


**National Oceanic and Atmospheric Administration's
National Marine Fisheries Service
Endangered Species Act Section 7 Consultation**

Biological Opinion

Agency: Permits and Conservation Division of the Office of Protected Resources, National Oceanic and Atmospheric Administration's National Marine Fisheries Service

Activity Considered: Proposal to issue permit No. 16473 to Ann Pabst, Ph.D, for research on abundance and distribution of cetaceans along the east coast of the U.S., pursuant to section 10(a)(1)(A) of the Endangered Species Act.

Consultation Conducted by: Endangered Species Act Interagency Cooperation Division of the Office of Protected Resources, National Oceanic and Atmospheric Administration's National Marine Fisheries Service

Approved by: 

Date: MAY 30 2012

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 designated for 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 the 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 and Conservation Division (Permits Division). The consulting agency is NMFS' Office of Protected Resources – Endangered Species Act Interagency Cooperation Division (ESA Interagency Cooperation Division). This document represents NMFS' Biological Opinion (Opinion) on the effects that the proposed research activities have on listed threatened and endangered species and designated critical habitat in accordance with section 7 of the ESA. This Opinion is based on information submitted by the Permits Division as part of their initiation package (i.e., draft environmental assessment, original application provided by the applicant,

etc.), recovery plans, monitoring reports, published and unpublished scientific information on the biology and ecology of the listed species affected, and other relevant sources of information.

CONSULTATION HISTORY

On January 31, 2012, the Permits Division requested formal consultation with the ESA Interagency Cooperation Division on a proposed action to issue scientific research permit No. 16473 to Ann Pabst to conduct aerial and vessel cetacean surveys along the east coast of the U.S. The permit 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 proposed survey activities, and figures showing proposed survey track lines. Upon reviewing the initiation package, the ESA Interagency Cooperation Division initiated formal consultation.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The proposed action is the issuance of a permit authorizing direct “takes”¹ to listed and non-listed cetaceans for the purposes of scientific research, 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. The permit would authorize Ann Pabst, Ph.D, to conduct aerial and vessel surveys along predetermined transect lines from Delaware Bay to Cape Canaveral, Florida. The purpose of the surveys are to document the presence of North Atlantic right (*Eubalaena glacialis*) and humpback whales (*Megaptera novaeangliae*) in the Mid-Atlantic region as well as to describe cetacean abundance and distribution within specific geographic areas currently utilized for military training activities or those that may be targeted in the future (specifically, areas off Cape Hatteras, North Carolina, and off Jacksonville, Florida). The Permits Division provided proposed takes to listed cetaceans in their initiation package and these numbers are presented in **Table 1** below. All proposed takes are expected to be in the form of non-lethal harassment² during surveys including approaches to listed whales for photo-

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.

2 The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. However, the Marine Mammal Protection Act 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 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 USFWS’ 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.

documentation purposes. The proposed permit would be valid for five years after the date of issuance.

Table 1. Annual Takes to Listed Species Proposed for Permit No. 16473

SPECIES	LISTING UNIT/STOCK	AUTHORIZED TAKE*	TAKES PER ANIMAL**	OBSERVE/ COLLECT METHOD	PROCEDURES
North Atlantic Right Whale	Western Atlantic Stock	200	3	Aerial/Vessel Surveys	Count/survey; Photo-id
Humpback Whale	Western North Atlantic Stock	200	12	Aerial/Vessel Surveys	Count/survey; Photo-id
Sperm Whale	North Atlantic Stock	150	12	Aerial/Vessel Surveys	Count/survey; Photo-id
Fin Whale	Western North Atlantic Stock	100	12	Aerial/Vessel Surveys	Count/survey; Photo-id
Sei Whale	Nova Scotia Stock	40	12	Aerial/Vessel Surveys	Count/survey; Photo-id

* Takes equal the maximum number of animals, not necessarily individuals, that may be targeted for research annually.

** This column indicates the number of surveys an individual may be repeatedly taken annually. It is not meant to be multiplied by the “Authorized Take” column.

Aerial Surveys

Aerial surveys are focused in three main regions along the east coast of the U.S. and will be conducted using two different types of aircraft depending on the region. The three regions proposed are from Delaware Bay to northern Virginia, from northern Virginia to South Carolina, and a specific survey site off Jacksonville, Florida.

The majority of surveys (south of the Maryland-Virginia border) will utilize over wing, twin-engine Cessna 337 airplanes flown at altitudes at or above 305 meters (1,000 feet) and airspeeds approximately 185 kilometers per hour over pre-set track lines. Surveys focusing on documenting North Atlantic right and humpback whale abundance in the Mid-Atlantic will follow track lines already established from prior surveys flown from Virginia to the North Carolina-South Carolina border (see **Figure 1** below). These track lines have been flown by researchers at the University of North Carolina-Wilmington (UNCW) in the past and researchers intend to continue utilizing them under the proposed permit. Surveys will be flown from November to June each year. The number of survey days will depend on the weather; however, researchers report that prior effort resulted in each track line being flown 3-12 times per survey season.

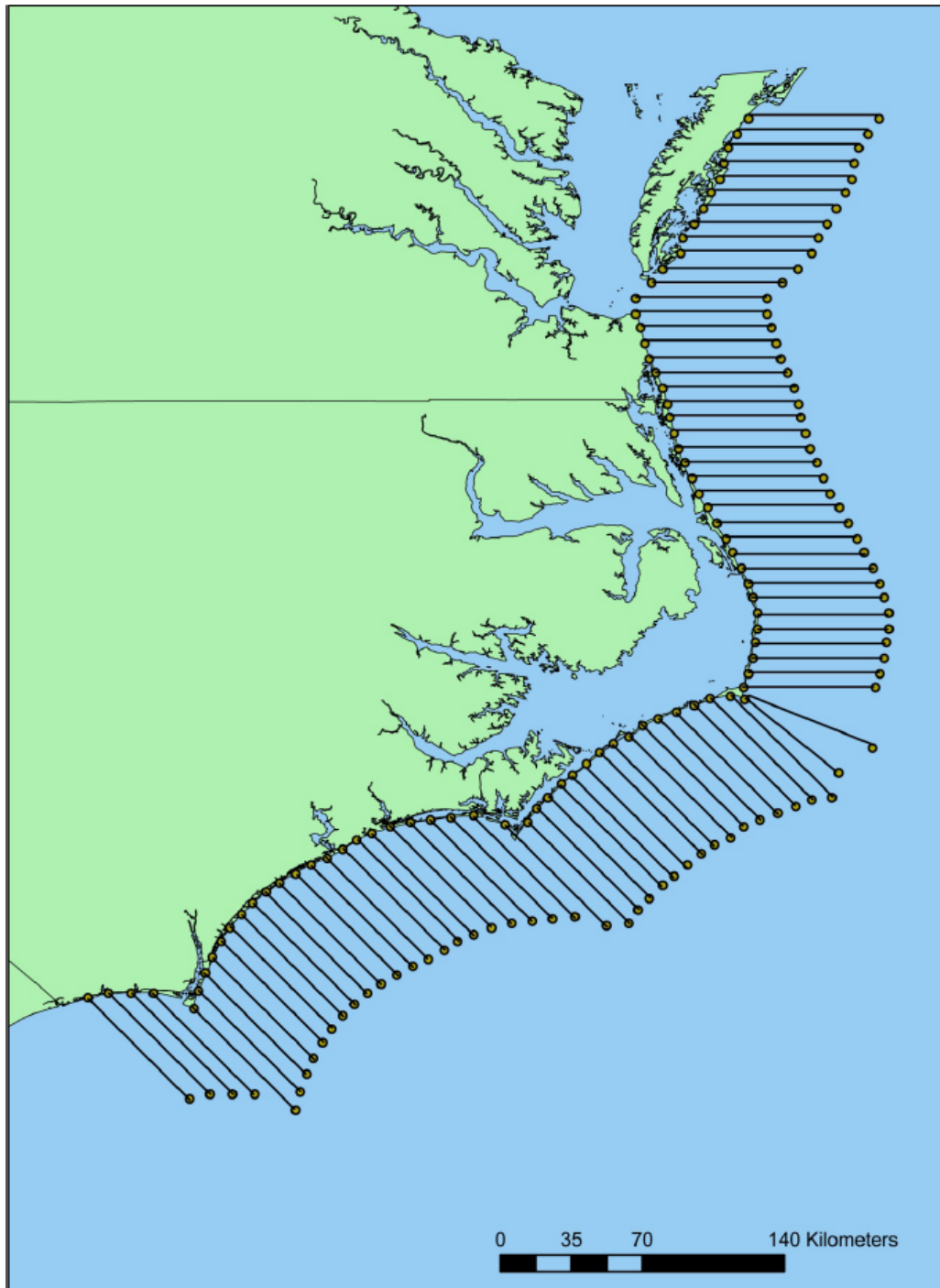


Figure 1. Aerial survey transect lines from Virginia to South Carolina conducted from 2001-2008 to be continued under this proposed permit. Surveys would focus on documenting the presence of North Atlantic right and humpback whales from November to June each year. Figure included in the initiation package sent to the ESA Interagency Cooperation Division on January 31, 2012.

Researchers are also proposing to conduct aerial surveys using the same aircraft at two specific sites targeted for possible military training activities (i.e., areas off Cape Hatteras, North Carolina, and off Jacksonville, Florida). The Cape Hatteras track lines overlap with the broader study area shown in **Figure 1** above; however, the track lines off Cape Hatteras (see **Figure 2**)

and off Jacksonville, Florida (see **Figure 3**), will be flown year round and will target all cetaceans found along the track line rather than focusing on specific species. Researchers anticipate conducting 2-4 survey days per month within these two specific study areas each year. Approach and circling procedures would be the same as the North Atlantic right and humpback whale surveys discussed previously.

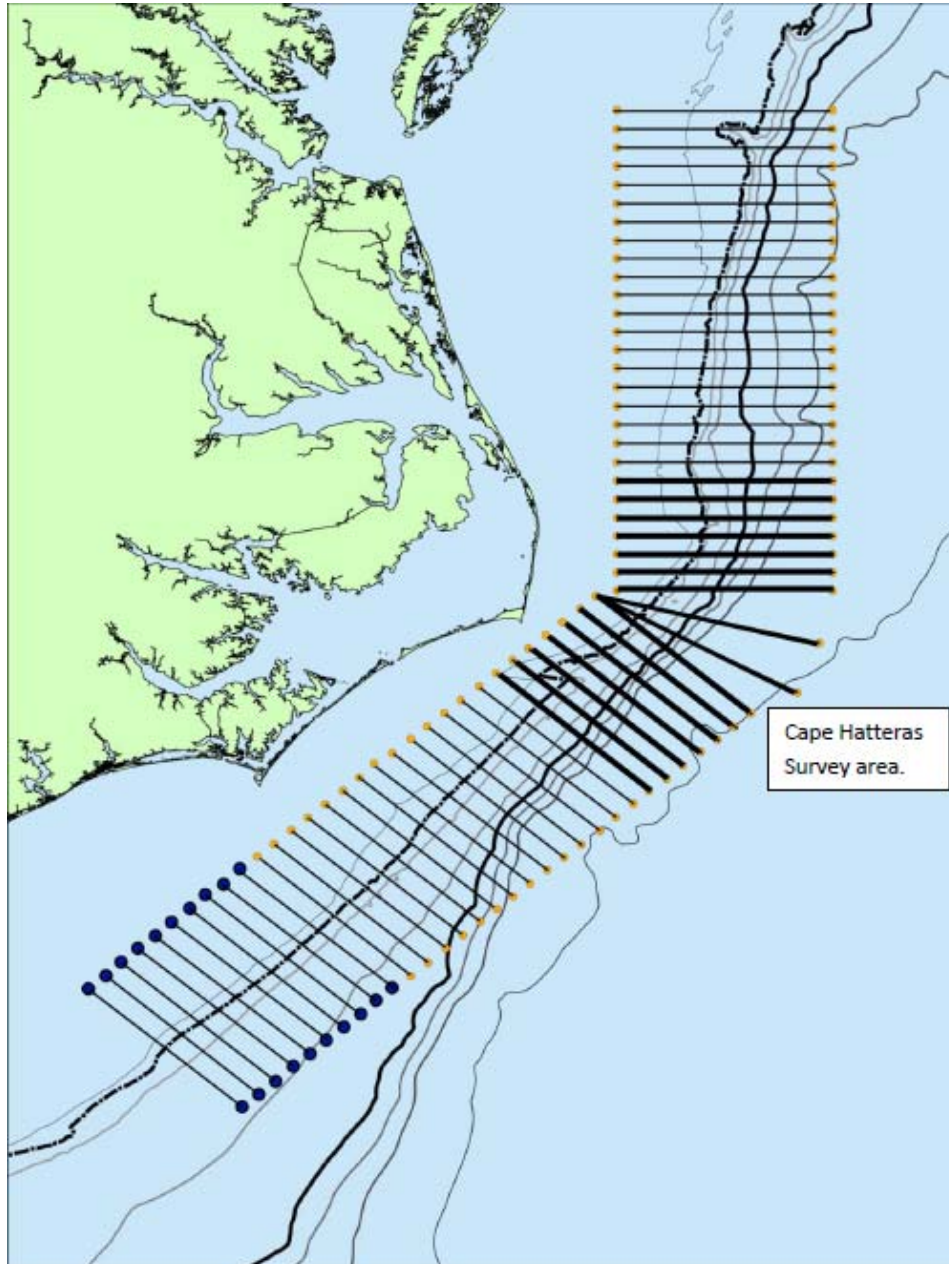


Figure 2. Additional aerial surveys proposed off Cape Hatteras, North Carolina. Note while these survey track lines overlap with track lines in **Figure 1**, they will be conducted year round rather than just from November to June each year. The dark lines represent the focus of the study. This figure was included in the initiation package sent to the ESA Interagency Cooperation Division on January 31, 2012.

