted in the future, means that short term behavioral harassment expected to listed whales and sea turtles from similar research activities has the ability to contribute to or even exacerbate the non-lethal stress responses generated from other threats occurring in the action area. The point at which this leads to a measurable cumulative impact on the survival and recovery of listed whales and/or sea turtles, however, is uncertain. Our ability to detect long-term effects from research activities will depend on several factors including our ability to better detect sub-lethal effects from research actions as well as funding and prioritizing long-term studies investigating survival and reproductive abilities of listed species targeted by similar types of research in the past. This may lead to statistically significant trends showing whether or not repeated non-lethal disturbances by research activities are affecting the ability of listed whales and sea turtles to survive and recover in the wild to an appreciable degree. More information on anticipated effects from similar research actions is included in the Effects of the Proposed Action section of this Opinion.
Conservation and Management Efforts
Several conservation and management efforts have been undertaken for listed whales and sea turtles in the action area to aid in recovery efforts. NMFS implements conservation and management activities for these species through its Regional Offices and Fishery Science Centers in cooperation with states, conservation groups, the public, and other federal agencies.

In the North Atlantic, NMFS has several programs in place to help reduce ship strikes and reduce gear entanglement by listed whales. One of these measures is the implementation of new rules that limit vessel traffic of ships greater than 65 feet to speeds of 10 knots or less in areas when right whales are known to congregate. Other programs include the modification of shipping lanes away from areas of high right whale concentrations. Although these efforts are targeted primarily to help conserve North Atlantic right whales, they are also beneficial to other whales which inhabit the same areas and are subject to similar threats. Similarly, in an effort to reduce fishing gear entanglement by whales in the North Atlantic, NMFS developed the Atlantic Large Whale Take Reduction Plan. This plan has improved safety measures in fishing gear in order to reduce entanglements by whales. This plan also expanded restrictions on fishing grounds and prohibited gillnet fishing in restricted areas during the calving season. As a result of these efforts, modified gear has been employed in areas such as Cape Cod Bay to protect listed whale species (Jaquet et al., 2005). It is expected that ongoing conservation and management efforts have an overall positive effect to the species; although the extent that these actions improve the species ability to survive and recover in the wild in the face of other stressors acting on these species in the action area remains uncertain.

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles from commercial fisheries in the action area. These include sea turtle release gear requirements for the Atlantic Highly Migratory Species Fishery, Gulf of Mexico reef fish, and South Atlantic snapper-grouper fishery, and TED requirements for Southeast shrimp trawl fishery. NMFS published a final rule on July 6, 2004, 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. In the Hawaii-based longline swordfish fishery which required vessels to switch from using a J-shaped hook with squid bait to a wider circle-shaped hook with fish bait has reduced capture rates of leatherback and loggerhead turtles significantly by 83% and 90% respectively (Gilman et al., 2007). There was also a highly significant reduction in the proportion of turtles that swallowed hooks (versus being hooked in the mouth or body or entangled) and a highly significant increase in the proportion of caught turtles that were released after removal of all terminal tackle, which could lead to the likelihood of turtles surviving the interaction (Watson et al., 2005; Read, 2007).

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries. In particular, NMFS has
required the use of TEDs in southeast United States shrimp trawls since 1989 and in summer flounder trawls in the Mid-Atlantic area (south of Cape Charles, Virginia) since 1992. It has been estimated that TEDs exclude 97 percent of the sea turtles caught in such trawls (Cox et al., 2007). These regulations have been refined over the years to ensure that TEDs are properly installed and used where needed to minimize the impacts on sea turtles. On August 3, 2007, NMFS published a final rule required selected fishing vessels to carry observers on board to collect data on sea turtle interactions with fishing operations, to evaluate existing measures to reduce sea turtle takes, and to determine whether additional measures to address prohibited sea turtle takes may be necessary (72 FR 43176).

In March 2002, NMFS published new restrictions for the use of gillnets with larger than 8-inch stretched mesh operating in federal waters (3-200 nautical miles) off North Carolina and Virginia. These restrictions were published in an interim final rule under the authority of the ESA (67 FR 13098) and were implemented to reduce the impact of the monkfish and other large-mesh gillnet fisheries on ESA-listed sea turtles in areas where sea turtles are known to concentrate. In addition to regulations, outreach programs have been established and data on sea turtle interactions with recreational fisheries has been collected through the Marine Recreational Fishing Statistical Survey.

