National Marine Fisheries Service
Endangered Species Act Section 7 Consultation
Biological Opinion

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

Activity Considered: Biological Opinion on the proposal to issue Permit Number 16325 to Dr. Jooke Robbins, Center for Coastal Studies, to authorize research on North Atlantic humpback, fin, blue, sei, sperm and two other non-listed cetacean species from Maine to Puerto Rico, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

Consultation Conducted by: ESA Interagency Cooperation Division of the Office of Protected Resources, National Marine Fisheries Service

Approved by: ________________

Date: AUG 2 4 2012

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1536(a)(2)) requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a federal agency "may affect" a listed species or critical habitat designated for them, that agency is required to consult with either National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service, depending upon the listed resources that may be affected. For the action described in this document, the action agency is the NMFS' Office of Protected Resources – Permits and Conservation Division. The consulting agency is the NMFS' Office of Protected Resources – ESA Interagency Cooperation Division.

This document represents the NMFS' biological opinion (Opinion) of the effects of the proposed research on 7 cetacean species (five ESA listed) and the ESA listed species' designated critical habitat, as has been prepared in accordance with Section 7 of the ESA. This Opinion is based on our review of the Permits and Conservation Division's draft Environmental Assessment, draft permit 16325, the permit application from Dr. Jooke Robbins, annual reports of similar past research, the most current marine mammal stock assessment reports, recovery plans for listed species, scientific and technical reports from government agencies, peer-reviewed literature, biological opinions on similar research, and other sources of information.

Consultation history

The NMFS' Permits and Conservation Division (Permits Division) requested consultation with the NMFS' Endangered Species Division on the proposal to issue scientific research permit authorizing studies on North Atlantic humpback, fin, blue, sei, and sperm whales. Issuance of the permit constitutes a federal action, which may affect marine species listed under the ESA. On April 18th 2012, the Permits Division requested initiation of Section 7 consultation to issue a new permit to Dr. Jooke Robbins (CCS), and the ESA Interagency Cooperation Division formally initiated consultation with the Permits Division on April 23rd 2012.

BIOLOGICAL OPINION

Description of the proposed action

NMFS' Office of Protected Resources – Permits and Conservation Division proposes to issue a permit for scientific research pursuant to the ESA and the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 et seq., Section 104). Issuance of permit 16325to Dr. Jooke Robbins would authorize research on North Atlantic humpback, fin, blue, sei, sperm and two other non-listed cetacean species from Maine to Puerto Rico. The research would focus on population dynamics; movement and habitat use patterns (including exchange with other North Atlantic areas); entanglement and other human impacts; sample-based studies of molecular genetics, aging, toxicology, reproduction and health of North Atlantic humpback whales. Research on other species would focus primarily on studies of population structure, human impacts, and health. If issued, the permit would be valid for five years. The proposed actions and "take" [1] authorizations for the species that are listed and proposed for listing can be found in the following tables.

Table 1. Proposed "takes" of listed cetaceans during research activities from Maine to Rhode Island, including waters in and adjacent to the Gulf of Maine. All lifestages and both sexes could be targeted.

Species	ESA Listing	Procedures	Takes per Individual per year	Maximum Authorized Takes*
Blue whales	Endangered	Collect, sloughed skin; count/survey; observation, monitoring; behavioral observations, photo-id; photograph/video; sample, exhaled air, fecal	3	50
		(Adult/Juvenile) Sample, skin and blubber biopsy	3	30
Fin whales	Endangered	Collect, sloughed skin; count/survey; observation, monitoring; behavioral observations, photo-id; photograph/video; sample, exhaled air, fecal	10	200

[1] Under the MMPA, "take" is defined as to "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." [16 U.S.C. 1362(18)(A)] 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." The term "harm" is further defined by regulations (50 CFR §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering."

		(Adult/Juvenile) Sample, skin and blubber biopsy	3	50
		(Calf) Sample, skin and blubber biopsy	3	10
Humpback whale	Endangered	Collect, sloughed skin; count/survey; observation, monitoring; behavioral observations, photo-id; photograph/video; sample, exhaled air, fecal	20	1850
		Range wide (Adult/Juvenile) Sample, skin and blubber biopsy, underwater photo/videography	3	80
		Western North Atlantic Stock (Adult/Juvenile) Sample, skin and blubber biopsy, underwater photo/videography (previously identified)	3	80
		Western North Atlantic Stock (Calf) Sample, skin and blubber biopsy	3	50
North Atlantic right whales	Endangered (Range-wide)	Incidental harassment	1	15
Sei whales	Endangered	Collect, sloughed skin; count/survey; observation, monitoring; behavioral observations, photo-id; photograph/video; sample, exhaled air, fecal	3	50
		(Adult/Juvenile) Sample, skin and blubber biopsy	3	30
		(Calf) Sample, skin and blubber biopsy	3	10
Sperm whales	Endangered	Collect, sloughed skin; count/survey; observation, monitoring; behavioral observations, photo-id; photograph/video; sample, exhaled air, fecal	3	50
		(Adult/Juvenile) Sample, skin and blubber biopsy	3	30

* Takes = the maximum number of animals, not necessarily individuals, that may be targeted for research annually for the suite of procedures

Table 2. Proposed "takes" of listed cetaceans during research activities from New York to North Carolina. All lifestages and both sexes could be targeted.

Species	ESA Listing	Procedures	Takes per Individual per year	Maximum Authorized Takes*
Fin whales	Endangered	Count/survey; observation, monitoring; behavioral observations, photo-id; photograph/video; sample, exhaled air, fecal	3	50
		(Adult/Juvenile) Sample, skin and blubber biopsy	3	30
Humpback whale	Endangered	Collect, sloughed skin; count/survey; observation, monitoring; behavioral observations, photo-id; photograph/video; sample, exhaled air, fecal	3	50
		(Adult/Juvenile) Sample, skin and blubber biopsy	3	50
Sei whales	Endangered	Count/survey; observation, monitoring; behavioral observations, photo-id; photograph/video; sample, exhaled air, fecal	3	50
		(Adult/Juvenile) Sample, skin and blubber biopsy	3	30

* Takes = the maximum number of animals, not necessarily individuals, that may be targeted for research annually for the suite of procedures

Table 3. Proposed "takes" of listed cetaceans during research activities in South Carolina, Georgia and Florida. All lifestages and both sexes could be targeted.