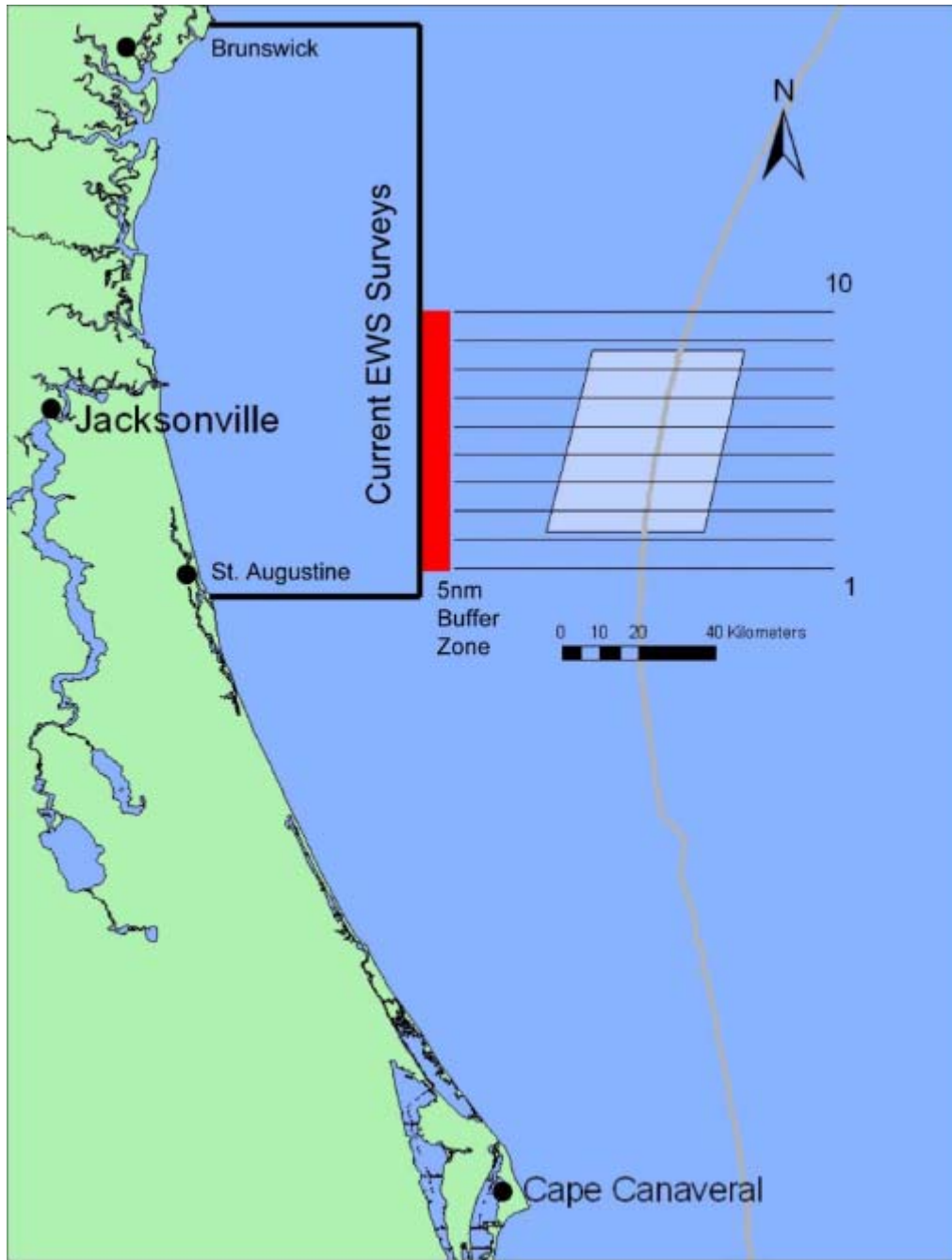


Figure 3. Aerial and vessel transect survey transect lines for the Jacksonville site. Track lines would be flown outside of North Atlantic right whale designated critical habitat. Figure included in the initiation package sent to the ESA Interagency Cooperation Division on January 31, 2012.

Finally, Dr. Pabst is proposing to partner with the Virginia Aquarium and Marine Science Center Foundation to conduct large whale surveys from North Carolina north to Delaware Bay to assist in the development of spatial planning maps for placement of offshore energy platforms. These efforts would be coordinated with NMFS' Northeast Regional Office and other researchers to fill in data gaps in ongoing surveys being performed in the region to avoid any duplication of effort. Researchers anticipate commencing these additional surveys in the years 2013-2015 of their proposed permit. Researchers will use a DeHavilland Twin Otter DHC-6 aircraft flown at an

altitude of 183 meters (600 feet) and 200 kilometers per hour. These surveys will be flown at lower altitudes than surveys conducted in other regions (i.e., 600 feet compared to 1,000 feet as described above).

When a large whale is spotted during any of the proposed surveys, the airplane would break transect to approach the whale for photo-documentation. Each whale would be circled and photographed, and its size, behavior, and evidence of any human interaction (e.g., evidence of entanglement) would be noted. This process may result in aircraft altitude periodically decreasing below 305 meters, to a minimum of 244 meters (800 feet) in order to obtain legible photographs. Based on past efforts, encounters may last up to 30 minutes and involve 10-20 circling events for researchers to assess the individual and obtain legible photographs. Researchers expect it is possible that some individuals would be photographed more than once although efforts will be made to minimize the overall time of the encounter in all cases.

Vessel Surveys

Researchers also plan to conduct vessel surveys in conjunction with aerial surveys for each region; although the focus and intensity of vessel surveys will vary according to the research objectives. Researchers will partner with the Virginia Aquarium and Marine Science Center Foundation to carry out vessel surveys from Delaware Bay to North Carolina to monitor and photo-document large whales to assist in the development of spatial planning maps for placement of offshore energy platforms. Similar to aerial surveys conducted for this region, surveys would most likely take place during the period 2013-2015 and follow similar track lines than those established for aerial surveys. Vessels to be utilized would carry a 13 meter diesel engine and survey at speeds of 8-12 knots. As whales are spotted, speeds would be reduced to 2-5 knots and the vessel will approach within 50-100 meters in order to obtain legible photographs. The vessel will travel parallel to the individual or group to match their speed, and to obtain images at a perpendicular angle to the photographer. All efforts will be made to spend the shortest time possible to obtain photographs and researchers will suspend the approach if the whale appeared to react negatively to the vessel (e.g., change in swimming speed or direction, etc.).

Vessel surveys will also be carried out in both sites targeted for potential military training activities (i.e., areas off Cape Hatteras, North Carolina, and off Jacksonville, Florida). Although these surveys may occur year-round, this work will also be conducted primarily in the spring, summer, and fall months. Surveys would occur approximately 10 days per month and researchers anticipate no more than 150 survey days per year. Vessel surveys will also be used to respond to opportunistic whale sightings that may occur year-round within the mid-Atlantic survey sites (northern Virginia to South Carolina). Vessel surveys conducted in this region may utilize smaller sized vessels (6-8 m in length) for cetaceans located closer to shore or may use larger vessels (13-15 m) for cetaceans spotted further offshore. Vessel survey speed is 10-14 knots for small vessels and 8-12 knots for larger vessels although vessel speed and approach protocols upon spotting a large whale would be the same as those described above.

Mitigation Measures

The following section summarizes the mitigation measures included in the proposed action 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 the Draft Environmental Assessment document. The relevant conditions included in the Permits Division's draft permit are summarized below:

1. In the event a serious injury or mortality³ of a protected species occurs, the Researchers must suspend permitted activities and contact the Chief of the Permits Division by phone within two business days. Researchers must also submit a written incident report. This includes events where tagging gear leads to entanglement of an animal. 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 take⁴ is exceeded, including accidental takes of protected species not listed in this permit, the Researchers must cease all permitted activities and notify the Chief of the Permits 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. Counting and Reporting Takes:
 - a. Any "approach"⁵ of a cetacean constitutes a take by harassment and must be counted and reported regardless of whether an animal reacts.
 - b. During aerial surveys flown at an altitude lower than 1,000 ft, any cetacean observed should be counted and reported as a take.
 - c. No individual may be taken more than 3 times in one day.
4. Aerial Surveys:
 - a. Aerial surveys must be flown at an altitude of 600ft (183 m) or higher for most

3 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.

4 By regulation, a take under the MMPA means to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal. This includes, without limitation, any of the following: The collection of dead animals, or parts thereof; the restraint or detention of a marine mammal, no matter how temporary; tagging a marine mammal; the negligent or intentional operation of an aircraft or vessel, or the doing of any other negligent or intentional act which results in disturbing or molesting a marine mammal; and feeding or attempting to feed a marine mammal in the wild. Under the ESA, a take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to do any of the preceding.

5 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.

species

- b. 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.
5. To minimize disturbance of the subject animals, the Permit Holder must exercise caution when approaching animals and must retreat from animals if behaviors indicate the approach may be interfering with reproduction, feeding, or other vital functions.
6. Where females with calves are authorized to be taken, Researchers:
 - a. Must immediately terminate efforts if there is any evidence that the activity may be interfering with pair-bonding or other vital functions.
 - b. Must not position the research vessel between the mother and calf.
 - c. Must approach mothers and calves gradually to minimize or avoid any startle response.
 - d. Must not approach any mother or calf while the calf is actively nursing.
 - e. Must not approach a right whale calf less than six months old if it appears unusually thin or emaciated.
7. Should other protected species be encountered including those species under the jurisdiction of the USFWS (e.g., manatees) during the research activities authorized under this permit, researchers must exercise caution and remain a safe distance from the animal(s) to avoid take, including harassment.
8. Individuals conducting permitted activities must possess qualifications commensurate with their roles and responsibilities.
9. 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.
10. The Permit holder must submit annual reports to the Chief of the Permits 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.
11. Research results must be published or otherwise made available to the scientific community in a reasonable period of time. Copies of technical reports, conference abstracts, papers, or publications resulting from permitted research must be submitted the Permits Division.

12. The Permit Holder must provide written notification of planned field work to the applicable NMFS Region at least two weeks prior to initiation of each field trip/season. If there will be multiple field trips/seasons in a permit year, a single summary notification may be submitted per year.
 - a. Notification must include:
 - i. Location of the intended field study and/or survey routes
 - ii. Estimated dates of activities
 - iii. Number and roles of participants
13. To the maximum extent practical, 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. Contact the applicable Regional Office(s) for information about coordinating with other Permit Holders.

In addition to the permit conditions listed above, researchers will not survey within critical habitat designated for North Atlantic right whales in the southeastern U.S. to avoid disturbing cow-calf pairs utilizing the critical habitat. Researchers plan to only transit through the critical habitat at slow speeds (around 10 knots) to and from the survey site located further offshore. While researchers may take opportunistic photographs while transiting, they will not actively approach any whales located within the critical habitat and will have trained observers onboard to assist in avoiding any whales that may appear within the path of the vessel.

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 a proposed action likely to have direct and/or 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). 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.

Destruction or adverse modification⁶ determinations are based on an action's effects on the conservation value of habitat that has been designated as critical to threatened or endangered species. If an area encompassed in a critical habitat designation is likely to be exposed to the direct or indirect consequences of the proposed action on the natural environment, we ask if primary or secondary constituent elements included in the designation (if there are any) or physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species are likely to respond to that exposure. If primary or secondary constituent elements of designated critical habitat (or physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) are likely to respond given exposure to the direct and/or indirect consequences of the proposed action on the natural environment, we ask if those responses are likely to be sufficient to reduce the quantity, quality, or availability of those constituent elements or physical, chemical, or biotic phenomena.

If the quantity, quality, or availability of the primary or secondary constituent elements of the area of designated critical habitat (or physical, chemical, or biotic phenomena) are reduced, we ask if those reductions are likely to be sufficient to reduce the conservation value of the designated critical habitat for listed species in the action area. In this step of our assessment, we combine information about the contribution of constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species, particularly for older critical habitat designations that have no constituent elements) to the conservation value of those areas of critical habitat that occur in the action area, given the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area.

If the conservation value of designated critical habitat in an action area is reduced, the final step of our analyses asks if those reductions are likely to be sufficient to reduce the conservation value of the entire critical habitat designation. In this step of our assessment, we combine information about the constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) that are likely to experience changes in quantity, quality, and availability given exposure to an action with information on the physical, chemical, biotic, and ecological processes that produce and

⁶ We are aware that several courts have ruled that the definition of destruction or adverse modification that appears in the section 7 regulations at 50 CFR 402.02 is invalid and do not rely on that definition for the determinations we make in this Opinion. Instead, as we explain in the text, we use the "conservation value" of critical habitat for our determinations which focuses on the designated area's ability to contribute to the conservation of the species for which the area was designated.

maintain those constituent elements in the action area. We use the conservation value of the entire designated critical habitat as our point of reference for this comparison. For example, if the designated critical habitat has limited current value or potential value for the conservation of listed species that limited value is our point of reference for our assessment.

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 Division when it initiates formal consultation, and the general scientific literature. We supplement this evidence with reports and other documents (e.g., environmental assessments, environmental impact statements, and monitoring reports, etc.) prepared by other federal and state agencies 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, among others. 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 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 statistical Type II error in our decisions).

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.” The proposed research would take place from Delaware Bay to Cape Canaveral, Florida out to 120 nautical miles offshore. The majority of the research effort is concentrated in the following areas:

1. From northern North Carolina to Delaware Bay;
2. From northern Virginia to the North Carolina-South Carolina border (see **Figure 1** above) including additional surveys conducted at the potential military use site off Cape Hatteras (see **Figure 2** above); and,

3. At the proposed undersea warfare training range (USWTR) site off Jacksonville, Florida (see **Figure 3** above).

Therefore, the Action Area for this consultation includes nearshore and offshore waters out to 120 nautical miles from Delaware Bay to Cape Canaveral, Florida.