NMFS published a final rule (66 FR 67495, December 31, 2001) detailing handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Those participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the final rule. These measures help to prevent mortality of hard-shelled turtles caught in fishing or scientific research gear. There is also an extensive network of Sea Turtle Stranding and Salvage Network participants along the Atlantic and Gulf of Mexico coasts who not only collect data on sea turtle mortality, but also rescue and rehabilitate any live stranded sea turtles that are encountered.

**EFFECTS OF THE PROPOSED ACTION**

Pursuant to Section 7(a)(2) of the ESA, federal agencies are directed to insure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed action, the probability of individuals of listed species being exposed to these stressors, and the probable responses of those individuals (given probable exposures) based on the best scientific and commercial evidence available. As described in the *Approach to the Assessment* section, for any responses that would be expected to reduce an individual’s fitness (i.e., growth, survival, annual reproductive success, and lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the listed species those populations represent. The purpose of this assessment is to determine if it is reasonable to expect the proposed research activities to have effects on listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.
For this consultation, we are particularly concerned about behavioral disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level consequences. The proposed permits would authorize non-lethal “takes” by harassment of listed species by way of aerial and vessel surveys. As stated earlier, we define harassment as 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.

Potential Stressors
The stressors associated with the proposed research activities to be authorized under Jeanette Wyneken’s permit include noise and visual disturbance during aerial and vessel surveys and the potential for vessel strikes during transit.

Exposure Analysis
Exposure analyses identify the co-occurrence of ESA-listed species with the action’s effects in space and time, and identify the nature of that co-occurrence. The exposure analysis identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the action’s effects and the population(s) or subpopulation(s) those individuals represent. For the exposure analysis conducted for this consultation, we estimated the number of individual whales and sea turtles likely to be exposed to the effects of the proposed research activities using the best information available to us including recent population estimates, expected growth rates over the life of the permits, the maximum survey effort expected from the researchers over the life of the permits, and past take numbers reported from permits authorizing similar types of research within or near the action area.

While annual reports detailing prior “takes” are useful in estimating exposure levels, it must be noted that the frequency, duration, area, and focus of research activities often vary on an annual basis due to factors such as weather, funding, opportunistic events, and evolving research goals and needs. Also, the threshold for reporting whether an actual “take” occurred has evolved over the years, thus possibly introducing some level of human error or bias into numbers reported in prior annual reports (e.g. some researchers may have reported a “take” only if the animal somehow reacted to an approach while other researchers may have assumed a “take” whether the animal exhibited a visible reaction or not). Thus, past annual reports introduce some level of uncertainty as to their accuracy for predicting future activities, levels of effort, and expected “takes” of listed species. Despite this uncertainty, annual reports remain one of the most valuable resources to NMFS Office of Protected Resources – Endangered Species Division for estimating exposure levels of future permit actions and were thus utilized in this consultation. NMFS Office of Protected Resources – Permits, Conservation, and Education Division has made an effort to standardize reporting of “takes” resulting from research activities which should lead to more accurate and informative annual reports in future years and hopefully reduce the level of error and uncertainty associated with the number of “takes” reported.
Our exposure analysis considered the amount of whale and sea turtle individuals expected to occur along the pre-determined transect lines based on prior survey data located in and around the action area. Table 2 below identifies the expected number and ages of listed whale and sea turtle species reasonably expected to be exposed annually to the stressors associated with permit No. 14586. Individuals may be of either sex and no individual may be harassed more than 3 times in one day. The duration of each exposure is expected to be minimal as no animal will be intentionally approached during either aerial or vessel surveys performed by the research applicants. NMFS expects that in any given year, not all proposed “takes” would occur. However, since the level of research effort expected is variable from year to year due to weather, funding, and other factors, these numbers represent a “worst-case scenario” for listed species by representing the highest level of exposure possible in any given year over the life of the permits based on the best available information.