Species	ESA Listing	Procedures	Takes per Individual per year	Maximum Authorized Takes*
Humpback whale	Endangered	Collect, sloughed skin; count/survey; observation, monitoring; behavioral observations, photo-id; photograph/video; sample, exhaled air, fecal	3	50
		(Adult/Juvenile) Sample, skin and blubber biopsy	3	50

* Takes = the maximum number of animals, not necessarily individuals, that may be targeted for research annually for the suite of procedures

Table 4. Proposed "takes" of listed cetaceans during research activities in Puerto Rico. All lifestages and both sexes could be targeted.

Species	ESA Listing	Procedures	Takes per Individual per year	Maximum Authorized Takes*
Humpback whale	Endangered	Collect, sloughed skin; count/survey; observation, monitoring; behavioral observations, photo-id; photograph/video; sample, exhaled air, fecal	5	150
		(Adult/Juvenile) Sample, skin and blubber biopsy	3	50

* Takes = the maximum number of animals, not necessarily individuals, that may be targeted for research annually for the suite of procedures

The research activities as proposed by the applicant would include close vessel approaches for: behavioral observations and photo-identification; photogrammetry; collection of exhaled air, feces and sloughed skin; skin and blubber biopsy sampling; and the import and export of parts. No research-related mortalities would be authorized.

<u>Methods:</u>
Proposed research would take place throughout the year, across their range in the western North Atlantic. Sampling in the northeast US (ME, NH, MA, RI, within and adjacent to US/Canadian Gulf of Maine) would be performed year-round, but primarily from March through December. Sampling off the US mid-Atlantic states (NY, NJ, DE, MD, VA, NC), the southeast US states (SC, GS, FL), and Puerto Rico is expected to occur primarily from November through May. The research would also involve research off Canada.

Close approach by vessels
Vessel approaches in the Gulf of Maine would be conducted primarily from CCS vessels, the *R/V Shearwater* (41 ') and *RlV Ibis* (30'), as well as small inflatable boats with single outboard engines (15-20'). Comparable vessels may be substituted for logistical reasons. Similar types of vessels will be used by co-investigators doing research off the US mid-Atlantic States, the southeast US and Puerto Rico.

The duration of a single approach would vary as sightings can last from 15 minutes to 1.5 hours. Approaches would be initiated from behind the target individual. When at a distance of 300 yards, the vessel would fall carefully into position behind or alongside the target individual and match the whale's speed and direction. An individual would not be selected for focal follows if its behavior is not conductive to approach, or if it exhibits evidence of disturbance when approached within 300 feet. Effort would be made to ensure that the vessel does not separate associated groups of individuals.

Photo-identification
Photographs would be used to estimate abundance, document movements and scarring rates, and in some cases estimate vital parameters such as survival and calving rates. They are also used for stock identification.

Animals would be approached close enough to optimize photographic quality (i.e., well-focused images, utilizing at least one half of the slide viewing area) while approaching from behind at a consistent speed and avoiding sudden changes in speed or direction. Distances for optimal approach vary with the species being photographed. Research vessels under this permit would usually maintain a distance greater than 100 feet for photo-identification.

Exhaled air/mucosa

For selected individuals, samples would also be obtained of exhaled mucosa/air. Sampling would involve careful vessel approaches to within 20-30 feet of the target individual. A customized collection devise will then be placed into the blow stream above the nares of the whale using a long pole. This would allow for the sampling of the blow while making no contact with the whale. For humpback and fin whales, individuals would be selected for this procedure based on catalogued age, sex and status. And individual would not be selected for this sampling if its behavior is deemed not to be conductive to approach, or if it exhibits evidence of disturbance when approached within 100 feet.

Fecal sampling

Fecal samples would be obtained opportunistically (when feces are observed in the water) or during focal follows of individual whales. Whenever feces are observed, the vessel would allow the whale to move away and then samples would be obtained from the water by scoop, net or pump, depending on the nature of the fecal cloud.

Naturally sloughed skin

Upon observing a surface-active whale, a sloughed skin sample may be collected. Naturally-sloughed skin samples are quite variable in size. While the whale is active, the vessel would stand by at a safe distance until its behavior changes or it moves out of the immediate area. The vessel would then search the water for floating pieces of sloughed skin. Any pieces that are found would be retrieved from the water using a long-handled sieve. Sloughed skin sampling would not typically required approaches within 100 feet of the whale.

Skin/blubber biopsy

Biopsy sampling would be carried out in conjunction with photo-identification efforts to reduce unnecessary darting of previously sampled individuals and to ensure that the photographic data is linked to the sample. For biopsy sampling of humpback whales, no more than 168 samples would be collected each year, with up to three samples from an individual in a given year. No more than three biopsy attempts would be allowed per whale for every sample collected. No biopsying of calves under three months old would be authorized, and an individual calf would be biopsied only once under the permit. The number of humpback whale calves biopsied would vary each year, but would not exceed 85 calves over the five years of this permit.

Fin, sei, blue, and sperm whales would also be biopsied, and only one sample from an individual per year. No more than three attempts per sample on an individual whale would be authorized. Fin, and sei whale calves would be biopsied at six months of age or older; no biopsying of calves under six months old would be authorized. An individual calf would be biopsied only once under the permit.