STATUS OF THE SPECIES

The ESA Interagency Cooperation Division has determined that the following ESA-listed and proposed species and designated critical habitat occur within the action area and may be affected by the research activities to be authorized in the proposed permit:

<u>LISTED RESOURCE</u>	<u>SCIENTIFIC NAME</u>	<u>LISTING</u>
Cetaceans		
Blue Whale	<i>Balaenoptera musculus</i>	Endangered
Fin Whale	<i>Balaenoptera physalus</i>	Endangered
Humpback Whale	<i>Megaptera novaeangliae</i>	Endangered
Sei Whale	<i>Balaenoptera borealis</i>	Endangered
Sperm Whale	<i>Physeter macrocephalus</i>	Endangered
North Atlantic Right Whale	<i>Eubalaena glacialis</i>	Endangered
Sea Turtles		
Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Endangered
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	Endangered
Kemp's Ridley Sea Turtle	<i>Lepidochelys kempii</i>	Endangered
Green Sea Turtle	<i>Chelonia mydas</i>	
-Florida and Mexico's Pacific Coast Breeding Colonies		Endangered ⁷
-All other areas		Threatened
Loggerhead Sea Turtle	<i>Caretta caretta</i>	
-Northwest Atlantic Ocean DPS		Threatened
Marine and Anadromous Fish		
Atlantic Sturgeon	<i>Acipenser oxyrinchus oxyrinchus</i>	
-Chesapeake Bay DPS		Endangered
-Carolina DPS		Endangered
-South Atlantic DPS		Endangered
Shortnose Sturgeon	<i>Acipenser brevirostrum</i>	Endangered
Smalltooth Sawfish U.S. DPS	<i>Pristis pectinata</i>	Endangered

⁷ Green sea turtles in U.S. waters are listed as threatened except for the Florida and Mexico Pacific coast breeding colonies, which are 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.

Critical Habitat

North Atlantic Right Whale Critical Habitat

Designated

Listed Resources Not Likely to be Adversely Affected

Blue Whale

The Action Area coincides with the range of endangered blue whales. However, blue whales are expected to occur in deeper water further offshore than the proposed survey areas. At best, blue whales are considered occasional visitors in waters off the U.S. Atlantic coast (Waring et al., 2011) with a few individuals detected and acoustically tracked in deep water east of the U.S. Atlantic EEZ (i.e., further than 200 nautical miles from shore) (Clark, 1995 *as cited in* Waring et al., 2011) which is outside of the Action Area considered in this consultation (i.e., out to 120 nautical miles from shore). We anticipate it highly unlikely that blue whales would be exposed to the aerial and vessel surveys, as proposed. Therefore, issuance of permit No. 16473 is not likely to adversely affect listed blue whales and this species will not be considered further in this Opinion.

Sea Turtles

The Action Area coincides with the ranges of listed hawksbill sea turtles, leatherback sea turtles, Kemp's ridley sea turtles, green sea turtles (including the endangered Florida breeding colony as well as individuals in other areas listed as threatened), and the Northwest Atlantic Ocean DPS of loggerhead sea turtles. Researchers are not proposing to target listed sea turtles and will not break transect during aerial or vessel surveys to approach sea turtles. We consider it highly unlikely that listed sea turtles would be exposed to ship strikes given the anticipated speeds of the vessels as well as the fact that trained observers will be onboard to assist in avoiding any species located in the path of the vessel. We do not expect exposure to aerial and vessel surveys would illicit any reactions that would rise to the level of take given the fact that researchers are not proposing to break transect to approach listed sea turtles and the threats posed by possible vessel strikes are discountable. Therefore, issuance of permit No. 16473 is not likely to adversely affect any listed sea turtles and these species will not be considered further in this Opinion.

Marine and Anadromous Fish

The Action Area coincides with the ranges of three listed DPSs of Atlantic sturgeon (i.e., Chesapeake Bay, Carolina, and South Atlantic DPSs), shortnose sturgeon, and the U.S. DPS of smalltooth sawfish. Researchers are expected to focus a majority of their research offshore and will not be conducting research activities in nearshore coastal and estuarine habitats where a higher density of marine and anadromous fish species occur. Even when in the marine stages of their life histories, we consider it highly unlikely that listed marine and anadromous fish species would be exposed to ship strikes and any threats posed by this stressor are considered discountable. Therefore, issuance of permit No. 16473 is not likely to adversely affect any listed marine and anadromous fish species and these species will not be considered further in this Opinion.

North Atlantic Right Whale Designated Critical Habitat

Portions of critical habitat designated for the North Atlantic right whale occurs in the Action Area off the coast of Jacksonville west of the survey site proposed for that region. This portion of critical habitat encompasses nursery habitat used by North Atlantic right whales during their annual migration. The physical, chemical, and biotic features that form right whale critical habitat in the southeastern U.S. include water depth, water temperatures, and distance from shore for calving and nursery areas (59 FR 28793). Researchers are not proposing to conduct aerial and vessel surveys within the critical habitat but do plan to transit to and from the survey site over and through the critical habitat maintaining slow speeds (10 knots). Any opportunistic photographs during transit are not expected to illicit any reactions that would rise to the level of a take since researchers will not actively approach any whales and the threat of a ship strike is considered discountable due to the slow speeds during transit and the fact that trained observers would assist in avoiding any whales located in the path of the vessel. Transit to and from the survey site is not expected to cause North Atlantic right whales to abandon critical habitat areas and would not affect water depth, water temperature, and distance from shore for calving and nursery areas. Therefore, issuance of permit No. 16473 is not expected to affect critical habitat designated for North Atlantic right whales and this resource will not be discussed 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.

North Atlantic Right Whale

Species Description, Distribution, and Population Structure

The North Atlantic right whale 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). Right whales congregate in six major habitats in the western North Atlantic region: 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) noted some year-to-year variation in space and time for right whale distribution in the western North Atlantic which is likely resulting from patchy prey distribution.

North Atlantic right whales exhibit annual migrations 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., 2011). 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 at the time of this consultation.

North Atlantic right whales consist of one single population as no subpopulations have been identified thus far (Waring et al., 2011). Despite some rare sightings of right whales in the eastern North Atlantic in the past, the 1998 International Whaling Commission's (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). The calving interval for North Atlantic right whales is between 2 and 7 years (Knowlton et al., 1994; Best et al., 2001; Burnell, 2001; Cooke et al., 2001). 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., 2001) which may reflect lowered recruitment and/or high juvenile mortality.

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). Although North Atlantic right whales historically separated from their calves within one year, a shift appears to have taken place around 2001 where mothers (particularly less experienced mothers) return to wintering grounds with their yearling at a much greater frequency although the significance of this change is unknown (Hamilton and Cooper, 2010).

Diving Behavior, Hearing, and Vocalization

Although North Atlantic right whales are known to be primarily surface feeders, foraging dives frequently extend to the deepest layers of the water column (i.e., over 1,000 feet down) (Mate et al., 1992; Goodyear, 1993; Mate et al. 1997; Baumgartner et al., 2003). Feeding dives are characterized by a rapid descent from the surface to between 260 and 575 feet, where dives level off and individuals remain for 5 to 14 minutes before rapidly ascending back to the surface (Baumgartner and Mate, 2003). Dive depth has been shown to be strongly correlated with the depth of peak copepod abundance although cow-calf pairs are known to spend more prolonged periods at the surface compared to other foraging individuals (Baumgartner and Mate, 2003). Shallow foraging dives in the Great South Channel have averaged two minutes in duration (Winn

et al., 1995) while dives along the outer shelf have averaged seven minutes in duration (CETAP, 1982).

Evidence indicates that the North Atlantic right whales, like other baleen whales, are able to hear at least low frequency sounds (less than 1 kilohertz) 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. (2007a) reported the hearing range of North Atlantic right whales to be from 10 Hz to 22 kilohertz 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 this listing remained following the ESA's 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, NMFS published two proposed rules (71 FR 77704 and 71 FR 77694) 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 the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the MMPA and is listed as endangered on the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species.

Critical habitat is designated for North Atlantic right whales on June 3, 1994 under the original Northern right whale listing in the Great South Channel⁸, Cape Cod Bay⁹, and off the states of Georgia and Florida¹⁰ (59 FR 28793). The critical habitat designation encompasses three primary feeding and nursery habitats in the United States used by right whales during their annual migration. NMFS received a petition to revise critical habitat by expanding the areas designated as critical feeding and calving habitat areas for the species. Additionally, the petition seeks to include a migratory corridor as part of the critical habitat designation. On October 6, 2010, NMFS published a 90-day finding that the petition presented substantial scientific information indicating that the requested revision may be warranted (75 FR 61690). At the time of this consultation, NMFS has not formally proposed to revise the critical habitat so the current listing remains in effect.

Abundance and Trends

Historically, North Atlantic right whales were greatly affected by commercial whaling pressure. An estimate of pre-exploitation population size of North Atlantic right whales is not available;

8 Right whale critical habitat in the Great South Channel is bounded by 41° 40' N and 69° 45' W; 41° 0' N and 69° 5' W; 41° 38' N and 68° 13' W; and 42° 10' N and 68° 31' W.

9 Right whale critical habitat in Cape Cod Bay is bounded by 42° 04.8' N and 70° 10.0' W; 42° 12' N and 70° 15' W; 42° 12' N and 70° 30' W; 41° 46.8' N and 70° 30' W; and on the south and east by the interior shoreline of Cape Cod, Massachusetts.

10 Off the southeastern United States, right whale critical habitat is designated in waters between 31° 15' N and 30° 15' N (or approximately from the mouth of the Altamaha River in Georgia to Jacksonville, Florida) from the shoreline to 15nm offshore; as well as the waters between 30° 15' N and 28° 00' N (or Jacksonville south to Sebastian Inlet, Florida) from the shoreline out to 5nm.

however, Reeves and Mitchell (1987) and Reeves et al. (1992) concluded there were 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 the species (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 361 individuals for 2005 based on the most recent reviews of the photo-id recapture database (Waring et al., 2011). 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., 2001; Clapham, 2002). The most recent stock assessment for the species reported a mean growth rate of 2.1 percent for the period 1990-2005, giving evidence that annual growth in the population remains extremely low (Waring et al. 2011). 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.

From 1980 to 1992, the average calving interval for females was measured at 3.67 years (Knowlton et al., 1994) and this interval increased to 5 years during the 1990's (Kraus et al., 2001). This increase represented a significant trend suggesting lowered reproductive output for the population. There are several possible causes for the depressed reproductive rate including higher abortion or perinatal losses for pregnant females, among others (Browning et al., 2009). More recent analyses, however, found calving intervals were closer to three years for the population suggesting more positive reproductive output (Kraus et al., 2007), although the most recent stock assessment report indicate the population abundance (361 individuals) and growth rate (2.1 percent per year) remain very low for the population (Waring et al., 2011).

Current Threats

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 the North Atlantic right whale 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). More recently, a right whale female that had been calving regularly for the past ten years based on prior catalogued data was found dead off the coast of Virginia in early March of 2011, possibly from a ship strike (NMFS, 2011a). The fact that this female had successfully reproduced multiple times during her lifetime is particularly concerning given that she not only would have been expected to continue reproducing but may also have produced calves with similar reproductive potential. With such small numbers of North Atlantic right whales occurring in the North Atlantic, it is expected that ship strikes, especially to females, will continue to threaten survival and recovery of the species in the near future.

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 are large baleen whales known for their long pectoral fins (up to 15 feet 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 kilometers (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 wintering off Greenland, Norway, Newfoundland, the southern Gulf of Maine, Bermuda, and also in the eastern North Atlantic off the Cape Verde Islands (Katona and Beard, 1990). 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).

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, 1967; 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 Ocean, humpback whales occur in waters off Antarctica and migrate to the waters off Venezuela, Brazil, southern Africa, western and eastern Australia, New Zealand, and islands in the southwest Pacific during the austral winter (Perry et al., 1999). A separate population of humpback whales appears to reside in the Arabian Sea in the Indian Ocean off the coasts of Oman, Pakistan, and India (Mikhalev, 1997).

Data compiled by the IWC on breeding stocks suggests multiple groupings of humpback whales (Bannister, 2005); however, it is uncertain how such aggregations translate into individual biological populations. Nevertheless, NMFS recognizes three stocks of humpback whales in the North Pacific for management purposes under the MMPA: the western North Pacific, central North Pacific, and eastern North Pacific stocks. 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 the region (Palsbøll et al., 2001 *as cited in* Waring et al., 2011). In 2002, the IWC also acknowledged the evidence for treating the Gulf of Maine as a separate management unit (IWC, 2002 *as cited in* Waring et al., 2011). 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 ocean basins is also noted (Pomilla and Rosenbaum, 2005).

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; 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.

Humpback whales exhibit seasonal migrations from warmer temperate and tropical waters where they give birth to calves and cooler, temperate or sub-Arctic waters in the summer months where they feed (Gendron and Urban, 1993). Despite this known migration pattern, the seasonal distributions of this species have yet to be fully understood (Reeves et al., 2004).

In a review of the social behavior of humpback whales, Clapham (1996) reported that they can form small, unstable social groups during the breeding season while more stable aggregate groups form in areas with high prey densities. There is also evidence that humpbacks exhibit territoriality for both feeding (Clapham, 1996) and calving areas (Tyack, 1981). Humpbacks 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). Although largely solitary, humpback whales often cooperate during feeding activities (Elena et al., 2002).

Diving Behavior, Hearing, and Vocalization

Since a majority of humpback whale prey is found above 300 meters (or 984 feet), most dives are relatively shallow (approximately 60-170 meters) (Hamilton et al., 1997). Dives usually range between 2-5 minutes, but can last as long as 20 minutes in some cases (Dolphin, 1987).

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 kilohertz) 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 hertz to 10 kilohertz. 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 hertz, pulses in the frequency range of 25-89 hertz, and songs with components ranging from 30-8,000 hertz.

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. No critical habitat is currently designated for the species.

Abundance and Trends

It is difficult to assess the current status of humpback whales since there is no general agreement on the size of the humpback whale population prior to whaling. While current abundance estimates of the species' worldwide population varies, some robust estimates do exist for more

regional areas (i.e. western North Atlantic). 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, 1974a), 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 in the North Atlantic (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., 2011). 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 2012 population size for North Atlantic humpback whales would be around 20,700 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 (1978) 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 latitude 60°S (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.