Table 2. Exposure Analysis for Permit No. 14586

<table>
<thead>
<tr>
<th>SPECIES (LIFE STAGE)</th>
<th>ACTIVITY</th>
<th>INDIVIDUALS PROPOSED TO BE TAKEN ANNUALLY</th>
<th>INDIVIDUALS PROPOSED TO BE TAKEN OVER FIVE YEAR DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>390</td>
<td>1,950</td>
</tr>
<tr>
<td>Green Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>106</td>
<td>530</td>
</tr>
<tr>
<td>Hawksbill Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>49</td>
<td>245</td>
</tr>
<tr>
<td>Hawksbill Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>19</td>
<td>95</td>
</tr>
<tr>
<td>Kemp’s Ridley Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>49</td>
<td>245</td>
</tr>
<tr>
<td>Kemp’s Ridley Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>19</td>
<td>95</td>
</tr>
<tr>
<td>Leatherback Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>390</td>
<td>1,950</td>
</tr>
<tr>
<td>Leatherback Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>106</td>
<td>530</td>
</tr>
<tr>
<td>Loggerhead Sea Turtle (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>992</td>
<td>4,960</td>
</tr>
<tr>
<td>Species</td>
<td>Survey Method</td>
<td>Count</td>
<td>Surveyed KM</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------</td>
<td>-------</td>
<td>-------------</td>
</tr>
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<td>Loggerhead Sea Turtle (All)</td>
<td>Vessel Survey; Count/Survey</td>
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<td>North Atlantic Right Whale (All)</td>
<td>Aerial Survey; Count/Survey</td>
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<td>400</td>
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<tr>
<td>North Atlantic Right Whale (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Fin Whale (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>8</td>
<td>50</td>
</tr>
<tr>
<td>Fin Whale (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Sperm Whale (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>Sperm Whale (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Humpback Whale (All)</td>
<td>Aerial Survey; Count/Survey</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>Humpback Whale (All)</td>
<td>Vessel Survey; Count/Survey</td>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>

For sea turtles, we considered the highest density estimates from prior surveys and then multiplied this by the proposed survey transect length (1800km to be surveyed per month during each month of the year). The applicants expected that approximately 50 percent of sea turtles encountered would react to the survey vessel based on similar observations reported by NMFS-SEFSC and we found this approach to be reasonable based on similar survey methods proposed in this case. The proposed permit requested an additional 550 and 150 takes for unidentified sea turtles from aerial and vessel surveys, respectively. These estimates were based on similar numbers of unidentified takes reported by the NMFS-SEFSC for sea turtles that may have reacted to the surveys but were not identified to species. For this Opinion, we have broken out this additional take for each species by using the relative percentage of confirmed takes that were identified to species and then applying those percentages to the amount of unidentified take expected. For example, approximately 53 percent of the total sea turtle exposure is expected to be loggerhead sea turtles based on abundance data and prior surveys. Using this relative percentage, we took 53 percent of the total take expected for unidentified sea turtles and applied this additional take to the loggerhead sea turtle exposure analyzed in this Opinion. This additional exposure is reflected in the numbers reported in Table 2 above for all affected sea turtle species respectively. NMFS expects some individuals to be taken multiple times per year (e.g. turtles that remain in the area for multiple months or nesting sea turtles that return to nesting beaches each year).
For listed whales, we also used survey data to determine reasonable exposure levels to both aerial and vessel surveys to be performed by the researchers. Although the proposed permit did not separate out listed whale takes between aerial and vessel surveys, the applicants expect that approximately 25 percent of takes to occur from vessel surveys compared to 75 percent for aerial surveys so the exposure analyzed in this Opinion was adjusted accordingly based on this approach. Due to the uncertainty involved in estimating abundance expected for listed whales compared to sea turtles in the action area, we assessed the exposure at the proposed levels for fin, humpback, and sperm whales.

For North Atlantic right whales, we expect that more individuals may be exposed to the north and south aerial surveys performed due to these surveys crossing important calving grounds during the winter months. To estimate exposure, we calculated the average annual calf production seen in the U.S. southeastern calving area from 2001-2010 based on quarterly reports published for the North Atlantic Right Whale Consortium (NARWC). According to these reports, the average annual calf production for the period was 23 calves, with the lowest production occurring in 2004 (16 calves) and the highest production occurring in 2009 (39 calves). The most recent publication reported that 19 calves were observed in 2010, which represents the most recent data at the time of this consultation (NARWC, 2010). Using this dataset, we estimated the maximum expected calf production that may occur in any given year in the U.S. southeastern calving grounds during the life of the proposed permits by taking the mean calf production out to 4 standard deviations. Based on this analysis, we expected that 55 more North Atlantic right whale individuals may be exposed to aerial surveys each year than what was proposed and this additional exposure is reflected in the numbers reported in Table 2 above.