The position of the vessel during a biopsy attempt would be directly abeam and at a distance ranging from 25 to 100 feet from the whale. The darter would collect the biopsy sample using a crossbow and specially designed CETA-DART bolts and tips (Palsbøll et al. 1991). The bolt is a standard carbon fiber shaft, equipped with a pressed foam stop collar/float. CETA-DART cylindrical sampling tips are constructed from stainless steel. Samples would be collected from the upper flank of the animal, generally below or posterior to the dorsal fin. In most instances, this is performed when the whale arches to initiate its terminal dive. Once the dart is fired, the animal would be allowed to move out of the area before the vessels moves in to retrieve the floating bolt. Biopsy sampling would be terminated when a sample was obtained, or after three shots.

Import/Export
The CSS would be authorized to import/export/re-export biological samples collected during research activities. In addition, they would be authorized to import/export/re-export parts and specimens salvaged by them and biological samples or parts and specimens collected by other researchers. Such sample material would be archived and analyzed for information such as molecular genetics, life history, stable isotopes ratios and fatty acid composition.

Permit conditions

The proposed permit lists general and special conditions to be followed as part of the proposed research activities. These conditions are intended to minimize the potential adverse effects of the research activities on targeted endangered species and include the following that are relevant to the proposed permit:

Measures to minimize effects to animals would include:

- In the event of serious injury or mortality or if the permitted "take" is exceeded, researchers must suspend permitted activities and contact the Permits Division by phone within two business days, and submit a written incident report. The Permits Division may grant authorization to resume permitted activities.
- 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. Measures to minimize effects to animals would include:
  - Any "approach[2]" of a cetacean constitutes a "take" by harassment and must be counted and reported. Regardless of success, any attempt, which includes close approach to photograph, constitutes a take and must be counted and reported.
  - Individual humpbacks would not be "taken" more than 5 times per day by close approach, and not more than three attempts for biopsy sampling per encounter.
  - A biopsy attempt must be discontinued if an animal exhibits repetitive strong adverse reactions to the activity or the vessel.
  - No animal would be taken for biopsy samples more than three times per field season.

[2] 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.

- Animals would be approached at a slow speed and obliquely (rather than direct movement towards them) to allow them to continue their activities, and to not overtake or disturb. Researchers would remain parallel to the animals, matching speed with the group, minimizing changes in speed, and terminating activities if active avoidance is occurring.
- Researchers would not travel in front of or too close to, or block any intended path for pairs or small groups of whales that are attempting to stay together.
- Researchers would cease approach after suitable identification photographs have been obtained topside.
- Researchers would avoid multiple approaches of same groups of whales on a given day.
- Activities would be suspended if researchers determine that activities result in any disruption of normal whale activities.
- Researchers must approach mothers and calves gradually to minimize or avoid any startle response, especially where females with calves are resting at depth, and must not approach any mother or calf while the calf is actively nursing.
- Researchers would be especially prudent and cautious when approaching any mother/calf pods, assess behavior prior to close approach, and have stationed experienced observers looking for any indication of take. They would avoid separating or coming between a mother/calf pair, and must not position the research vessel between the mother and calf.
- Researchers would not work any humpback whale mother/calf group that does not seem "at ease" with an approach or that does not remain in rest mode.
- Must immediately terminate efforts if there is any evidence that the activity may be interfering with pair-bonding or other vital functions;
- An experienced collection team would conduct research.
- Researchers would coordinate activities with other researchers and avoid unnecessary duplication and harassing the same pods.

• When practicable, researchers should monitor and record the behavior of target animals at least 15 minutes before and after conducting research activities. Observed negative impacts should be included in annual reports.
• This permit does not authorize takes of any protected species not identified in Tables 1-4 of Appendix 1 of the permit, including those species under the jurisdiction of the USFWS. Should other protected species be encountered 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.

Reports

- The Permit Holder must submit annual, final, and incident reports, and papers or publications resulting from the research authorized herein to the Permits Division.
- Reports may be submitted through the online system at https://apps.nmfs.noaa.gov, by email attachment to the permit analyst for this permit, or by hard copy mailed or faxed to the Chief, Permits Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Suite 13705, Silver Spring, MD 20910; phone (301)427-8401; fax (301)713-0376.
- Written incident reports related to serious injury and mortality events or to exceeding authorized takes, must be submitted to the Chief, Permits Division 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 research related mortality or exceedence of authorized take.
- An annual report must be submitted to the Chief, Permits Division at the conclusion of each year for which the permit is valid.
- A final report must be submitted to the Chief, Permits Division 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.
- Research results must be published or otherwise made available to the scientific community in a reasonable period of time.

Notification and Coordination

- The Permit Holder must provide written notification of planned field work to the Assistant Regional Administrator(s) for Protected Resources at the address of the NMFS regional office. Such notification must be made at least two weeks prior to initiation of a field trip/season and must include the locations of the intended field study and/or survey routes, estimated dates of research, and number and roles (for example: PI, CI, veterinarian, boat driver, safety diver, animal restrainer, Research Assistant "in training") of participants.
- 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. The Regional Office may be contacted at the address listed above for information about coordinating with other Permit Holders.

APPROACH TO THE ASSESSMENT

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

The final steps of our analyses – establishing the risks those responses pose to listed resources are different for listed species and designated critical habitat (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 of vertebrate species. The continued existence of these "species" depends on the fate of the populations that comprise them. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them – populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

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

We measure risks to listed individuals using the individuals' "fitness," or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable lethal, sub-lethal, or behavioral responses to an action's effect on the environment (which we identify during our response analyses) are likely to have consequences for the individual's fitness.

When individual, listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions are likely to reduce the abundance, reproduction, or growth rates (or increase the variance in these measures) of the populations those individuals represent (see Stearns 1992). Reductions in at least one of these variables (or one of the variables we derive from them) is a necessary condition for reductions in a population's viability, which is itself a necessary condition for reductions in a species' viability. As a result, when listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Anderson 2000; Brandon 1978; Mills and Beatty 1979; Stearns 1992). 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 listed resources sections of this Opinion) as our point of reference. If we conclude that reductions in individual fitness 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 listed resources section of this Opinion) as our point of reference. Our final determinations are based on whether threatened or endangered species are likely to experience reductions in their viability and whether such reductions are likely to be appreciable.