Current Threats

At present, there are several stressors affecting humpback whales globally, although the significance of any effects emanating from these individual stressors remains uncertain. Historically, whaling represented the greatest threat to every population of humpback whales and

was ultimately responsible for listing humpback whales under the ESA. 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).

Entanglement in commercial fisheries also occurs in Hawaiian waters. In 1995, a humpback whale in Maui waters was found trailing numerous lines (not fishery-related) and entangled in mooring lines. The whale was successfully released, but subsequently stranded and was attacked and killed by tiger sharks in the surf zone. From 2001-2007, there were five observed interactions between humpback whales and gear associated with the Hawaii-based shallow-set and deep-set longline fisheries (Allen and Angliss, 2011), one of which was later determined to be a serious injury. According to NMFS observer characterizations of the event, the whale was entangled several times in the main longline and branchline around the body and flukes and was released by cutting the main lines on either side of the whale (NMFS, 2010a). NMFS issued an incidental take permit for the take of Central North Pacific humpback whales in Hawaii-based longline fisheries which was published on May 28, 2010 (75 FR 29984).

Organochlorines and polychlorinated biphenyls (PCBs) 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 (Metcalf et al., 2004). Bioaccumulation as a result of ingesting contaminated prey continues to affect the health of whale populations throughout the Atlantic and Pacific Ocean basins.

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 is currently conducting its scientific whaling program (i.e. JARPA II) with anticipated harvests of 50 humpback whales from two 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.

Fin Whale

Species Description, Distribution, and Population Structure

Fin whales 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 (Aglar 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 are less concentrated in nearshore environments while appearing to favor deeper waters. Although fin whales are certainly migratory, moving seasonally into and out of high latitude feeding areas, the overall migration pattern is confusing and likely complex (Christensen et al., 1992a).

NMFS currently recognizes three fin whale management stocks in U.S. Pacific waters: Alaska (Northeast Pacific), California/Oregon/Washington, and Hawaii (NMFS, 2010b). In the North Pacific Ocean, the IWC recognizes two "stocks" of fin whales for management purposes: (1) East China Sea and (2) rest of the North Pacific (Donovan, 1991). However, Mizroch et al. (1984a) concluded that there were at least five possible "stocks" of fin whales within the North Pacific based on histological analyses and tagging experiments: (1) East and West Pacific that intermingle around the Aleutian Islands; (2) East China Sea; (3) British Columbia; (4) Southern-Central California to Gulf of Alaska; and (5) Gulf of California. Fin whales have been observed feeding in Hawaiian waters during mid-May (Balcomb, 1987; Shallenberger, 1981), and their sounds have been recorded there during the autumn and winter (Northrop et al., 1968; Thompson and Friedl, 1982; Shallenberger, 1981). Fin whales have also been observed year-round off central and southern California, with peak numbers in summer and fall (Dohl et al., 1983; Barlow, 1995; Forney et al., 1995), in summer off Oregon (Green et al., 1992), and in summer and fall in the Gulf of Alaska (including Shelikof Strait), and the southeastern Bering Sea (Leatherwood et al., 1986; Brueggeman et al., 1990). Their regular summer occurrence has also been noted in recent years around the Pribilof Islands in the northern Bering Sea (Baretta and Hunt, 1994).

Based on other genetic analyses, Bérubé et al. (1998) concluded that fin whales in the Sea of Cortez represent an isolated population that has very little genetic exchange with other populations in the North Pacific Ocean (although the geographic distribution of this population and other populations can overlap seasonally). They also concluded that fin whales in the Gulf of St. Lawrence and Gulf of Maine are distinct from fin whales found off Spain and in the Mediterranean Sea. Regardless of how different authors structure the fin whale population, mark-recapture studies have demonstrated that individual fin whales migrate between management units (Mitchell, 1974a; Gunnlaugsson and Sigurjónsson, 1990), which suggests that these management units are not geographically isolated populations.

In the North Atlantic Ocean, fin whales occur in summer foraging areas from the coast of North America to the Arctic, around Greenland, Iceland, northern Norway, Jan Meyers, Spitzbergen, and the Barents Sea. In the western Atlantic, they winter from the edge of sea ice south to the Gulf of Mexico and the West Indies. In the eastern Atlantic, they winter off southern Norway, the Bay of Biscay, and Spain with some whales migrating into the Mediterranean Sea (Gambell, 1985a).

In the Southern Hemisphere, fin whales are distributed broadly south of latitude 50° S in the summer while in the winter the whales migrate into the Atlantic, Indian, and Pacific Oceans along the coast of South America (as far north as Peru and Brazil), Africa, and the islands in Oceania north of Australia and New Zealand (Gambell, 1985a).

Life History Information

Most reproductive activity for fin whales, including mating and births, takes place in the winter season (Haug, 1981; Mitchell, 1974b), although some out-of-season births are known to occur off the eastern United States (Hain et al., 1992). The gestation period is probably somewhat less than a year, and calves are nursed for approximately six to seven months (Haug, 1981; Gambell, 1985a). Fin whales become sexually mature at 5-15 years of age (Gambell, 1985a; COSEWIC, 2005) have a calving interval of 2-3 years (Agler et al., 1993), and have a life expectancy of 70-80 years (Kjeld et al., 2006).

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). The movements and distribution of fin whales are thought to be based on prey availability. The availability of sand lance, in particular, is thought to have had a strong influence on the distribution and movements of fin whales along the east coast of the United States (Kenney and Winn, 1986; Payne et al., 1990; Hain et al., 1992).

Fin whales occur year-round in a wide range of latitudes and longitudes, but the density of individuals in any one area changes seasonally. 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 other species (Perry et al., 1999). They are known to occur in high densities in the northern Gulf of Alaska and southeastern Bering Sea from May to October, with some movement through the Aleutian passes into and out of the Bering Sea (Reeves et al., 1985; NMFS, 2010b). Although some fin whales apparently are present in the Gulf of California year-round, there is a marked increase in their numbers in the winter and spring (Tershy et al., 1990) which is thought to be related to the high seasonal abundance of krill (Tershy, 1992).

Diving Behavior, Hearing, and Vocalization

The percentage of time fin whales spend at the surface varies. Gambell (1985a) reported fin whales making 5-20 shallow dives each lasting 13-20 seconds followed by a deep dive lasting from 1.5-15 minutes (Gambell, 1985a). Other authors have reported common dives lasting from 2-6 minutes, with 2-8 blows occurring between dives (Watkins, 1981a; Hain et al., 1992).

Fin whales can be found singly or in pairs, but can also form larger groupings of more than three individuals, particularly while feeding. Balcomb (1987) noted that fin whales commonly travel in herds ranging from six to more than 100 individuals. They have also been reported grouped with other balaenopterid whale species at times (e.g. blue whales) while feeding (Corkeron et al., 1999; Shirihai, 2002).

Fin whales produce a variety of low-frequency sounds in the 10-200 hertz band range (Watkins, 1981a; Watkins et al., 1987; Edds, 1988; Thompson et al., 1992). The most typical signals are long, patterned sequences of short duration (0.5-2 second) infrasonic pulses in the 18-35 herz range (Patterson and Hamilton, 1964). Estimated source levels are as high as 190 decibels (dB) in some cases (Patterson and Hamilton, 1964; Watkins et al., 1987; Thompson et al., 1992; McDonald et al., 1995). In temperate waters, intense bouts of long patterned sounds are very

common from fall through spring, but also occur to a lesser extent during the summer in high latitude feeding areas (Clark and Charif, 1998).

Listing Status

Fin whales were originally listed as endangered 1970, and this status remained following the inception of the ESA in 1973. They are also listed as endangered on the IUCN Red List of Threatened Species and are also protected by CITES and the MMPA. Critical habitat has not been designated for the species.

Abundance 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 (Cherfas, 1989 *as cited in* Perry et al., 1999). Braham (1991) compiled available regional 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 3,985 individuals (CV=0.24) (Waring et al., 2011).

In the North Pacific, there may have been as many as 42,000-45,000 fin whales prior to commercial exploitation; however, it is estimated that this population was 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 while more recent survey data estimated the fin whale population west of the Kenai Peninsula to be 5700 individuals (Moore et al., 2002; Zerbini et al., 2006, *both as cited in* Allen and Angliss, 2011). 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 surveys conducted in 2005 and 2008 in the same region estimated the fin whale population at 3,044 individuals (CV=0.18) (Carretta et al., 2011). A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 174 individuals (CV=0.72) which currently represents the best available abundance estimate for the Hawaiian stock (Barlow, 2003). 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 is estimated this population may have been 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).

Current Threats

The main stressors affecting the ability of the species to recover include ongoing effects from prior commercial whaling, interaction with fishing gear, ship strikes, and various sources of habitat degradation. Historically, whaling represented the greatest threat to every population of fin whales and was ultimately responsible for listing fin whales as an endangered species. From 1904 to 1975, the IWC estimates that 703,693 fin whales were captured and killed in Antarctic whaling operations alone (IWC, 1990). Whaling in the Southern Ocean originally targeted humpback whales, but by 1913, those whales had become so rare that whalers shifted their focus to other species including fin and blue whales (Mizroch et al., 1984a). From 1911 to 1924, it was estimated that whalers harvested between 2,000–5,000 fin whales each year. After the introduction of factory whaling ships in 1925, the number of whales killed each year increased substantially which had a major impact on global fin whale populations prior to the ban on international commercial whaling.

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. 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 three whales dying of their wounds and an additional three whales 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 and PCBs 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 species 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 are insufficient data to know the effects that current climate-related trends are having on fin whale populations.

Sei Whale

Species Description, Distribution, and Population Structure

Sei whales have a long, sleek body that is dark bluish-gray to black in color and pale underneath and have baleen plates that are dark in color with gray/white fine inner fringes in their enormous mouths. The distribution of the sei whale population is not well known, but this whale is found in all oceans and appears to prefer mid-latitude temperate waters often associated with deeper waters and areas along continental shelf edges (Hain et al., 1985). However, this general offshore pattern is disrupted during occasional incursions into shallower inshore waters (Waring et al., 2011). The difficulty of distinguishing sei whales at sea from their close relatives (e.g., fin whales) has created confusion about distributional limits and frequency of occurrence (NMFS, 2011b).

During summer in the North Pacific, the sei whale can be found from the Bering Sea to the northern Gulf of Alaska and south to southern California, and in the western Pacific from Japan to Korea (Leatherwood et al., 1982; Nasu, 1974). Its winter distribution is concentrated at about latitude 20° N, and sightings have been made between southern Baja California and the Islas Revilla Gigedo (Rice, 1998) with some sightings occurring in the waters off Hawaii as well (Smultea et al., 2010). Masaki (1977) reported sei whales concentrating in the northern and western Bering Sea from July-September, although many researchers question those findings and many believe the sei whale occurs mainly south of the Aleutian Islands (Leatherwood et al., 1982; Nasu, 1974).

In the western North Atlantic, a major portion of the sei whale population occurs in northern waters, believed to include the Scotian Shelf, along Labrador and Nova Scotia, the Gulf of Maine, and the Georges Bank region (Mitchell and Chapman, 1977; Waring et al., 2011). These whales summer in northern areas before migrating south to Florida, in the Gulf of Mexico, and the northern Caribbean Sea (Gambell, 1985b; Mead, 1977). In the U.S. EEZ, the greatest abundance of sei whales occurs during spring, with most sightings occurring on the eastern edge of Georges Bank, in the Northeast Channel, and in Hydrographer Canyon (CETAP, 1982). During years of greater prey abundance (e.g., copepods), sei whales are found in more inshore waters (Payne et al., 1990; Schilling et al., 1992). In the eastern Atlantic, sei whales occur in the Norwegian Sea, occasionally occurring as far north as Spitsbergen Island, and migrate south to Spain, Portugal, and northwest Africa (Gambell, 1985b; Jonsgård and Darling, 1977).

The population structure of sei whales is generally unknown although NMFS currently recognizes four distinct stocks for management purposes: (1) Hawaiian Stock, (2) Eastern North Pacific Stock, (3) Nova Scotia Stock, and a (4) Western North Atlantic Stock. Wada and Numachi (1991) concluded that a single sei whale population existed in the North Pacific based on genetic studies while Masaki's (1977) evaluation of tag recoveries, catch distributions, sightings, and baleen morphology led him to propose three North Pacific stocks, divided by longitudes 175° W and 155° W. The fact that sei whales seem to occur in two main centers of abundance off eastern Canada was used as the primary basis for recognizing two stocks in the northwestern Atlantic, one from the southeastern coast of Newfoundland northward (Labrador Sea stock) and the other south from Newfoundland (Nova Scotia stock) (Mitchell and Chapman, 1977). There is little information on the population structure of sei whales in Antarctic waters,

although some degree of separation among IWC Areas I–VI in the Southern Ocean has been noted (Donovan, 1991).

Life History Information

Best and Lockyer (2002) calculated an average age of sexual maturity for sei whales at 8.2 years and 8.6 years for Southern Hemisphere females and males, respectively. Reproductive activities generally occur during the winter months with calving thought to occur from September to March each year (Rice, 1977). The gestation period is approximately 12-13 months, calves are weaned at 6-9 months, and the calving interval is 2-3 years (Gambell, 1985b; Rice, 1977).

Sei whales are highly mobile, and there is no indication that any population remains in a particular area year-round, but studies are lacking to make definitive conclusions regarding possible residency. Poleward summer feeding migrations occur, and sei whales generally winter in warm temperate or subtropical waters (Horwood, 1987; Jefferson et al., 2008). Pregnant females are believed to lead the migration to and from northern feeding grounds (Mizroch et al., 1984b), and the migration along the Canadian coast is believed to occur in stages based both on gender and age (Gregr et al., 2000).