Response Analysis
As discussed in the Approach to the Assessment section of this Opinion, response analyses determine how listed resources are likely to respond after being exposed to an action’s effects on the environment or directly on listed animals themselves. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal, physiological or behavioral responses that might reduce the fitness of individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

Responses to Aerial Surveys
The aerial surveys authorized by the proposed permits would be flown at a steady altitude of 150 m (or 500ft). Sea turtles may or may not respond to an aircraft passing overhead depending upon the altitude of the plane, the proximity of the sea turtle to the trackline, and the sea turtle itself. NMFS Southeast Fisheries Science Center (SEFSC) staff have conducted aerial surveys and based on their past observations estimated that approximately 30-50% of the sea turtles near the track line react to aircraft during surveys. Sea turtle’s reactions to SEFSC aerial surveys indicate that animals would dive as a plane is approaching or passes directly overhead. While these reactions may result in a change in behavior for sea turtles observed along the transect line or in the vicinity of the aircraft, it would be similar to other natural behaviors such as predator avoidance.
NMFS does not believe the animals would experience significant effects or consequences from the proposed action. Given the minimal effects of the research that would occur and the ability of the animals to recover from effects between surveys, NMFS believes that even those animals that may be affected more than once a year would not suffer any significant fitness consequences as a result of the proposed aerial surveys.

When survey aircraft fly below certain altitudes (about 500m or 1600ft), they have caused marine mammals to exhibit behavioral responses that might constitute a significant disruption of their normal behavioral patterns (Perry, 1998; Patenaude et al., 2002). For instance, about 14 percent of bowhead whales approached during aerial surveys exhibited short-term behavioral reactions (Patenaude et al., 2002), and gray whale cow-calf pairs have shown to react sensitively to aircraft with calves swimming beneath their mothers (Moore and Clark, 2002). Richter et al. (2006) noted that sperm whales had a small reaction to whale-watching aircraft and that there was a difference in reactions between transient and resident whales. While North Atlantic right, fin, humpback, and sperm whales exposed to aerial surveys may exhibit similar short-term behavioral reactions to approaching aircraft, the proposed research does not allow for close approaches to whales that may result in a more stressful response than simply an aircraft passing overhead. Therefore, it is expected the aerial surveys conducted during the proposed research activities would result in only mild short-term behavioral reactions and would not result in any long term behavioral changes or reduce the fitness of individuals within the action area.

Responses to Vessel Surveys
Vessel surveys have the potential to disturb listed whale and sea turtle species by inducing behavioral and possibly physiological stress to animals observed along the transect line or in the vicinity of the survey vessel. Whales may respond differently to vessel surveys depending on what behavior the animals are engaged in before the vessel approaches (Würsig et al., 1998; Hooker et al., 2001; Jahoda et al., 2003) and the degree to which they become accustomed to vessel traffic (Lusseau, 2004; Richter et al., 2006). Reactions include little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation, diving and time spent submerged, foraging, respiratory patterns, and also may include aerial displays like breaching and lobtailing (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005). Baker et al. (1983) described two responses of whales to vessels, including: (1) “horizontal avoidance” of vessels 2,000 to 4,000 m away characterized by faster swimming and fewer long dives; and (2) “vertical avoidance” of vessels from 0 to 2,000 m away during which whales swam more slowly, but spent more time submerged. Other studies have found that humpbacks respond to the presence of boats by increasing swimming speed (e.g., Au and Green, 2000; Scheidat et al., 2004; Koehler, 2006), with some evidence that swimming speed then decreased after boats left the area. Just as with aerial surveys, sea turtles would be expected to dive in response to an oncoming inwater survey vessel if they noticed it based on observations reported by the NMFS-SEFSC.
Reactions to vessel noise have been observed when engines are started at distances of 3,000 ft (Malme et al., 1983; Richardson et al., 1995), suggesting that some level of disturbance may result even if the vessel does not undergo a close approach. In addition, changes in whale behavior have also been reported to correspond to vessel speed, size, and distance from the whale, as well as the number of vessels operating in the proximity (Baker et al., 1988; Koehler, 2006). Jahoda et al. (2003) noted the potential for long-term responses of whales to vessel disturbance can not be ruled out, but concluded that approaching vessels maneuvering at low speeds were less likely to cause visible reactions. Also, Clapham and Mattila (1993) studied reactions of humpback whales to close approaches for biopsy sampling in Caribbean breeding areas. The investigators concluded that the way a vessel approached a group of whales had a major influence on the whale’s response to the approach, particularly for cow-calf pairs. The relatively slow speeds at which the researchers will travel along the transect lines (9 km/hr) should minimize the stress response of the close approach to listed whales and sea turtles during vessel survey activities. Also, the fact that no whales or sea turtles would be approached during vessel surveys and the fact that researchers will actively avoid any oncoming whale or sea turtle located in the path of the vessel would also serve to minimize the stress response resulting from the presence of the vessel.