To conduct these analyses, we rely on all of the evidence available to us. This evidence consists of monitoring reports submitted by past and present permit holders, reports from NMFS Science Centers; reports prepared by natural resource agencies in States and other countries, 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 – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies like the Minerals Management Service, U.S. Coast Guard, and U.S. Navy whose operations extend into the marine environment.

During the consultation, we conducted electronic searches of the general scientific literature using search engines, including Agricola, Ingenta Connect, Aquatic Sciences and Fisheries Abstracts, JSTOR, Conference Papers Index, First Search (Article First, ECO, and WorldCat), Web of Science, Oceanic Abstracts, Google Scholar, and Science Direct.

We supplemented these searches with electronic searches of doctoral dissertations and master's theses. These searches specifically tried to identify data or other information that supports a particular conclusion (for example, a study that suggests whales will exhibit a particular response to close vessel approach) as well as data that do not support that conclusion. When data were equivocal or when faced with substantial uncertainty, our decisions are designed to avoid the risks of incorrectly concluding that an action would not have an adverse effect on listed species when, in fact, such adverse effects are likely (i.e., Type II error).

The analyses used in this Opinion include several assumptions. As far as we are able to determine, field researchers cannot generally identify specific individuals in the field and, therefore, have no mechanism to know what previous exposure an individual has had to proposed activities or other natural or anthropogenic stressors. Based upon descriptions in past annual monitoring reports from the applicant and documentation provided by the Permits Division, we assume that proposed activities will be similar to those that the applicant has conducted in the past and the level of "effort" (magnitude of time and asset resources dedicated to the proposed action) will be roughly similar to that which has previously occurred. We assume that free-ranging cetaceans range over wide areas and although they likely occupy restricted regions for relatively brief periods (hours to days), individuals are expected to move widely and, as far as we can predict, broadly within an oceanographic region. Although we expect that variability in reporting exists within the applicant's annual reports and other specific information provided, these reports accurately document the number of "takes" that occurred under the MMPA and that additional, accessory data not rising to the level of "take" (observations of unusual or rare species) are also reported.

Action Area

The proposed activities would occur in the waters of the western North Atlantic. This includes the waters off the Northeast US (ME, NH, MA, RI), the US Mid-Atlantic States (NY, NJ, DE, MD, VA, NC), the southeast US (SC, GS, FL) and Puerto Rico. The research would also involve research off Canada. The applicant would be permitted to conduct research throughout the year.

Status of listed resources

NMFS has determined that the actions considered in this Opinion may affect the following listed resources provided protection under the ESA of 1973, as amended (16 U.S.C. 1531 *et seq*.):

Cetaceans		
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
North Atlantic right whale*	*Eubalaena glacialis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Sea Turtles		
Green sea turtle – most areas	*Chelonia mydas*	Threatened
Florida and Mexico's Pacific coast breeding colonies		Endangered
Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered
Leatherback sea turtle	*Dermochelyts coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Olive ridley sea turtle – most areas	*Lepidochelys olivacea*	Threatened
Mexico's Pacific coast breeding colonies		Endangered

Marine and Anadromous Fish		
Atlantic salmon Gulf of Maine DPS	*Salmo salar*	Endangered
Atlantic sturgeon Gulf of Maine DPS New York Bight DPS Chesapeake Bay DPS Carolina DPS South Atlantic DPS	*Acipenser oxyrinchus oxyrinchus*	Threatened and Endangered
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Largetooth Sawfish	*Pristis perotteti*	Endangered
Marine Invertebrates		
Elkhorn coral*	*Acropora palmate*	Threatened
Staghorn coral*	*Acropora cervicornis*	Threatened

* denote listed species with Critical Habitat in the general area of the proposed action.

Species not considered further in this opinion

To refine the scope of this Opinion, NMFS used two criteria (risk factors) to determine whether any endangered or threatened species or critical habitat are not likely to be adversely affected by vessel traffic, aircraft traffic, or human disturbance associated with the proposed actions. The first criterion was *exposure*: if we conclude that particular endangered or threatened species or designated critical habitat are not likely to be exposed to vessel traffic, aircraft traffic, or human disturbance, we must also conclude that those listed species or designated critical habitat are not likely to be adversely affected by the proposed action. The second criterion is *susceptibility* upon exposure: species or critical habitat may be exposed to vessel traffic, aircraft traffic, or human disturbance, but may not be unaffected by those activities—either because of the circumstances associated with the exposure or the intensity of the exposure —are also not likely to be adversely affected by the vessel traffic, aircraft traffic, or human disturbance. This section summarizes the results of our evaluations.

Cetaceans

Researchers are proposing to limit their research to the targeted species (blue, humpback, fin, sei, and sperm whales) that may be in the vicinity of primarily targeted humpbacks. The directed focus of the research should avoid exposing any other listed cetacean in the action area to harassment and the potential for a ship strike during transit is highly unlikely given the experience of the observers at spotting listed species and avoiding any non-targeted species as they are encountered. If a North Atlantic right whale is observed in the action area, it would be avoided and the vessel would operate at a reduced speed, following marine mammal viewing guidelines, and therefore are not likely to be exposed to the effects from the proposed action. Therefore, issuance of permit No. 16325 is not likely to adversely affect North Atlantic right whales, and this species will not be considered further in this Opinion.

Critical habitat has been designated for the endangered North Atlantic right whale in the Great South Channel, Cape Cod Bay, and off the states of Georgia and Florida (50 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. The physical, chemical, and biotic features that form right whale critical habitat include the composition of zooplankton in feeding areas, the topographic and seasonal oceanographic characteristics conducive to zooplankton growth; and water depth, water temperatures, and distance from shore for calving and nursery areas. The action would not alter the physical and biological features that were the basis for determining this habitat to be critical; therefore this habitat is not considered further.