Sei whales are primarily planktivorous, feeding mainly on euphausiids and copepods, although they are also known to consume fish (Waring et al., 2006). In the Northern Hemisphere, sei whales consume small schooling fish such as anchovies, sardines, and mackerel when locally abundant (Mizroch et al., 1984b; Rice, 1977). Sei whales in the North Pacific feed on euphausiids and copepods, which make up about 95 percent of their diets (Calkins, 1986). The dominant food for sei whales off California during June-August is northern anchovy before switching to krill from September-October (Rice, 1977). In the Southern Ocean, analysis of stomach contents indicates sei whales consume *Calanus spp.* and small-sized euphausiids with prey composition showing latitudinal trends (Kawamura, 1974). Sei whales in the Southern Hemisphere may reduce direct interspecific competition with blue and fin whales by consuming a wider variety of prey and by arriving later to feeding grounds (Kirkwood, 1992). Rice (1977) suggested that the diverse diet of sei whales may allow them greater opportunity to take advantage of variable prey resources, but may also increase their potential for competition with commercial fisheries.

Diving Behavior, Hearing, and Vocalization

Sei whales, unlike fin whales, tend not to roll high out of the water as they dive (NMFS, 2011b). The blowholes and dorsal fin are often exposed above the water surface simultaneously and they rarely breach or raise their flukes out of the water (Jefferson et al., 2008). The species appears to lack a well-defined social structure and individuals are usually found alone or in small groups of up to six whales (Perry et al., 1999). However, larger groupings have been observed when on feeding grounds (Gambell, 1985b).

Data on sei whale vocal behavior is limited, but includes records off the Antarctic Peninsula of broadband sounds in the 100-600 hertz range with 1.5 second duration and tonal and upsweep calls in the 200-600 hertz range of 1-3 second durations (McDonald et al., 2005). It is reasonable to assume that sei whale hearing includes, and likely extends beyond, the frequencies described

for these vocalizations (NMFS, 2011b). Rankin and Barlow, (2007) suggest that differences in vocalizations may exist between ocean basins.

Listing Status

The sei whale was originally listed as endangered in 1970 (35 FR 18319), and this status remained following inception of the ESA in 1973. Sei whales are listed as endangered on the IUCN's Red List of Threatened Species are also protected by CITES and the MMPA. No critical habitat is currently designated for the species.

Abundance and Trends

While there are insufficient data to determine population trends for the species (Waring et al., 2011), application of various models to whaling catch and effort data suggests that the total population of adult sei whales in the North Pacific declined from about 42,000 to 8,600 individuals between 1963 and 1974 (Tillman, 1977). This was consistent with the dropoff in catch per unit effort for sei whales in California shore whaling during the same period (Rice, 1977). There have been no direct estimates of sei whale populations for the eastern Pacific Ocean (or the entire Pacific for that matter). The minimum estimate of individuals along the U.S. west coast between 1996-2001 was estimated at a mere 35 individuals (Carretta et al., 2006).

In 1974, the North Atlantic stock was estimated to number about 2,078 individuals, including 965 whales in the Labrador Sea group and 870 whales in the Nova Scotia group (Mitchell and Chapman, 1977). Sei whale sighting information from surveys conducted in summer 2004 in waters north of Maryland (38° N) yielded an abundance estimate of 386 individuals (CV=0.85) (Palka, 2006) while an abundance estimate of 207 (CV=0.62) was obtained from an aerial survey conducted in August 2006 which covered 10,676 kilometers of trackline in the region on the southern edge of Georges Bank to the upper Bay of Fundy and the entrance of the Gulf of St. Lawrence (Waring et al., 2009). In another location, MacLeod et al. (2005) reported that an estimated 1,011 (CI: 497-2058) sei whales occur in waters off Scotland, based on vessel-based surveys in that region.

Mizroch et al. (1984b) and Braham (1991) provided pre-exploitation estimates of 63,100 and 65,000 sei whale individuals, respectively, in the Southern Hemisphere prior to whaling. In the Southern Hemisphere, more recent population estimates range between 9,800 and 12,000 individuals (Perry et al., 1999). The IWC reported an estimate of 9,718 sei whales based on results of surveys performed between 1978 and 1988 in the region (IWC, 1996).

Current Threats

Just as with other listed baleen whales, there are several stressors affecting sei whales globally such as effects from prior commercial whaling, current whaling under subsistence or special permit programs, and the threat of ship strike from increasing maritime vessel traffic. Historically, whaling represented the greatest threat to every population of sei whales and was ultimately responsible for listing sei whales as an endangered species. Sei whales in the North Pacific declined from about 42,000 individuals to 8,600 individuals between 1963 and 1974 (Tillman, 1977). While the IWC moratorium on commercial whaling significantly reduced

whaling pressure, sei whale populations have yet to recover to pre-exploitation levels suggesting they continue to feel the effects of historical whaling.

Sei whales also face the threat of ship strikes in many regions throughout its range. In a database of nearly 300 vessel strike records worldwide between 1975 and 2002, Jensen and Silber (2004) reported two sei whale vessel strikes in the North Atlantic (one each off Massachusetts and Maryland) and one record of a whale struck in 1994 in Hauraki Gulf, New Zealand. A total of three sei whale deaths were attributed to collisions with vessels between 2003 and 2008 in the waters off of the U.S. eastern seaboard (one each off Maine, Maryland, and Virginia) (Nelson et al. 2007; Waring et al. 2009; Glass et al., 2010).

Sei whales are also known to accumulate organochlorines and PCBs in their tissues (Borrell, 1993; Borrell and Aguilar, 1987; Henry and Best, 1983). Males carry larger burdens than females, as gestation and lactation transfer these toxins from mother to offspring. The highest concentrations of organochlorines found in cetaceans, including sei whales, are in the Mediterranean Sea. High concentrations of organochlorines in cetaceans also occur, although to a lesser extent, along the Pacific coast of the U.S. and generally in other mid-latitudes in the Northern Hemisphere (Aguilar et al., 2002).

Subsistence whaling in Greenland targeted at fin whales, occasionally result in the killing of sei whales (Kapel, 1985). In recent years sei whales were a target species for Japanese North Pacific whalers as exempted under a special permit. Between 2001 and 2003, 91 individuals were believed to be taken while 100 sei whales were believed to be taken each year between 2004 and 2008 based on the special conditions of the permit (IWC, 2010 *as cited in* NMFS, 2011b). Other current threats affecting sei whale recovery include effects of ocean noise as well as the potential for climate variability to affect prey resources similar to fin and humpback whales.

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, 2010c). 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 have a strong preference for deep water and are rarely found in waters less than 1,000 meters (3,281 feet) deep (Watkins, 1977; Reeves and Whitehead, 1997). While deeper water is their preferred habitat, sperm whales have also been observed near Long Island, New York, in water between 41-55 meters deep (135-180 feet) (Scott and Sadove, 1997). When they are found relatively close to shore, sperm whales are usually associated with sharp increases in bottom depth where upwelling occurs and biological production is high, implying the presence of generous prey resources (Clarke, 1956).

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., 1994, 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, 2010c). 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

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). Female and immature animals stay in Atlantic temperate or tropical waters year round. In the western North Atlantic, groups of female and immature sperm whales concentrate in the Caribbean Sea (Gosho et al., 1984) and south of New England in continental-slope and deep-ocean waters along the eastern United States (Blaylock et al., 1995). In eastern Atlantic waters, groups of female and immature sperm whales aggregate in waters off the Azores, Madeira, Canary, and Cape Verde Islands (Tomilin, 1967). 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 Arnborn, 1987).

Sperm whales appear to feed regularly throughout the year (NMFS, 2010c), 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).

Diving Behavior, Hearing, and Vocalization

Sperm whales are well known for their prolific diving behavior with some whales diving as deep as 3 kilometers down at durations exceeding 2 hours (Clarke, 1976; Watkins et al., 1985). Most dives, however, are generally shorter (25-45 minutes) and shallower (400-1,000 meters) 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.

Sperm whales produce loud broad-band clicks from about 0.1 to 20 kilohertz (Weilgart and Whitehead, 1993; Weilgart and Whitehead, 1997; Goold and Jones, 1995). Long series of monotonous regularly spaced clicks are associated with feeding and are thought to be produced for echolocation. Distinctive, short, patterned series of clicks, called codas, are associated with social behavior and intragroup interactions and are thought to facilitate intra-specific communication to maintain social cohesion within the group (Weilgart and Whitehead, 1993).

The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate (Carder and Ridgway, 1990). These data suggest that neonatal sperm whales respond to sounds from 2.5-60 kilohertz. 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).

Listing Status

Sperm whales were listed as endangered under the ESA in 1973. Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead, 1997). The species is also protected through CITES and the MMPA and is currently listed as vulnerable on the IUCN's Red List of Threatened Species. Critical habitat has not been designated for the species.

Abundance 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 (2002) 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 (2002) probably represent the most current and best available estimates of global sperm whale abundance at the time of this consultation.

Based on historic whaling data, the population of sperm whales in the entire North Atlantic is 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 (Mullin, 2007 *as cited in* Waring et al., 2011). 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 (2002) 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* Carretta et al. 2011), 6,919 individuals in Hawaiian waters (Barlow, 2006 *as cited in* Carretta et al., 2011), and 971 individuals for the California/Oregon/Washington stock (Forney, 2007; Barlow, 2010 *both as cited in* Carretta et al., 2011). 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, 2010c). Perry et al. (1999) estimated that 20,000 individuals were harvested in the Southern Hemisphere from 1956-1976. Whitehead (2002) 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, 2010c).

Current Threats

Just as with other listed whales, there are several stressors affecting sperm whales globally such as effects from prior commercial whaling, current whaling as allowed under subsistence or special permit programs, threats from ship strikes from increasing maritime vessel traffic, entanglement in commercial fishing gear, and threats posed by climate change and/or variability on essential prey.

Historically, whaling represented the greatest threat to every population of sperm whales and was ultimately responsible for listing sperm whales as an endangered species. 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. Caretta et al. (2005) estimated that at least 436,000 sperm whales were killed by whalers between 1800 and 1987. Hill and DeMaster (1999) estimated that 258,000 sperm whales were harvested in the North Pacific alone between 1947 and 1987 while Perry et al. (1999) estimated that 20,000 sperm whales were harvested in the Southern Hemisphere each year from 1956-1976. Sperm whale populations were also impacted by illegal and unreported whaling before and after the IWC moratorium went into effect by both Soviet (Yablokov et al., 1998; Yablokov and Zemsky, 2000) and Japanese fleets (Reeves and Whitehead, 1997). Sperm whale populations continue to feel the effects of past commercial and illegal whaling activities as they have yet to recover to their pre-exploitation abundance.

Bycatch in commercial fisheries represents an ongoing threat to sperm whale populations in U.S. waters. Sperm whales are known to have been incidentally captured in northeastern Pacific drift gillnet operations, which killed or seriously injured an average of nine sperm whales per year from 1991-1995 (Barlow et al., 1997). Interactions between longline fisheries and sperm whales in the Gulf of Alaska have also been reported in the past few decades (Rice, 1989; Hill and DeMaster, 1999) and observers aboard Alaskan sablefish and halibut longline vessels have documented sperm whales feeding on fish caught in longline gear. During 1997, the first entanglement of a sperm whale in Alaska's longline fishery was recorded, although the animal was not seriously injured (Hill and DeMaster, 1998). In U.S. east-coast waters, bycatch of sperm whales has been documented in the pelagic drift gillnet fishery, which targeted primarily swordfish and tuna (Waring et al., 1997). In Gulf of Mexico waters in 2008, there was one sperm whale released alive after an entanglement interaction with the pelagic longline fishery operating in the region (Garrison et al., 2009). It is possible that sperm whale interactions with fisheries are greatly underestimated throughout its range due to the fact that not all whales killed by entanglement wash ashore nor do they show evidence of the interaction. Nevertheless, bycatch in commercial fisheries represent a threat to the species throughout its range.

Sperm whales are also killed by ship strikes. In May 1994 a sperm whale that had been struck by a ship was observed south of Nova Scotia (Reeves and Whitehead, 1997) and in May 2000 a

merchant ship reported a strike in Block Canyon (NMFS, unpublished data), which is a major pathway for sperm whales entering southern New England continental shelf waters in pursuit of migrating squid (CETAP, 1982; Scott and Sadove, 1997).

Seismic vessel operations in the Gulf of Mexico represent an ongoing threat due to noise disturbance and vessel interactions (Waring et al., 2011). 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 population as well as those found throughout the eastern North Pacific and Alaskan waters where seismic survey activities have been increasing in recent years.

Sperm whales in Gulf of Mexico waters also continue to feel the effects of past and present oil spills occurring in the region. The Gulf of Mexico 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 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 other cetacean species occurring in the Gulf of Mexico would be similarly exposed as a result of the *Deepwater Horizon* oil spill event that occurred in 2010.

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). 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 levels similar to those found in human lung tissue afflicted with chromium-induced cancer (Wise et al., 2009).

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 species within the action area. While some stressors uniquely occur within the action area and are thus easily identified for their respective impacts, there are other stressors where the impacts are felt only in part within the action area at an unspecified magnitude (e.g. disease, effects from prior commercial exploitation, etc.). In those situations, we will discuss impacts generally and make the assumption that listed species are exposed to these ongoing effects in the action area at an unspecified degree.

Natural Sources of Stress and Mortality

Natural stressors acting on listed species in the action area include predation, diseases and parasitic infections, and other stochastic phenomena. Killer whales and/or large sharks are known to occasionally prey on very young or sick fin, sei, and humpback whales (Perry et al., 1999; Ford and Reeves, 2008; Steiger et al., 2008). 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 may be impeded by competition with other whales (most notably sei whales) for copepod food resources in the western North Atlantic (Rice, 1974; Mitchell, 1975a; Scarff, 1986).