Detection of vessel noise is dependent on several factors, including weather, vessel engine type and size, habituation, and other ambient noise. However, since the vessels are below 50 ft in length for the proposed research activities, the sound generated is expected to be at higher frequencies than larger vessels such as supply ships, container/cargo ships, and cruise vessels in terms of contributing to overall marine ambient noise in the action area that could cause masking effects and the ability of listed whales to hear mates and other conspecifics (OSPAR, 2009). So, while there is the potential for vessel surveys to contribute to marine ambient noise in the action area, the effects to sea turtles and large whales who hear and vocalize at lower frequencies than those generated by the proposed survey vessel is sufficiently low and therefore discountable.

The probability of a vessel collision during transit and actual vessel surveys depends, in part, on the size and speed of the vessel. Pace and Silber (2005) found that the probability of death or serious injury increased rapidly with increasing vessel speed. According to Jensen and Silber (2003) the majority (79 percent) of records of vessels striking large whales occurred when the vessel was traveling at speeds of 13 knots or greater with 18.6 knots representing the average speed that resulted in serious injury or death. However, because the personnel involved would be trained observers and the research vessels would operate at relatively slow speeds, the probability of whales and/or sea turtles being struck by research vessels is extremely unlikely and, therefore, discountable.

Given the information available and recognizing the conditions of the proposed permit, we provisionally assume that the proposed vessel surveys would result in a short- to mid-term stress response that generate no long-term behavioral changes that might result in fitness consequences for individual whales or sea turtles located in the action area.
Risk Analysis

Our risk analyses reflect relationships between listed species, the populations that comprise that species, and the individuals that comprise those populations. Our risk analyses begin by identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action’s effects. Our analyses then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population-level risks to the species those populations comprise.

Based on a review of available information, we would expect whales and sea turtles exposed to aerial and vessel surveys under the proposed permit to exhibit either no visible response or short-term behavioral responses similar to those seen for predator avoidance. These responses may result in interruptions of essential behavior and physiological processes such as feeding, mating, nursing, resting, digestion etc., which can result in stress, injury and increased susceptibility to disease and predation (Frid and Dill, 2002; Romero, 2004; Walker et al., 2006). Gill et al., (2001) noted that changes in animal behavior do not necessarily reflect consequences of disturbance at the population level. Therefore, we can not definitively know whether such short-term behavioral responses have long-term consequences, as such consequences would be primarily sub-lethal for individual animals (that is, they would affect their growth, health, or reproductive success), and the associated consequences on whale and/or sea turtle populations would be delayed in time and concealed by any imprecision in population estimates. We assume aerial and vessel surveys conducted under the proposed permit might still be stressful for some individuals, and might temporarily interrupt behaviors such as foraging, but evidence in the literature (Perry, 1998; Patenaude et al., 2002) and from observations reported by previous investigators (e.g. NMFS-SEFSC) for similar actions suggests that responses are expected to be short-lived. Assuming an animal is no longer disturbed after it returns to pre-approach behavior, we do not expect long-term consequences for the fitness of any loggerhead, hawksbill, green, Kemp’s ridley, or leatherback sea turtles nor any North Atlantic right, humpback, fin or sperm whale individuals as a result of the proposed research activities.