Sea Turtles
The action area coincides with the ranges of hawksbill sea turtles, leatherback sea turtles, Kemp's ridley sea turtles, green sea turtles (including Florida and Mexico's Pacific coast breeding colonies listed as endangered and threatened individuals in other areas), olive ridley sea turtles (including Mexico's Pacific Coast breeding colonies listed as endangered and threatened individuals in other areas) and loggerhead sea turtles (Northwest Atlantic Ocean DPSs).

Researchers are expected to have observers onboard to monitor for the presence of non-targeted listed sea turtles and will avoid the species if encountered. We consider it highly unlikely that listed sea turtles would be exposed to ship strikes or interactions with the tagging activities given that research is targeted at humpback whales and other listed cetaceans and any threats posed by the proposed action are discountable. Therefore, issuance of permit No. 16325 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
ESA-listed Atlantic salmon, Atlantic sturgeon, shortnose sturgeon, and largetooth sawfish may be present in the action area; however the proposed activities would target other species and would be conducted in a manner that is not expected to adversely affect these species. Although these listed resources may occur in the action area, we believe they are either not likely to be exposed to the proposed research or are not likely to be adversely affected. Therefore, they will not be considered further in this Opinion.

Marine Invertebrates
Two listed invertebrate species (elkhorn and staghorn coral) occur within the action area. However, researchers are expected to direct their activities offshore in deeper water than where these species typically reside and would not alter water conditions or affect the ocean bottom. Researchers are expected to take all proper precautions to avoid and/or minimize the impact of accidental fuel spills during transit. We do not anticipate these species being exposed to the effects of the proposed action. Therefore, issuance of permit No. 16325 would not affect any listed invertebrate species and these species will not be considered further in this Opinion.

Joint critical habitat designated for elkhorn and staghorn coral occurs in the Atlantic off the east coast of Florida and the Florida Keys. The essential feature important to the conservation of these coral species includes natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover. Research activities are expected to occur further offshore in deeper water than critical habitat areas designated for elkhorn and staghorn coral. Researchers are also expected to take all proper precautions to avoid and/or minimize the impact of accidental fuel spills during transit. Therefore, issuance of permit No. 16325 is not expected to affect critical habitat designated for elkhorn and staghorn coral and this resource will not be considered further in this Opinion.

Species Considered Further in this Biological Opinion
The rest of this section of our Opinion consists of narratives for each of the threatened and endangered species that occur in the action area and that may be adversely affected by the activities Dr. J. Robbins proposes to conduct. In each narrative, we present a general species description and a summary of information on the distribution and population structure of each species to provide a foundation for the exposure analyses that appear later in this Opinion. Then we summarize information on the threats to the species and the species' status given those threats to provide points of reference for the determinations we make later in this Opinion. That is, we rely on a species' status and trend to determine whether or not an action's direct or indirect effects are likely to increase the species' probability of becoming extinct.

More detailed background information on the status of these species and critical habitat can be found in a number of published documents including status reviews, recovery plans for the blue whale (NMFS 1998b), fin whales (NMFS 2010d), fin and sei whale (NMFS 1998a), humpback whale (NMFS 1991), sperm whale (NMFS 2010e), a status report on large whales prepared by Perry et al. (1999a).

Blue Whale
The blue whale, *Balaenoptera musculus* (Linnæus 1758), is a cosmopolitan species of baleen whale. Blue whales are the largest species of whale. Blue whales in the Northern Hemisphere are generally smaller than those in the Southern Ocean. Maximum body length in the North Atlantic was about 88.5 feet (27 m) and the largest blue whale reported from the North Pacific was about 88 feet (26.8 m). Adults in the Antarctic can reach a maximum body length of about 108 feet (33 m) and can weigh more than 330,000 pounds (150,000 kg).

As is true of other baleen whale species, female blue whales are somewhat larger than males. Blue whales are identified by the following characteristics: a long-body and comparatively slender shape; a broad, flat "rostrum" when viewed from above; a proportionately smaller dorsal fin than other baleen whales; and a mottled gray color pattern that appears light blue when seen through the water.

Distribution
Blue whales are found along the coastal shelves of North America and South America (Clarke 1980; Donovan 1984; Rice 1989) in the North Pacific Ocean. In the North Pacific Ocean, blue whales occur in summer foraging areas in the Chukchi Sea, the Sea of Okhotsk, around the Aleutian Islands, and the Gulf of Alaska; in the eastern Pacific, they occur south to California; in the western Pacific, they occur south to Japan. Blue whales in the eastern Pacific winter from California south; in the western Pacific, they winter from the Sea of Japan, the East China and Yellow Seas, and the Philippine Sea.

In the western North Atlantic Ocean, blue whales are found from the Arctic to at least the mid-latitude waters of the North Atlantic (CETAP 1982; Gagnon and Clark 1993; Wenzel et al. 1988;

Yochem and Leatherwood 1985). Blue whales have been observed frequently off eastern Canada, particularly in waters off Newfoundland, during the winter. In the summer month, they have been observed in Davis Strait (Mansfield 1985), the Gulf of St. Lawrence (from the north shore of the St. Lawrence River estuary to the Strait of Belle Isle), and off eastern Nova Scotia (Sears 1987a). In the eastern North Atlantic Ocean, blue whales have been observed off the Azores Islands, although Reiner et al. (1996) do not consider them common in that area.

In 1992, the U.S. Navy conducted an extensive acoustic survey of the North Atlantic using the Integrated Underwater Surveillance System's fixed acoustic array system (Clark 1995). Concentrations of blue whale sounds were detected in the Grand Banks off Newfoundland and west of the British Isles. In the lower latitudes, one blue whale was tracked acoustically for 43 days, during which time the animal traveled 1400 nautical miles around the western North Atlantic from waters northeast of Bermuda to the southwest and west of Bermuda (Gagnon and Clark 1993).