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 throughout their ranges (Lambertsen, 1992). Endoparasitic helminths (worms) are commonly found in sei whales and can result in pathogenic effects when infestations occur in the liver and kidneys (Rice, 1977) while calcivirus and papillomavirus are known pathogens of sperm whales (Smith and Latham, 1978; Lambertsen et al., 1987). Biotoxins from red-tide blooms are other potential causes of mortality of listed baleen whales in the action area (Perry et al., 1999). 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, North Atlantic right whales are expected to have a lower resilience to disease-related stressors that could affect this species' ability to recover. Highly migratory species such as large whales affected by the proposed action can carry pathogens across large distances (Perry et al., 1999) thus potentially introducing new diseases in the action area originating in regions outside of the action area.

Oceanographic Features and Climate Variability

Oceanographic conditions in the Atlantic Ocean can be altered due to periodic weather patterns such as El Niño, La Niña, and the North Atlantic Oscillation (NAO) that can alter habitat conditions and prey distribution for listed cetaceans in the action area (Mantua et al., 1997; Francis et al., 1998; Beamish et al., 1999; Hare et al., 1999; Benson and Trites, 2002; Stabeno et al., 2004; Mundy and Cooney, 2005; Mundy and Olsson, 2005). 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 NAO (Hurrell, 1995) can affect the position of the Gulf Stream (Taylor et al., 1998) and other circulation patterns in the North Atlantic that act as migratory and transport pathways for various prey species.

In addition to periodic weather patterns affecting oceanographic conditions in the action area, longer term trends in climate change and/or variability also have the potential to alter habitat conditions suitable for listed species in the action area on a much longer time scale. For example, from 1906-2006, global surface temperatures have risen 0.74° C and this trend is continuing at an accelerating pace. Twelve of the warmest years on record since 1850 have occurred since 1995 (Poloczanska et al., 2009). Possible effects of this trend in climate change and/or variability for listed whales in the action area 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, and altered timing of breeding (MacLeod et al., 2005; Robinson et al., 2005; Kintisch, 2006; Learmonth et al., 2006; McMahon and Hays, 2006). Climate change can influence reproductive success, as evidenced by data suggesting that sperm whale females have lower rates of conception following periods of unusually warm sea surface temperature (Whitehead, 1997). Increases in ocean temperature due to interannual, decadal, and longer time-scale variability in climate may also cause dramatic shifts in the reproductive rate of North Atlantic right whales (Drinkwater et al., 2003; Greene et al., 2003) and possibly a northward shift in the location of right whale calving areas (Kenney, 2007). 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).

Anthropogenic Sources of Stress and Mortality

Historical Whaling

As discussed in the *Status of the Species* section of this Opinion, large whale populations have been severely depleted in the action area as a result of historical whaling operations. Humpback whales were one of the predominant species targeted by commercial whalers in the western North Atlantic during the 19th and 20th centuries (Stevick et al., 2003) with American whalers alone harvesting 14,000-18,000 humpbacks during the period (Best, 1987 *as cited in* NMFS, 1991). North Atlantic right whales were also heavily depleted in the North Atlantic with their greatest rates of decline probably occurring during the 18th century (Reeves and Mitchell, 1987; Reeves et al., 1992). Subsequent hunting in the 19th and early 20th centuries, largely by Norwegian whaling operations, likely irreversibly damaged this stock (Collett, 1909; Brown, 1976). 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).

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.

Fishing Gear Entanglement

Entrapment in commercial fishing gear continues to impact listed cetaceans in the action area (especially North Atlantic right whales and humpback whales). NMFS records show that from 1990-2007, there were 46 confirmed North Atlantic right whale entanglements with fishing gear, including whales entangled in weirs, gillnets, and trailing line and buoys (Waring et al., 2009). During the period 2004-2008, there were 24 confirmed reports of North Atlantic right whales entangled in fishing gear off the Atlantic coast of the U.S. and Maritime Provinces of Canada, with three confirmed deaths and one whale sustaining serious injury as a result of the entanglement (Glass et al., 2010). The same report cited 81 humpback whale entanglements (five confirmed deaths and 11 sustaining serious injuries), 14 fin whale entanglements (three confirmed mortalities and three sustaining serious injuries), and three sei whale entanglements (one confirmed mortality and two sustaining serious injuries). In addition, Robbins and Mattila (2001) studied entanglement-related scarring on 134 individual humpback whales and concluded that between 48 and 65 percent of the surveyed individuals displayed physical evidence of prior entanglement and according to the most recent stock assessment reports, the annual rate of serious injury and mortality of fin and sei whales from fishery interactions is 1.2 and 0.6 individuals per year, respectively (Waring et al., 2011).

In addition to direct injury and/or mortality, entanglements also make listed species more vulnerable to additional dangers (e.g., predation and ship strikes) by restricting agility and swimming speed. Robbins and Mattila (2001) found that female humpbacks showing evidence of prior entanglements produced significantly fewer calves, suggesting entanglement may significantly reduce reproductive success. Also, many 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. This, in addition to a lack of observer coverage in the case of many fisheries operating in the action area, mean that many “takes” associated with commercial fisheries are likely being underreported for many of the listed species affected.

Ship Strikes

Collisions with commercial ships are an increasing threat to listed whales in the action area particularly as shipping volume increases across breeding areas, foraging habitat, and migratory routes. Jensen and Silber’s (2004) review of the NMFS’ ship strike database revealed fin whales as the most frequently confirmed victims of ship strikes (i.e., 26 percent of the recorded ship strikes) although humpbacks are also frequently struck. Most collisions occur off the U.S. east coast, followed by the west coast of the U.S. and Alaska/Hawaii. Glass et al. (2010) reported 17 North Atlantic right whales getting struck (including eight confirmed mortalities) 14 humpbacks

getting struck (including eight confirmed mortalities), 13 fin whales getting struck (including 10 confirmed mortalities), and three sei whales getting struck (including two confirmed mortalities) off the U.S. east coast and Canada during the period 2004-2008. While ship strike data is useful in determining the relative frequency that different whale species are struck, we also assume that many incidents go unreported or the affected whale doesn't strand ashore making it difficult to estimate the true population-level impact of ship strikes on listed whales found in the action area.

While ship strikes are an ongoing problem, NMFS has several programs in place in the western North Atlantic to help minimize the impact. 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 where North Atlantic 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 in the near future and may even increase as populations recover and individuals populate new areas thereby increasing their range of exposure to various vessel interactions (Swingle et al., 1993; Wiley et al., 1995).

Whale Watching

Private and commercial shipping vessels engaged in marine mammal watching also have the potential to impact whales in the action area. A 2001 study of whale watch activities worldwide found that the business of viewing whales and dolphins in their natural habitat has grown rapidly in the past couple decades (Hoyt, 2001). In 1988, a workshop sponsored by the Center for Marine Conservation and NMFS was held in Monterey, California to review and evaluate whale watching programs and management needs. That workshop produced several recommendations for addressing potential harassment of marine mammals during wildlife viewing activities that included developing regulations to restrict operating thrill craft near cetaceans, swimming and diving with the animals, and feeding cetaceans in the wild.

Several studies have specifically examined the effects of whale watching on marine mammals, and investigators have observed a variety of short-term responses from animals, ranging from no apparent response to changes in vocalizations, duration of time spent at the surface, swimming speed, swimming angle or direction, respiration rate, dive time, feeding behavior, and social behavior. Responses appear to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity (Watkins, 1986; Corkeron, 1995; Au and Green, 2000; Erbe, 2002; Magalhaes et al., 2002; Williams et al., 2002a; Williams et al., 2002b; Richter et al., 2003; Scheidat et al., 2004). Although numerous short-term behavioral responses to whale watching vessels are documented, little information is available on possible long-term effects to listed whales. One concern is that animals may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle et al., 1993; Wiley et al., 1995). Another concern is that preferred habitats may be abandoned if disturbance levels are too high. We expect that a portion of the individuals targeted in this proposed action may be exposed to whale watching activities up and down the east coast of the U.S.

Increased Ambient Background Noise from Shipping and Transportation

Increases in underwater sound generated from various man-made sources such as commercial shipping, recreational vessels, cruise ships, research vessels, helicopters, and airplanes have the potential to affect listed whales in the action area through decreased communication and habituation to sound sources. Marine mammals use sound in the ocean environment to find prey, locate mates, rear young, navigate, and to avoid predators (Bradley and Stern, 2008). Several investigators have argued that anthropogenic sources of noise have increased ambient noise levels in the ocean over the last 50 years (Richardson et al., 1995; NRC, 2003; Jasny et al., 2005; NRC, 2005) with surface shipping being the most widespread in terms of low frequency (0 to 1,000 hertz) anthropogenic noise. The Navy estimated that the 60,000 vessels of the world's merchant fleet annually emit low frequency sound into the world's oceans for the equivalent of 21.9 million days, assuming that 80 percent of the merchant ships are at sea at any one time (U.S. Navy, 2001).

Continual increases in background ambient noise levels in the action area from these various sources can cause 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 (Hatch et al., 2008; OSPAR, 2009). Changes in acoustic communication in call rates and frequencies has already been proposed in North Atlantic right whales (Parks et al., 2009; Parks et al., 2007b), blue whales (Di Iorio and Clark, 2009), and fin whales (Castelotte et al., *in press*) as a result of increasing background ambient noise levels in the marine environment. It is expected that listed cetaceans will continue to exhibit these types of behavioral responses in the action area in the near future.

Another concern of increased sound from vessels is the gradual habituation of listed whales to vessels and other sound sources. Habituation to this increasing ambient noise 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 nurse areas (Jurasz and Jurasz, 1979; Glockner-Ferrari and Ferrari, 1985; Salden, 1988; Glockner-Ferrari and Ferrari, 1990), while others have suggested humpback whales may become habituated to vessel traffic and its associated noise (e.g. Watkins, 1986). Croll et al. (2001) 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 over larger spatial and time scales.

Pulsed Sound Generated by Seismic Surveys, Military Activities, and In-Water Construction

High energy pulsed sound generated in the marine environment from seismic surveys, military sonar training and underwater detonations, and construction (e.g., pile driving and blasting) has 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 death to listed cetaceans depending on the proximity of the animal to the sound source (Richardson et al., 1995; NRC, 2003; Clark and Ellison, 2004; NRC, 2005; Nowacek et al., 2007; Southall et al., 2007; Wright et al., 2008).

Surveys have been conducted in the northwest Atlantic using seismic airguns. Airguns are typically fired every 10-15 seconds with theoretical source levels of about 255 decibel (dB) \pm 3 dB which are detectable 50-75 kilometers away in shallow water and over 100 kilometers away in survey areas deeper than 50 meters (Richardson et al., 1995). As a general mitigation measure, airguns are shutdown if marine mammals approach too closely (generally within the 180 dB isopleths for cetaceans), presumably avoiding the potential for temporary or permanent threshold shifts in cetaceans exposed to the airgun pulses. While onboard observers and passive acoustic monitoring help identify the presence of whales, the possibility exists that some non-vocalizing whales beneath the surface may be temporarily exposed to higher sound levels at an unspecified degree. In addition to possible physical trauma and stress, whales are known to respond behaviorally by actively avoiding the sound of the seismic survey vessel, thus causing some temporary habitat displacement upon exposure (Greene, 1982; Richardson et al., 1985; Wartzok et al., 1989; Richardson et al., 1990; Gallagher and Hall, 1993; Richardson et al., 1995; Schick and Urban, 2000; Richardson and Williams, 2003; Richardson et al., 2004; Richardson and Williams, 2004; Streever et al., 2008; George, 2010).

Naval activities occurring in the action area include, among others, vessel and aircraft transects, munition detonations, and sonar activities at various frequencies. Whales targeted by this proposed action may be exposed to activities conducted at the Virginia Capes Range Complex, Cherry Point Range Complex, and Jacksonville Range Complex. Effects to listed whales from these navy training exercises and other sonar activities conducted up and down the east coast within multiple operating areas are expected to be similar to seismic surveys (notably masking effects to whale communication and avoidance behavior leading to temporary habitat displacement). All exempted takes (if any) from naval activities are non-lethal based on a review of recent biological opinions (see NMFS, 2011c and NMFS, 2011d). The anti-warfare and sonar training exercises conducted by the Navy are expected to result in repeated exposures of targeted whales in the action area throughout the duration of the proposed permit as well as after this permit ceases although based on the cited biological opinions, it is expected that all takes are expected to be non-lethal. 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.

Other sound fields are generated by coastal construction, pile driving, dredging and blasting activities in nearshore environments throughout the action area. Source sound pressure levels vary widely between construction activities with drilling operations comprising relatively low source levels while pile-driving and the use of explosives comprises very high source levels (OSPAR, 2009). The majority of the sound energy associated with pile driving and dredging is in the low frequency range (less than 1,000 Hz) within the hearing range of large cetaceans (Illingworth and Rodkin Inc., 2001; Reyff, 2003; Clarke et al., 2003; Illingworth and Rodkin Inc., 2004). Several measures have been adopted to reduce the sound pressure levels associated with in-water construction activities or prevent exposure of marine mammals to sound. For example, six inch blocks of wood placed between the pile and the impact hammer used in

combination with a bubble curtain can reduce sound pressure levels by about 20 dB (NMFS 2008). Alternatively, pile driving with vibratory hammers produces peak pressures that are about 17 dB lower than those generated by impact hammers (Nedwell and Edwards, 2002). Other measures used in the action area to reduce the risk of disturbance from these activities include avoidance of in-water construction activities during times of year when listed whales may be present; monitoring for marine mammals during construction activities; and maintenance of a buffer zone around the project area (NMFS, 2008). Injuries from either dredging or drilling operations are unlikely, 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 coastal construction and renewable 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.

Pollution and Ocean Debris

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 in the action 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 whales (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 including immune system abnormalities, endocrine disruption and reproductive effects (Krahn et al., 2007). 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 (Grant and Ross, 2002).

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). The Gulf of Mexico represents an area of high-density offshore oil extraction with chronic, low-level spills and occasional massive spills such as the *Deep Horizon* oil spill event in 2010 the effects of which may extend into the Atlantic as well as portions of the action area. 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).

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.