Based on the best scientific information available, we expect that responses to aerial and vessel surveys by the proposed research is not likely to cause a reduction in listed whale or sea turtles’ growth, survival, annual reproductive success, or lifetime reproductive success (i.e. fitness). As a result, we do not expect activities authorized by the proposed permits to have an appreciable effect on the extinction risk of the population(s) these individuals represent or the species those populations comprise.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions, including research authorized under ESA Section 10(a)(1)(A), 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. Future cumulative effects from these and other types of federal actions will be investigated in future consultations, most notably in the Status of the Species and Environmental Baseline sections of Opinions which inform the effects analyses for specific federal actions. Other possible effects that may be acting in conjunction with federal actions and could possibly contribute to a cumulative impact on listed species are described below.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, natural mortality) will continue to influence listed species as described in the Environmental Baseline section of this Opinion. Climatic variability has the potential to affect listed species in the action area in the future; however, the prediction of any specific effects leading to a decision on the future survival and recovery of listed species is currently speculative. Nevertheless, possible effects of climatic variability for listed whales and/or sea turtles include the alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, alterations to prey composition and altered timing of breeding (MacLeod et al., 2005; Robinson et al., 2005; Kintisch, 2006; Learmonth et al., 2006; McMahon and Hays, 2006). The effects of climate-induced shifts in productivity, biomass, and species composition of zooplankton on the foraging success of North Atlantic right whales have received little attention. Such shifts in community structure and productivity may alter the distribution and occurrence of foraging right whales in coastal habitats and affect their reproductive potential as well. Atmospheric warming creates habitat alteration which may change sex ratios and affect reproductive periodicity for nesting sea turtles. Also, climate variability may increase hurricane activity leading to an increase in debris in nearshore and offshore waters, thereby resulting in increased entanglement, ingestion, or drowning as well as increased physical destruction of sea turtle nests.

We also expect anthropogenic effects described in the Environmental Baseline will continue, including habitat degradation, vessel traffic and risk of ship strikes, interactions with fishing gear, and tourism activities. Expected increases in vessel traffic would further increase collision risks for whales and sea turtles by the increased traffic itself and/or through habituation of animals to the sounds of oncoming traffic making them more prone to being struck. The number of vessels and tonnage of goods shipped by the U.S. fleet are increasing (e.g. there has been nearly a 30 percent increase in volume between 1980 and 2000) (NRC, 2003) and will lead to more vessel traffic throughout the action area in the future. The primary concern of increased levels of shipping noise expected from increased vessel traffic is not related to acute exposures, but rather to the general increase in continuous background ambient noise and the potential masking of marine animals’ communication systems, their ability to hear mating calls, and their ability to pick up acoustic environmental cues that animals use to navigate and/or sense their surroundings, including sounds that are used to detect predators (OSPAR, 2009). Expanded use of commercial sonars is also expected to increase, further exacerbating these effects (NRC, 2003).
For sea turtle species in the Atlantic, international activities, particularly fisheries, are significant factors impacting populations. NMFS estimates that, each year, thousands of sea turtles of all species are incidentally caught and a proportion of them killed incidentally or intentionally by international activities. The impact of international fisheries is a significant factor in the baseline inhibiting sea turtle recovery. Due to insufficient information on future management regimes associated with commercial and recreational fisheries, we cannot estimate the probability of future injuries or deaths of listed whales due to interactions with these fisheries. However, given interactions with fisheries in the action area during the recent past, such interactions remains a major threat to the survival and recovery of listed whale and sea turtles globally.

As the size of human communities increase, there is an accompanying increase in habitat alterations resulting from an increase in housing, roads, commercial facilities, and other infrastructure that result in increased discharge of sediments and pollution into the marine environment. These activities are expected to continue to degrade the habitat of listed species as well as that of the prey on which they depend. Pollutants may also affect prey populations which could impact food and habitat availability for other listed whale and sea turtle species in the future.

Additionally, unrelated factors may be acting together to affect listed species. For example, vessel effects combined with the stresses of reduced prey availability or increased contaminant loads may reduce foraging success and lead to chronic energy imbalances and poorer reproductive success which all may work to lower an animal’s ability to suppress disease (Williams et al., 2002; NMFS, 2008). The net effect of these disturbances is dependent on the size and percentage of the population affected, the ecological importance of the disturbed area to the animals, the parameters that influence an animal’s sensitivity to disturbance or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). More studies need to be done to identify the long term effects to listed whales and sea turtles from current stressors as well as the potential additive effect that multiple stressors acting in conjunction over time will have on the survival and recovery of these species.

After reviewing the available information, NMFS is not aware of any additional future non-federal activities or potential stressors reasonably certain to occur in the action area that could contribute to a cumulative impact to listed species affected by the proposed action.

INTEGRATION AND SYNTHESIS OF EFFECTS

The following text integrates and synthesizes the Status of the Species, the Environmental Baseline and the Effects of the Proposed Action sections of this Opinion. This information, in addition to any known or expected cumulative effects, was used to assess the risk the proposed research activities pose to the future survival and recovery of loggerhead, hawksbill, green, Kemp’s ridley, and leatherback sea turtles as well as North Atlantic right, fin, humpback, and sperm whales.
As explained in the Approach to the Assessment section, risks to listed individuals are measured using changes to an individual’s “fitness.” When listed plants or animals exposed to an action’s effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). When individuals of listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions can reduce the abundance, reproduction, or growth rates of the populations that those individuals represent (see Stearns, 1992). If we determine that reductions in individual plants’ or animals’ fitness reduce a population’s viability, we consider all available information to determine whether these reductions are likely to appreciably reduce the viability of the species as a whole.