There have only been a few reliable reports of blue whales from the Gulf of Mexico and these have been of animals that had stranded in 1924 and 1940 (Würsig et al. 2000). They are assumed to occur only extralimitally in the Gulf of Mexico.

In the North Pacific Ocean, blue whales have been recorded off the island of Oahu in the main Hawaiian Islands and off Midway Island in the western edge of the Hawaiian Archipelago (Barlow 1994; Northrop et al. 1971; Thompson and Friedl 1982), although blue whales are rarely sighted in Hawaiian waters and have not been reported to strand in the Hawaiian Islands. Nishiwaki (1966) reported that blue whales occur in the Aleutian Islands and in the Gulf of Alaska. Fifteen blue whale sightings off British Columbia and in the Gulf of Alaska have been made since 1997 (Calambokidis et al. 2009). Three of these photographically verified sightings were in the northern Gulf of Alaska within 71 nm of each other and were less than 100 nm offshore (Calambokidis et al. 2009).

In the eastern tropical Pacific Ocean, the Costa Rica Dome appears to be important for blue whales based on the high density of prey (euphausiids) available in the Dome and the number of blue whales that appear to reside there (Reilly and Thayer 1990). Blue whales have been sighted in the Dome area in every season of the year, although their numbers appear to be highest from June through November.

Blue whales have also been reported year-round in the northern Indian Ocean, with sightings in the Gulf of Aden, Persian Gulf, Arabian Sea, and across the Bay of Bengal to Burma and the Strait of Malacca (Mizroch et al. 1984). The migratory movements of these whales are unknown.

Historical catch records suggest that "true" blue whales and "pygmy" blue whale (B. m. brevicada) may be geographically distinct (Brownell and Donaghue 1994; Kato et al. 1995). The distribution of the "pygmy" blue whale is north of the Antarctic Convergence, while that of the "true" blue whale is south of the Convergence in the austral summer (Kato et al. 1995). "True" blue whales occur mainly in the higher latitudes, where their distribution in mid-summer overlaps with that of the minke whale (Balaenoptera acutorostrata). During austral summers, "true" blue whales are found close to the edge of Antarctic ice (south of 58° S) with concentrations between 60°-80° E and 66°-70° S (Kasamatsu 1996).

Population Structure

For this and all subsequent species, the term "population" refers to groups of individuals whose patterns of increase or decrease in abundance over time are determined by internal dynamics (births resulting from sexual interactions between individuals in the group and deaths of those individuals) rather than external dynamics (immigration or emigration). This definition is a reformulation of definitions articulated by Futuymda (1986) and Wells and Richmond (1995) and is more restrictive than those uses of 'population' that refer to groups of individuals that co-occur in space and time but do not have internal dynamics that determine whether the size of the group increases or decreases over time (see review by Wells and Richmond 1995). The definition we apply is important to section 7 consultations because such concepts as 'population decline,' 'population collapse,' 'population extinction,' and 'population recovery' apply to the restrictive definition of 'population' but do not explicitly apply to alternative definitions. As a result, we do not treat the different whale "stocks" recognized by the International Whaling Commission or other authorities as populations unless those distinctions were clearly based on demographic criteria. We do, however, acknowledge those "stock" distinctions in these narratives.

At least three subspecies of blue whales have been identified based on body size and geographic distribution (*B. musculus intermedia*, which occurs in the higher latitudes of the Southern Oceans, *B. m. musculus*, which occurs in the Northern Hemisphere, and *B. m. brevicauda* which occurs in the mid-latitude waters of the southern Indian Ocean and north of the Antarctic convergence), but this consultation will treat them as a single entity.

In addition to these subspecies, the International Whaling Commission's Scientific Committee has formally recognized one blue whale population in the North Pacific (Donovan 1991), although there is increasing evidence that there may be more than one blue whale population in the Pacific Ocean Gilpatrick et al. (1997), Barlow et al. (1995), Mizroch et al. (1984), Ohsumi and Wada (1972). For example, studies of the blue whales that winter off Baja California and in the Gulf of California suggest that these whales are morphologically distinct from blue whales of the western and central North Pacific (Gilpatrick et al. 1997), although these differences might result from differences in the productivity of their foraging areas more than genetic differences (Barlow 1997; Calambokidis et al. 1990; Sears 1987b).

A population or "stock" of endangered blue whales occurs in waters surrounding the Hawaiian archipelago (from the main Hawaiian Islands west to at least Midway Island), although blue whales are rarely reported from Hawai'ian waters. The only reliable report of this species in the central North Pacific was a sighting made from a scientific research vessel about 400 km northeast of Hawai'i in January 1964 (NMFS 1998b). However, acoustic monitoring has recorded blue whales off Oahu and the Midway Islands much more recently (McDonald and Fox 1999; Northrop et al. 1971; Thompson and Friedl 1982).

The recordings made off Oahu showed bimodal peaks throughout the year, suggesting that the animals were migrating into the area during summer and winter (McDonald and Fox 1999;

Thompson and Friedl 1982). Twelve aerial surveys were flown within 25 nm of the main Hawaiian Islands from 1993-1998 and no blue whales were sighted. Nevertheless, blue whale vocalizations that have been recorded in these waters suggest that the occurrence of blue whales in these waters may be higher than blue whale sightings. There are no reports of blue whale strandings in Hawaiian waters.

The International Whaling Commission also groups all of the blue whales in the North Atlantic Ocean into one "stock" and groups blue whales in the Southern Hemisphere into six "stocks" (Donovan 1991) which are presumed to follow the feeding distribution of the whales.

Threats to the Species

Natural Threats. Natural causes of mortality in blue whales are largely unknown, but probably include predation and disease (not necessarily in their order of importance). Blue whales are known to become infected with the nematode *Carricauda boopis* (Baylis 1928), which are believed to have caused fin whales to die as a result of renal failure (Lambertsen 1986); see additional discussion under Fin whales). Killer whales and sharks are also known to attack, injure, and kill very young or sick fin and humpback whale and probably hunt blue whales as well (Perry et al. 1999a).