Research Activities

Listed whales are exposed to numerous non-lethal scientific research activities throughout the action area as authorized by NMFS permits. Activities include close vessel and aerial approaches, biopsy sampling, suction cup tagging, dart tagging, implantable tagging, ultrasound, and acoustic playback activities. All takes currently exempted would be characterized as non-lethal harassment or wounding (in the case of implantable tagging, dart tagging, and biopsy). Seventeen research permits are currently authorized off the U.S. east coast that may overlap the action area (at least in part). We note that many of these research permits have a larger study area but we acknowledge that the species targeted by this proposed action may be affected by these research activities in and around the action area. Since issuance of a permit is a federal activity, each scientific research permit currently authorized or will be authorized is reviewed for compliance with section 7(a)(2) of the ESA to ensure that issuance of the permit does not jeopardize the continued existence of listed species. A review of the active permits shows that North Atlantic right and humpback whales are the most heavily researched in the western North Atlantic followed by fin, sei, and sperm whales, respectively.

The stress response associated with a particular research activity is often directly tied to the speed and direction of the approach. For instance, whales that are biopsied or tagged following a fast approach or a head-on approach may respond more intensely to the impact of the dart than if approached slowly and from the side (Whitehead et al., 1990; Brown et al., 1991; Weinrich et al., 1991; Jahoda et al., 2003). Researchers operating in the action area are required to approach listed cetaceans slowly using a converging course technique in order to minimize the stress response and are required to coordinate their activities so that repeated exposure can be either avoided or minimized.

The fact that multiple permitted “takes” of listed whales is already permitted will continue to be permitted in the future means that listed whales will be repeatedly harassed throughout the action for the purposes of scientific research. The point at which this leads to a measurable cumulative impact on the survival and recovery of these species in the action area, however, is uncertain. Our ability to detect long-term population-level effects from research activities will depend on several factors including our ability to better detect sub-lethal effects, our ability to differentiate an animal that has become habituated to a particular activity from one who has learned to cope with the added stress (both of which have very different consequences), and our ability to prioritize long-term studies investigating survival and reproduction of species targeted by similar types of research in the past. The latter in particular may lead to statistically significant trends showing whether or not repeated disturbances by research activities are affecting the ability of listed species to survive and recover in the wild to an appreciable degree and may help to further refine research methods to minimize stress to listed species.

The ESA Interagency Cooperation Division, in cooperation with the Permits Division, reviews monitoring reports submitted by researchers in order to monitor the effects of permitted activities and requires researchers to suspend research and consult with NMFS in the event that additional take occurs that was not anticipated and/or evaluated in the biological opinion. At the time of

this consultation, we are aware that listed whales are repeatedly harassed by research activities throughout the action area as a result of previously issued permits all of which have been shown to not jeopardize the continued existence of any species targeted by this proposed action. The consequences of exposing listed whales to the additional activities to be authorized in the proposed permit is the subject of this consultation and will be assessed in the *Effects of the Proposed Action* section below.

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 will 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 permit would authorize non-lethal "takes" by harassment 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 or disturb a marine mammal or marine mammal population in the wild by causing disruption of 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"¹¹ pursuant to the ESA. For this Opinion, we define harassment similarly: an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents.

11 An intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3)

Potential Stressors

Our effects analysis begins by identifying all possible stressors for which listed species would be exposed. During this consultation, we identified the following stressors associated with the proposed action:

- Disturbance from aircraft noise during aerial surveys flown at altitudes of 183-305 meters (600-1000 feet),
- Disturbance due to aerial approaches and circling as close as 244 meters (800 feet),
- Disturbance from engine noise during vessel surveys and transit,
- Disturbance due to close vessel approaches as close as 50 meters (164 feet),
- Habitat contamination due to unexpected oil or fuel spill,
- Ship strikes during vessel surveys and transit,

Exposure Analysis

Exposure analyses identify the ESA-listed species that are likely to co-occur with the actions' effects on the environment in space and time, and identify the nature of that co-occurrence. The analysis identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the actions' effects and the population(s) or subpopulation(s) those individuals represent. Our exposure analyses are based on the best information available to us including recent population estimates, expected growth rates over the life of the permits, the maximum survey effort expected, and data from past surveys conducted in the action area. Annual reports remain one of the most valuable resources for estimating exposure levels of similar permit actions and were thus utilized in this consultation as appropriate.

Listed species as well as their prey are not expected to be exposed to fuel or other contaminant spills from the survey vessel as researchers are expected to take all proper precautions to avoid a spill or minimize the impact of a spill if it were to occur thus preventing any type of widespread, high-dose contamination. Therefore, we consider the threats posed by this stressor to be discountable. Similarly, ship strikes are considered extremely rare for research conducted on listed whales. Researchers will have trained observers on board watching for any listed species located in the direct path of the vessel so they can be avoided. Researchers plan to use a slow, converging course technique and will not approach a whale head on. Therefore, we do not anticipate exposure of listed whales to ship strikes and the threats posed by this stressor are discountable.

This consultation focused our assessment on the following stressors for which listed species are likely to be exposed and may have a measurable effect: (1) Disturbance from aircraft noise during aerial surveys flown at altitudes of 183-305 meters (600-1000 feet), (2) Disturbance due to aerial approaches and circling as close as 244 meters (800 feet), (3) Disturbance from engine noise during vessel surveys and transit, and (4) Disturbance due to close vessel approaches as close as 50 meters (164 feet).

We reviewed the researchers' past monitoring reports for surveys performed in the same or similar regions in order to identify likely exposure given the researchers prior record. Aerial

surveys were previously carried out by UNC-Wilmington in the Mid-Atlantic for the years 2001-2002 and from 2005-2008 under prior permits¹². Researchers also performed aerial and vessel surveys in recent years in the Onslow Bay USWTR (which is near the study site off Cape Hatteras proposed in this permit) as well as the military site off Jacksonville, Florida. For regions where data existed, we calculated the mean number of sightings per survey season and carried the estimate out to four standard deviations. We then applied the potential growth in the population(s) over the permit period using growth rates from recent stock assessment reports (if available). Given the increase in survey effort expected, we also applied this increase to our estimated exposure where possible. For instance, past aerial surveys conducted by UNC-Wilmington in the Mid-Atlantic region were conducted over a six month timeframe. While these efforts are expected to continue, we doubled the estimate for this proposed action given that surveys will be conducted year round within the Cape Hatteras focus site located in the same region. Our analysis resulted in the following exposure estimates for surveys to be conducted from Virginia to South Carolina (including the Cape Hatteras focus site): 77 humpback whales, 131 North Atlantic right whales, 39 fin whales, and 59 sperm whales each year. The researchers' past record did not always differentiate between sightings resulting from aerial surveys compared to sightings resulting from vessel surveys making it difficult to project exposure likely to occur for each survey method under this proposed action. Therefore, these exposure estimates include both aerial and vessel surveys to be conducted in the Virginia to South Carolina subset of the action area.

While the researcher's past record allowed us to project probable exposure in certain regions, it was difficult to assess exposure in other proposed regions given the lack of past records for these individual sites. For instance, researchers expect to conduct additional aerial and vessel surveys from North Carolina to Delaware Bay in conjunction with the Virginia Aquarium and Marine Science Center Foundation during the final two years of the proposed permit (in the years 2013-2015) to fill in data gaps for research already being done. It was difficult to assess the likely survey effort given that the nature of these surveys would be to fill in data gaps rather than be ongoing continuous surveys during that time-span. Also, very limited data exists for the Jacksonville study site making it difficult to project likely exposure over the next five years. Given these uncertainties, we are provisionally accepting the take numbers proposed by the Permits Division across all regions although we have separated out the exposure likely to occur from the Virginia to South Carolina subset given the researchers' past record. We also note that while no sei whales have been sighted in the Mid-Atlantic surveys conducted by researchers in the recent past this species has been recorded in the action area by other researchers under previous permits. Also, one sei whale carcass was found stranded ashore just west of the survey track lines in 2003 suggesting that sei whales do utilize the action area on occasion¹². Given this as well the fact that researchers will be expanding their effort and surveying in additional areas than have been surveyed in the past, we found it likely that sei whales may be encountered under this proposed action. Subsequent data collected by the researchers will further inform this analysis and may be utilized in future consultations.

12 Data obtained online at <http://seamap.env.duke.edu/>.

Table 2. Estimated Annual Exposure of Listed Species to Stressors Resulting from Issuance of Permit No. 16473

SPECIES (LIFE STAGE)	STRESSORS	EXPOSURE ACROSS ALL REGIONS	EXPOSURE WITHIN VIRGINIA TO SOUTH CAROLINA SUBSET*
North Atlantic Right Whale (All)	Disturbance from Aerial and Vessel Surveys (including noise and close approaches)	200	131
Humpback Whale (All)	Disturbance from Aerial and Vessel Surveys (including noise and close approaches)	200	77
Sperm Whale (All)	Disturbance from Aerial and Vessel Surveys (including noise and close approaches)	150	59
Fin Whale (All)	Disturbance from Aerial and Vessel Surveys (including noise and close approaches)	100	39
Sei Whale (All)	Disturbance from Aerial and Vessel Surveys (including noise and close approaches)	40	2

* Numbers represent a subset of the exposure anticipated across all regions of the action area (includes aerial and vessel surveys to be carried out from Virginia to South Carolina from November to June each year as well as year round surveys at the study site focused off Cape Hatteras).

Individuals may be exposed multiple times during the permit period to aerial and vessel surveys as well as close approaches although permit conditions allow for only three attempts to obtain photographs to the same individual per day. All life stages (including cow-calf pairs) will be approached for observation and for obtaining photographs. Approaches may take up to 30 minutes and involve 10-20 circling events in the case of aerial approaches to get accurate counts and legible photographs.

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 expected given the results seen in the literature as well as published and unpublished data on the effects of similar actions. Where information on the responses of the target individuals was

lacking, we relied on documented responses of similar species to serve as a proxy for our analysis.

Behavioral and Stress Responses to Aircraft Noise and Aerial Approaches

Aircraft overflights often elicit many different behavioral changes in cetaceans such as sudden dives or turns, swimming away, and occasionally tail or flipper slaps (Richardson et al., 1995; Richardson and Wursig, 1997). A majority of reacting cetaceans respond to aircraft by diving (Luksenburg and Parsons, 2008). About 14 percent of bowhead whales approached during aerial surveys changed their behavior coincident with the approach of the aircraft (Patenaude et al., 2002). Reactions of migrating gray whales to a Bell 212 helicopter consisted of abrupt turns, dives, or both (SRA, 1988). Beluga and bowhead whale responses to aircraft have been classified as short surfacings, immediate dives or turns, changes in behavioral state, vigorous swimming, and breaching (Patenaude et al., 2002). Smultea et al., (2008) viewed unique behavioral reactions of a group of sperm whales where the whales ceased their forward movement and positioned themselves closer to each other which may have represented agitation, distress, or self-defense. This behavior was also seen in another study in the Bahamas when a Cessna 172 passed and circled a group of six sperm whales (Luksenburg and Parsons, 2008).

Degree of response and reaction could also vary with altitude. A stronger avoidance response has been reported when planes fly at lower altitudes (Walker, 1949; Bel'kovich, 1960; Kleinenberg et al., 1964; Best, 1981; Sergeant and Hoek, 1988). When survey aircraft fly below certain altitudes (about 500 meters), 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). Bowhead whales have been observed avoiding planes flying at 305 m or lower (Perry, 1998). Although some whales show stronger avoidance responses to lower altitude planes, some whales also exhibit no response to low-flying planes. Some humpbacks are disturbed by overflights at 305 meters but others show no response to flights at 152 meters. Cetaceans sometimes react to an aircraft passing as high as 300 or 400 meters, while at other times the same species can show no obvious reaction to the same aircraft at 150 meters (Richardson and Wursig, 1997). Smultea et al. (2008) reported that sperm whales exhibited no reactions to their study's lowest aircraft passes, 103 meters and 208 meters lateral distance, as compared to the higher passes in their study. Watkins (1981a) observed fin whales from an aircraft at 50-300 meters and implied that engine noise or the aircraft's shadow caused reactions. Other cetaceans also react if the aircraft shadow passes over them (Watkins, 1981b; Mullin et al., 1991). Bottlenose dolphins have been observed to react when an aircraft's shadow passed over them (Mullin et al., 1991). Some species such as beluga whales and Dall's porpoises have been observed looking up at aircraft (Withrow et al., 1985; Richardson et al., 1995; Richardson and Wursig, 1997). Sperm whales have also been observed looking up at aircraft (Smultea et al., 2008).

In past monitoring reports submitted by the researchers from 2006-2011, whale reactions to approaching aircraft included no apparent reaction, mild or medium reactions such as the whales changing their surface intervals or diving beneath the surface upon approach, and occasional stronger reactions such as active lobsailing and breaching. Species that appeared to react stronger to aircraft surveys included North Atlantic right and humpback whales although sperm whales were also observed to exhibit medium reactions to the presence of the aircraft by diving

beneath the surface. The researchers also noted that for those individuals that did react, the behavioral response was short in duration and the animal appeared to resume normal behavior shortly after responding. Similarly, we do not anticipate any prolonged stress response to aircraft surveys to be conducted as part of this proposed action as conditions in the permit requires that the aircraft retreat to higher altitudes if a whale exhibits an adverse reaction upon approach. Therefore, it is expected that aerial surveys conducted during the proposed research activities would result in only short-term behavioral reactions ranging from short term avoidance (i.e., diving beneath the surface) to active lobtailing and/or breaching with exposed individuals returning to pre-approach behavior soon after the aircraft retreats to higher altitudes.

Behavioral and Stress Responses to Vessel Engine Noise and Close Vessel Approaches

Vessel surveys and close approaches have the potential to disturb listed whale species and induce behavioral and physiological stress to whales targeted by the approach as well as other whales in the vicinity of the approaching vessel. Detection of vessel noise is dependent on several factors, including weather, vessel engine type and size, habituation, and other ambient noise. The sound generated by the research vessels is expected to be at higher frequencies than larger vessels like supply ships, container/cargo ships, and cruise vessels operating in the action area (OSPAR, 2009). Since large cetaceans tend to hear and vocalize at lower frequencies, the contribution of marine ambient noise generated by the research vessels is expected to be minimal and would not adversely affect listed whales' ability to hear mates and other conspecifics but may induce behavioral reactions as described below.