NMFS Office of Protected Resources - Permits, Conservation, and Education Division proposes to issuance permit No. 14586 to Jeanette Wyneken of Florida Atlantic University that would authorize direct "takes" of loggerhead, hawksbill, green, Kemp’s ridley, and leatherback sea turtles as well as North Atlantic right, fin, humpback, and sperm whales in the Straits of Florida. The proposed activities under this permit include aerial and vessel surveys that will occur along the southeast coast of Florida west to the Bahamas. Additional aerial surveys would be performed from West Palm Beach to Jacksonville in addition to surveys going west to the Bahamas. The permits would be valid for five years and would exempt “take” of listed sea turtles and whales by way of incidental harassment during aerial and vessel surveys by noise disturbance as well as from the general presence of aircraft and vessel surveys in the vicinity. In addition, no direct mortality of listed species is to be authorized.

Sea turtles have been impacted historically by domestic and international fishery operations that often capture, injure, and even kill sea turtles at various life stages. Other significant threats include habitat modification, dredging operations, contaminant pollution including effects of oil spills, destruction of nesting beaches, and effects from research activities. Listed whales were heavily reduced by whaling up to the late 19th century. Other factors currently threatening the survival and recovery of these species include entrapment and entanglement in commercial fishing gear, ship strikes, habitat issues such as pollutants and noise, subsistence harvest, scientific whaling and research, and commercial and private whale watching.

Taken together, the components of the environmental baseline for the action area include sources of natural mortality – such as predation, disease, and parasites – as well as influences from natural oceanographic and climatic features in the action area. Circulation and productivity patterns may influence prey distribution and habitat quality for listed species at present and in the future. The baseline also includes human activities resulting in disturbance, injury, or mortality of individuals. These activities include the direct commercial harvest, habitat degradation (e.g., due to contaminants and noise), vessel traffic and risk of ship strikes, entrapment or entanglement in fishing gear, and harassment from other permitted scientific research activities. Conservation and
management efforts are ongoing and have a positive effect on the status of listed species found within the action area.

The assessment for this consultation identified several possible stressors as a result of the proposed research activities that would be measured and evaluated against the stressors already occurring in the Environmental Baseline section. These stressors included noise and visual disturbance during aerial and vessel surveys as well as the possibility of ship strikes during transit.

Based on the best available information, it is expected the aerial surveys conducted during the proposed research activities would result in only mild short-term behavioral reactions and would not result in any long term behavioral changes or reduce the fitness of individual whales or sea turtles in the action area.

Vessel approaches have the potential to disturb listed whale and sea turtle species and induce behavioral and possibly physiological stress. However, given the information available and recognizing the conditions of the proposed permit, we assume proposed vessel surveys performed by the applicants to result in short- to mid-term stress responses that generate no long-term behavioral changes that might result in fitness consequences for individual whales or sea turtles. Also, given the procedures to be followed in the proposed research activities (e.g. slow transit speeds, the fact that no species would be intentionally approached, and the use of trained observers to maneuver around oncoming individuals), it’s expected that the probability of whales or sea turtles being struck by research vessels is extremely unlikely and, therefore, discountable.

A number of studies involving vessel surveys indicate that responses are generally minimal to non-existent when approaches were slow and careful and when more pronounced behavioral changes occur, the responses appear to be short-lived (Weinrich et al., 1991; 1992; Clapham and Mattila, 1993; Gauthier and Sears, 1999; Best et al., 2005). Permit conditions will help to minimize long-term effects. Assuming an animal is no longer disturbed after it is encountered by an aircraft or in-water vessel, we do not expect long-term consequences for the fitness of whale or sea turtle individuals, populations, or species level consequences as a result of the proposed research activities.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, natural mortality) will continue to influence listed species as described in the Environmental Baseline. Climatic variability has the potential to affect listed species in the action area through alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, alterations to prey composition and altered timing of breeding (MacLeod et al., 2005; Robinson et al., 2005; Kintisch, 2006; Learmonth et al., 2006; McMahon and Hays, 2006).