Anthropogenic Threats. Two human activities are known to threaten blue whales: whaling and shipping. Historically, whaling represented the greatest threat to every population of blue whales and was ultimately responsible for listing blue whales as an endangered species. As early as the mid-seventeenth century, the Japanese were capturing blue, fin, and other large whales using a fairly primitive open-water netting technique (Cherfas 1992; Tonnessen and Johnsen 1982). In 1864, explosive harpoons and steam-powered catcher boats were introduced in Norway, allowing the large-scale exploitation of previously unobtainable whale species. Before fin whales became the focus of whaling operations, populations of blue whales had already become commercially extinct (IWC 2005).

From 1889 to 1965, whalers killed about 5,761 blue whales in the North Pacific Ocean (NMFS 1998b). From 1915 to 1965, the number of blue whales captured declined continuously (Mizroch et al. 1984). Evidence of a population decline was seen in the catch data from Japan. In 1912, whalers captured 236 blue whales; in 1913, 58 blue whales; in 194, 123 blue whales; from 1915 to 1965, the number of blue whales captured declined continuously (Mizroch et al. 1984). In the eastern North Pacific, whalers killed 239 blue whales off the California coast in 1926. And, in the late 1950s and early 1960s, Japanese whalers killed 70 blue whales per year off the Aleutian Islands (Mizroch et al. 1984).

Although the International Whaling Commission banned commercial whaling in the North Pacific in 1966, Soviet whaling fleets continued to hunt blue whales in the North Pacific for several years after the ban. Surveys conducted in these former-whaling areas in the 1980s and 1990s failed to find any blue whales (Forney and Brownell Jr. 1996).

By 1967, Soviet scientists wrote that blue whales in the North Pacific Ocean (including the eastern Bering Sea and Prince William Sound) had been so overharvested by Soviet whaling fleets that some scientists concluded that any additional harvests were certain to cause the species to become extinct in the North Pacific (Latishev 2007). As its legacy, whaling has reduced blue whales to a fraction of their historic population size and, as a result, makes it easier for other human activities to push blue whales closer to extinction. Otherwise, whaling currently does not threaten blue whale populations.

In 1980, 1986, 1987, and 1993, ship strikes were implicated in the deaths of blue whales off California (Barlow 1997). More recently, Berman-Kowalewski et al. (2010) reported that between 1988 and 2007, 21 blue whale deaths were reported along the California coast, typically one or two cases annually. In addition, several photo-identified blue whales from California waters were observed with large scars on their dorsal areas that may have been caused by ship strikes. Studies have shown that blue whales respond to approaching ships in a variety of ways, depending on the behavior of the animals at the time of approach, and speed and direction of the approaching vessel.

While feeding, blue whales react less rapidly and with less obvious avoidance behavior than whales that are not feeding (Sears 1983). Within the St. Lawrence Estuary, blue whales are believed to be affected by large amounts of recreational and commercial vessel traffic. Blue whales in the St. Lawrence appeared more likely to react to these vessels when boats made fast, erratic approaches or sudden changes in direction or speed (Edds and Macfarlane 1987).

Status

Blue whales were listed as endangered under the ESA in 1973. Blue whales are listed as endangered on the IUCN Red List of Threatened Animals (IUCN 2010). They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for blue whales.

It is difficult to assess the current status of blue whales because (1) there is no general agreement on the size of the blue whale populations prior to whaling and (2) estimates of the current size of the different blue whale populations vary widely. We may never know the size of the blue whale population prior to whaling, although some authors have concluded that there were about 200,000 animals before whaling. Similarly, estimates of the global abundance of blue whales are uncertain. Since the cessation of whaling, the global population of blue whales has been estimated to range from 11,200 to 13,000 animals (Maser et al. 1981). These estimates, however, are more than 20 years old.

A lot of uncertainty surrounds estimates of blue whale abundance in the North Pacific Ocean. Barlow (1994) estimated the North Pacific population of blue whales at approximately 1,400 to 1,900. Barlow (1995) estimated the abundance of blue whales off California at 2,200 individuals. Wade and Gerrodette (1993) and Barlow et al. (1997) estimated there were a minimum of 3,300 blue whales in the North Pacific Ocean in the 1990s.

The size of the blue whale population in the north Atlantic is also uncertain. The population has been estimated to number from a few hundred individuals (Allen 1970; Mitchell 1974b) to 1,000 to 2,000 individuals (Sigurjónsson 1995). Gambell (1976) estimated there were between 1,100 and 1,500 blue whales in the North Atlantic before whaling began and Braham (1991) estimated there were between 100 and 555 blue whales in the North Atlantic during the late 1980s and early 1990s. Sears et al. (1987) identified over 300 individual blue whales in the Gulf of St. Lawrence, which provides a minimum estimate for their population in the North Atlantic. Sigurjónsson and Gunnlaugson (1990) concluded that the blue whale population had been increasing since the late 1950s and argued that the blue whale population had increased at an annual rate of about 5 percent between 1979 and 1988, although the level of confidence we can place in these estimates is low.

Estimates of the number of blue whales in the Southern Hemisphere range from 5,000 to 6,000 (Yochem and Leatherwood 1985) with an average rate of increase that has been estimated at between 4 and 5 percent per year. Butterworth et al. (1993), however, estimated the Antarctic population at 710 individuals. More recently, Stern (2001) estimated the blue whale population in the Southern Ocean at between 400 and 1,400 animals (c.v. 0.4). The pygmy blue whale population has been estimated at 6,000 individuals (Yochem and Leatherwood 1985).

The information available on the status and trend of blue whales do not allow us to reach any conclusions about the extinction risks facing blue whales as a species, or particular populations of blue whales. With the limited data available on blue whales, we do not know whether these whales exist at population sizes large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as “small” populations (that is, “small” populations experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their population size to become a threat in and of itself) or if blue whales are threatened more by exogenous threats such as anthropogenic activities (primarily whaling, entanglement, and ship strikes) or natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate).