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 such as breaching and/or lobtailing (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005). Reactions to vessel noise have been observed when engines are started at distances of 3,000 feet or less (Malme et al., 1983; Richardson et al., 1995), suggesting that some level of disturbance may result even if the vessel does not undergo a very 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).

For humpback whales, Baker et al. (1983) described two responses of whales to vessels, including: (1) "horizontal avoidance" of vessels 2,000 to 4,000 meters away characterized by faster swimming and fewer long dives; and (2) "vertical avoidance" of vessels from 0 to 2,000 meters away during which whales swam more slowly, but spent more time submerged. Hall (1982) reported that humpback whales closely approached by survey vessels in Prince William Sound, Alaska, often reacted by diving and surfacing further from the vessel or with an altered direction of travel. The author noted that whale feeding activity and social behavior did not appear to be disturbed by the approaches; however, cow-calf pairs appeared to be wary and avoided the vessel. 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.

The slow and careful approach to humpback whales is important and is supported by studies conducted by Clapham and Mattila (1993) on the 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. Smaller pods and pods with calves also seem more responsive to approaching vessels (Bauer, 1986; Bauer and Herman, 1986). Based on their experiments with different approach strategies, researchers concluded that experienced, trained personnel approaching humpback whales slowly would result in fewer whales exhibiting strong, high energy responses that might indicate stress.

Jahoda et al. (2003) studied responses of fin whales feeding in the Ligurian Sea to vessels approaching with sudden speed and directional changes. Fin whales were approached repeatedly by a small speedboat to within 5-10 meters (or 16-33 feet) for approximately one hour for photo-identification and biopsy sampling. A larger vessel used for observations was also present. Fin whales responded by suspending feeding through the end of the study and changing their swimming, diving, and respiratory behavior. The whales tended to reduce the time they spent at the surface and increased their blow rates, suggesting an increase in their metabolic rates and possibly a stress response to the approach. In the study, fin whales that had been disturbed while feeding had not resumed feeding when the exposure ended, although the presence or absence of prey after the disturbance was unknown. Jahoda et al. (2003) noted the potential for long-term responses of fin whales to vessel disturbance cannot be ruled out, but concluded that approaching vessels maneuvering at low speeds were less likely to cause visible reactions than those approaching at higher speeds.

NMFS expects that the slow converging course technique employed by the researchers should minimize the stress response of the approached whales for purposes of behavioral observation and for obtaining photographs. Also, while temporary changes in whale behavior may occur as the whale reacts to the approaching vessel, the literature suggests these reactions are expected to be short in duration and that the whales would resume normal behavior after the approach consistent with the literature (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005).

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 given their exposure to the action's effects and the likely responses given that exposure. Ideally, risk analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences. We then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses then determine the consequences those population-level risks have to the species as a whole. 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. For more information

the specific parameters used to evaluate risk at each phase, please refer to the *Approach to the Assessment* section of this Opinion.

Based on a review of available information, we would expect listed humpback, North Atlantic right, fin, sperm, and sei whales 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. For example, reactions to close aerial and/or vessel approaches include little to no 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 such as breaching and/or lobtailing (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005). For aerial surveys, researchers are required to suspend their activities and retreat to higher altitudes if an adverse reaction is observed. We believe this mitigation measure should minimize the duration of the stress response of the targeted whales and should help reduce the time it takes for the whales to return to their pre-approach behaviors. For vessel surveys, we anticipate that the relatively slow transit speeds as well as the slow, converging course technique proposed by the researchers should minimize the stress response of the whales to the close vessel approach given observations seen in the recent past as well as observations reported in the literature (e.g., Clapham and Mattila, 1993; Best et al., 2005).

For those whales exhibiting higher energy responses (i.e., active avoidance, multiple breaches and/or lobtailing), the exposure and resulting response would be expected to impact the animal's energy budget that would normally be used for other essential behaviors such as feeding, swimming, and/or reproduction. While multiple high energy responses may impact an individual's fitness in the short term, a review of the literature suggests that repeat exposures are not likely to result in any long term fitness consequence (e.g., impacts to growth, survival, and lifetime reproductive success, etc.). For example, Glockner-Ferrari and Ferrari (2006) noted several female humpback whales that had been subjected to close vessel approaches multiple times over a 20 year period were resighted in the same area and were known to have reproduced several times suggesting that the multiple approaches did not affect survival and/or reproduction. Best et al. (2005) conducted repeat approaches on 20 southern right whale cow-calf pairs and were unable to detect a trend of increased or decreased sensitivity of calves to the approach and noted that the same whales were resighted in subsequent years. Best and Mate (2007) examined sighting patterns and reproductive intervals for southern right whales tagged off South Africa and found that six of seven reproductive females that were resighted post-tagging had given birth to a new calf and exhibited calving intervals that were similar to untagged whales, supporting the null hypothesis of no major effect on the reproductive success of adult females or (by inference) the survival of their calves. While we cannot definitively know whether repeat exposures to close approaches have longer term consequences (as many responses would be sub-lethal and/or difficult to detect), a review of the literature suggests that individuals subjected to repeat exposures are resighted with no apparent interruptions to survival and reproductive success, suggesting no long-term adverse fitness consequences.

In summary, we anticipate that research activities to be authorized in Permit No. 16473 may result in short term fitness consequences for exposed individuals but are not likely to result in any long term consequences such as mortality, serious injury, or disruption of essential behaviors

such as feeding, mating, or nursing, to a degree that the individual's likelihood of successful reproduction or survival would be substantially reduced. Since we do not anticipate any long term fitness consequences for individuals, we do not, in turn, anticipate adverse consequences for the populations those individuals represent or the species for which 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 (e.g., disease, predation, stochastic events such as strandings, etc.) will continue to influence listed whale populations in the action area 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 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). In addition, increases in ocean temperature may cause dramatic shifts in the reproductive rate of North Atlantic right whales (Drinkwater et al., 2003; Greene et al., 2003) and possibly a northward shift in the location of right whale calving areas currently designated in the southeast U.S. (Kenney, 2007).

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 large whales by the increased traffic itself and/or through habituation of whales 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).

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 whale interactions with fisheries in the action area during the recent past, such interactions remain a major threat to the survival and recovery of listed whale species in the action area.

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 whales as well as that of the prey on which they depend.

Additionally, unrelated factors may be acting together to affect listed species and/or the conservation value of designated critical habitat. 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., 2002b; 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 critical habitat 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 listed whales.

After reviewing the available information, NMFS is not aware of any additional future non-federal activities or potential stressors acting in the action area that would not require federal authorization or funding and are reasonably certain to occur during the foreseeable future and could contribute to a cumulative impact on listed species in the action area.

INTEGRATION AND SYNTHESIS OF EFFECTS

The following text integrates and synthesizes the *Description of the Action, Approach to the Assessment, Status of the Species, Environmental Baseline, Effects of the Proposed Action, and Cumulative Effects* sections of this Biological Opinion. This information was used to assess the effects and subsequent risks the proposed action poses to ESA-listed humpback, North Atlantic right, fin, sperm, and sei 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.

The Permits Division proposes to issue a scientific research permit to Ann Pabst, Ph.D, to conduct aerial and vessel surveys along predetermined transect lines from Delaware Bay to Cape Canaveral, Florida. The purpose of the surveys are to document the presence of North Atlantic right and humpback whales in the Mid-Atlantic region as well as to describe cetacean abundance and distribution within specific geographic areas currently utilized for military training activities or those that may be targeted in the future (specifically, areas off Cape Hatteras, North Carolina, and off Jacksonville, Florida). All proposed takes to listed whales are expected to be in the form of non-lethal harassment during surveys including approaches to listed whales for photo-documentation purposes. The proposed permit would be valid for five years after the date of issuance.

When a large whale is spotted during any of the proposed surveys, the airplane or vessel would break transect to approach the whale for photo-documentation and to note evidence of any human interaction (e.g., entanglement). This process may result in aircraft altitude periodically decreasing below 305 meters, to a minimum of 244 meters (800 feet) in order to obtain legible photographs. Vessels, on the other hand, would break transect and approach a whale within 50-100 meters. Based on past efforts, encounters may last up to 30 minutes and involve 10-20 circling events in the case of aerial surveys. Researchers expect it is possible that some individuals would be photographed more than once although efforts will be made to minimize the overall time of the encounter in all cases.

Historically, North Atlantic right, humpback, fin, sperm, and sei whale populations were severely affected by commercial whaling in the 20th century in the North Atlantic, North Pacific, and Southern oceans. The main stressors affecting these species' ability to recover include ongoing effects from prior commercial whaling, interaction with fishing gear, ship strikes, and various sources of habitat degradation. 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. The baseline also includes human activities resulting in disturbance, injury, or mortality of individuals. These activities include habitat degradation (e.g., due to contaminants); vessel traffic and risk of ship strikes; entrapment or entanglement in fishing gear; increasing ambient background noise from shipping and boating as well as pulse noise sources such as under water blasting, sonar, seismic surveys and other military activities; and harassment from other permitted scientific research activities.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, natural mortality) will continue to influence listed species in the action area. 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 to continue as well. The net effect of these disturbances (or cumulative effect) 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 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 listed whales in the action area.

For this consultation, we were 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 stressors analyzed in this Opinion included: (1) Disturbance from aircraft noise during aerial surveys flown at altitudes of 183-305 meters (600-1000 feet), (2) Disturbance due to aerial approaches and circling as close as 244 meters (800 feet), (3) Disturbance from engine noise during vessel surveys and transit, and (4) Disturbance due to close vessel approaches as close as 50 meters (164 feet). After reviewing the best available information, we assessed exposure at the levels proposed by the Permits Division across all regions (i.e., 200 humpback, 200 North Atlantic right, 150 sperm, 100 fin, and 40 sei whales each year) although we did separate out exposure likely to occur in the Mid-Atlantic region from Virginia to South Carolina given the researchers past record. We could not separate exposure likely to occur between aerial surveys versus vessel surveys given the more opportunistic nature of the vessel surveys so the exposure was evaluated for both types of surveys in this Opinion.

Aircraft overflights often elicit many different behavioral changes in cetaceans such as sudden dives or turns, swimming away, and occasionally tail or flipper slaps (Richardson et al., 1995; Richardson and Wursig, 1997). Cetaceans sometimes react to an aircraft passing as high as 300 or 400 meters, while at other times the same species can show no obvious reaction to the same aircraft at 150 meters (Richardson and Wursig, 1997). In past monitoring reports submitted by the researchers, whale reactions to approaching aircraft included no apparent reaction, mild or medium reactions such as the whales changing their surface intervals or diving beneath the surface upon approach, and occasional stronger reactions such as active lobtailing and breaching. The researchers also noted that for those individuals that did react, the behavioral response was short in duration and the animal appeared to resume normal behavior shortly after responding. Similarly, we do not anticipate any prolonged stress response to aircraft surveys to be conducted as part of this proposed action as conditions in the permit requires that the aircraft retreat to higher altitudes if a whale exhibits an adverse reaction upon approach.

Whales may respond differently to vessel surveys depending on what behavior the animals are engaged in before the vessel approaches (Wursig 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). Documented 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/or lobtailing (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993;

Jahoda et al., 2003; Best et al., 2005). While temporary changes in whale behavior may occur as the whale reacts to the approaching vessel, the literature suggests these reactions are expected to be short in duration and that the whales would resume normal behavior after the approach consistent with the literature (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005).

We analyzed the risks to individuals based on their expected responses to research activities. We expect that humpback, North Atlantic right, fin, sperm, and sei whales 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. We assume vessel surveys under the proposed permit might be stressful for some individuals, and might temporarily interrupt behaviors such as foraging, but evidence in the literature for similar actions (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005) suggests that responses are expected to be short-lived. Assuming an animal is no longer disturbed after it responds to the presence of the vessel, we do not expect long-term adverse fitness consequences for listed whales exposed to the proposed aerial and vessel surveys conducted by the researchers.

In summary, we anticipate that research activities may result in short term fitness consequences for exposed individuals but are not likely to result in any long term consequences such as mortality, serious injury, or disruption of essential behaviors such as feeding, mating, or nursing, to a degree that the individual's likelihood of successful reproduction or survival would be substantially reduced. Since we do not anticipate any long term fitness consequences for individuals, we do not, in turn, anticipate adverse consequences for the populations those individuals represent or the species for which those populations comprise.

CONCLUSION

After reviewing the current status of the affected species, the environmental baseline for the action area, the anticipated effects of the proposed research activities, and the possible cumulative effects, it is the ESA Interagency Cooperation Division's opinion that the Permits Division's proposed action of issuing permit No. 16473, as proposed, is not likely to jeopardize the continued existence of North Atlantic right, humpback, fin, sperm, or sei whales under NMFS' authority.

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 taken by way of harassment as part of the intended purpose of the proposed action. Therefore, NMFS does not expect the proposed action will incidentally take any 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 as well as reduce harassment related to the authorized activities:

1. *Reporting Survey Days in Annual Reports.* The Permits Division should encourage researchers to log the actual number of survey days completed (both for aerial and for vessel surveys) and include this information in the annual reports submitted to NMFS' Office of Protected Resources. Knowing the number of survey days in addition to the number of takes improves our ability to estimate exposure of listed species to aerial and vessel surveys occurring in the same region(s) and would help NMFS' Office of Protected Resources determine the appropriate level of take to authorize in future permits.
2. *Cumulative Impact Analysis.* The Permits Division should work with 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 whales. This includes the cumulative sub-lethal and behavioral impacts of research permits on listed species.

In order for the ESA Interagency Cooperation 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 ESA Interagency Cooperation 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. 16473. 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, the Permits Division must immediately request reinitiation of section 7 consultation.

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