We also expect anthropogenic effects described in the Environmental Baseline will continue, including habitat degradation, vessel traffic and risk of ship strikes, increases in background ocean noise levels, interactions with fishing gear, and tourism activities. The
net effect of these disturbances is dependent on the size and percentage of the population affected, the ecological importance of the disturbed area to the animals, the parameters that influence an animal’s sensitivity to disturbance, or the accommodation time in response to the prolonged disturbance (Geraci and St. Aubin, 1980). More studies need to be done to identify the long term effects to listed whales and sea turtles from current stressors as well as the potential additive effect that multiple stressors acting in conjunction over time have on the survival and recovery of these species in the future.

Based on the best scientific information available, we expect that responses to aerial and vessel surveys proposed by the research applicant is not likely to cause a reduction in any listed species’ individual growth, survival, annual reproductive success, or lifetime reproductive success (i.e. fitness) or contribute to a significant cumulative effect. As a result, we do not expect activities authorized by the proposed permits to have an appreciable effect on the extinction risk of the population(s) these individuals represent or the species those populations comprise.

CONCLUSION

After reviewing the current status of listed species affected by the proposed action, the environmental baseline for the action area, the anticipated effects of the proposed research activities and the possible cumulative effects, it is NMFS Office of Protected Resources – Endangered Species Division’s opinion that the NMFS Office of Protected Resources – Permits, Conservation and Education Division’s proposed action of issuing permit No. 14586 to Jeanette Wyneken of Florida Atlantic University, as proposed, is not likely to jeopardize the continued existence of loggerhead, hawksbill, green, Kemp’s ridley, or leatherback sea turtles or North Atlantic right, fin, humpback, or sperm whales under NMFS’ authority. In addition, no designated critical habitat under NMFS’ authority would be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the “take” of endangered and threatened species, respectively, without 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 the NMFS to include significant habitat modification or degradation that results in death or injury to 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. Under the terms of Sections 7(b)(4) and 7(o)(2), taking that is incidental and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement. However, as discussed in the accompanying Opinion, only the species targeted by the proposed research activities will be significantly harassed as part of the intended purpose of the proposed action. Therefore, NMFS does not expect the proposed action will incidentally take threatened or endangered species.
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 endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans or to develop information.

We recommend the following conservation recommendations, which would provide information for future consultations involving the issuance of permits that may affect listed whales and/or sea turtles as well as reduce harassment related to the authorized activities:

1. *Estimation of Actual Levels of “Take.”* The Permits Division should continue to review all annual and final reports submitted by investigators that have conducted whale and sea turtle research as well as any data and results that can be obtained from the permit holders. This should be used to estimate the amount of harassment that occurs given the level of research effort, and how the harassment affects the life history of individual animals. The results should be provided to NMFS Office of Protected Resource – Endangered Species Division for use in future consultations.

2. *Cumulative Impact Analysis.* The Permits Division should work with the sea turtle recovery team, the Marine Mammal Commission, International Whaling Commission, and the research community to identify a research program with sufficient scope and depth to determine cumulative impacts of existing levels of research on listed species. This includes the cumulative sub-lethal and behavioral impacts of research permits on listed species.

3. *Assessment of Permit Conditions.* The Permits Division should periodically assess the effectiveness of its permit conditions, including those for notification and coordination of research.

4. *Data Sharing.* The Permits Division should continue to encourage permit holders planning to be in the same geographic area during the same year to coordinate their efforts by sharing research vessels and the data they collect as a way of reducing duplication of effort and the level of harassment to threatened and endangered species as a result of field investigations.

5. *Coordination Meetings.* The Permits Division should continue to work with NMFS’ Regional Offices to conduct meetings among regional species coordinators, permit holders conducting research within a region, and future applicants to ensure that the results of all research programs or other studies on specific threatened or endangered species are coordinated among the different investigators.
In order for NMFS’ endangered Species Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, listed species or their habitats, the Permits Division should notify the endangered Species Division of any conservation recommendations they implement in their final action.

REINITIATION NOTICE

This concludes formal consultation on the proposal to issue scientific research permit No. 14586 for research on listed cetaceans and sea turtles within waters off the eastern coast of Florida. As provided in 50 CFR §402.16, 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 proposed take is exceeded; (2) new information reveals effects of the agency action that may affect 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 listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, NMFS Office of Protected Resources – Permits, Conservation, and Education Division must immediately request reinitiation of section 7 consultation.


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