Critical Habitat

Critical habitat has not been designated for blue whales.

Fin Whale

Fin whales (*Balaenoptera physalus*) are the second-largest species of whale, with a maximum length of about 75 ft (22 m) in the Northern Hemisphere, and 85 ft (26 m) in the Southern Hemisphere. Fin whales show mild sexual dimorphism, with females measuring longer than males by 5-10 percent. Adults can weigh between 80,000-160,000 lbs (40-80 tons).

Fin whales have a sleek, streamlined body with a V-shaped head. They have a tall, falcate dorsal fin, located about two-thirds of the way back on the body, that rises at a shallow angle from the animal's back. The species has a distinctive coloration pattern: the back and sides of the body are black or dark brownish-gray, and the ventral surface is white. The unique, asymmetrical head color is dark on the left side of the lower jaw, and white on the right side. Many individuals have several light-gray, V-shaped "chevrons" behind their head, and the underside of the tail flukes is white with a gray border.

Distribution

Fin whales are distributed widely in every ocean except the Arctic Ocean. In the North Pacific Ocean, fin whales occur in summer foraging areas in the Chukchi Sea, the Sea of Okhotsk, around the Aleutian Islands, and the Gulf of Alaska; in the eastern Pacific, they occur south to California; in the western Pacific, they occur south to Japan. Fin whales in the eastern Pacific winter from California south; in the western Pacific, they winter from the Sea of Japan, the East China and Yellow Seas, and the Philippine Sea (Gambell 1985a).

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 from 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 50° S in the summer and migrate into the Atlantic, Indian, and Pacific Oceans in the winter, 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).

Fin whales are common off the Atlantic coast of the United States in waters immediately off the coast seaward to the continental shelf (about the 1,000-fathom contour). In this region, they tend to occur north of Cape Hatteras where they accounted for about 46 percent of the large whales observed in surveys conducted between 1978 and 1982. During the summer months, fin whales in this region tend to congregate in feeding areas between 41°20'N and 51°00'N, from shore seaward to the 1,000-fathom contour. Fin whales in the eastern North Atlantic have been found in highest densities in the Irminger Sea between Iceland and Greenland (Víkingsson et al. 2009). In the Atlantic Ocean, a general migration in the fall from the Labrador and Newfoundland region, south past Bermuda, and into the West Indies has been theorized (Clark 1995). Historically, fin whales were by far the most common large whale found off Portugal (Brito et al. 2009).

In the Atlantic Ocean, Clark (1995) reported a general southward pattern of fin whale migration in the fall from the Labrador and Newfoundland region, south past Bermuda, and into the West Indies. The overall distribution may be based on prey availability, and fin whales are found throughout the action area for this consultation in most months of the year. This species preys opportunistically on both invertebrates and fish (Watkins et al. 1984). They feed by filtering large volumes of water for the associated prey. Fin whales are larger and faster than humpback and right whales and are less concentrated in nearshore environments.

Fin whales have been reported more frequently than blue whales in the Gulf of Mexico, although many of these reports are probably of Bryde's whales, which are more common in the Gulf. Like blue whales, fin whales are assumed to occur only extralimitally in the Gulf of Mexico (Jefferson and Schiro 1997; Würsig et al. 2000).

Population Structure

Fin whales have two recognized subspecies: *Balaoptera physalus physalus* occurs in the North Atlantic Ocean while *B. p. quoyi* (Fischer 1829) occurs in the Southern Ocean. Globally, fin whales are sub-divided into three major groups: Atlantic, Pacific, and Antarctic. Within these major areas, different organizations use different population structure.

In the North Atlantic Ocean, the International Whaling Commission recognizes seven management units or "stocks" of fin whales: (1) Nova Scotia, (2) Newfoundland-Labrador, (3) West Greenland, (4) East Greenland-Iceland, (5) North Norway, (6) West Norway-Faroe Islands, and (7) British Isles-Spain-Portugal. In addition, the population of fin whales that resides in the Ligurian Sea, in the northwestern Mediterranean Sea is believed to be genetically distinct from other fin whales populations (as used in this Opinion, "populations" are isolated demographically, meaning, they are driven more by internal dynamics — birth and death processes — than by the geographic redistribution of individuals through immigration or emigration. Some usages of the term "stock" are synonymous with this definition of "population" while other usages of "stock" do not).

In the North Pacific Ocean, the International Whaling Commission recognizes two "stocks": (1) East China Sea and (2) rest of the North Pacific (Donovan, 1991). However, Mizroch et al. (1984) concluded that there were 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. Based on genetic analyses, Berube 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; Sigurjonsson et al. 1989), which suggests that these management units are not geographically isolated populations.

Mizroch et al. (1984) identified five fin whale "feeding aggregations" in the Pacific Ocean: (1) eastern and western groups that move along the Aleutians (Berzin and Rovnin. 1966; Nasu 1974); (2) an East China Sea group; (3) a group that moves north and south along the west coast of North America between California and the Gulf of Alaska (Rice 1974); and (4) a group centered in the Sea of Cortez (Gulf of California).

Hatch (2004) reported that fin whale vocalizations among five regions of the eastern North Pacific were heterogeneous: the Gulf of Alaska, the northeast North Pacific (Washington and British Columbia), the southeast North Pacific (California and northern Baja California), the Gulf of California, and the eastern tropical Pacific.

Sighting data show no evidence of migration between the Sea of Cortez and adjacent areas in the Pacific, but seasonal changes in abundance in the Sea of Cortez suggests that these fin whales might not be isolated (Tershy et al. 1993). Nevertheless, Bérubé et al. (2002) concluded that the Sea of Cortez fin whale population is genetically distinct from the oceanic population and has lower genetic diversity, which suggests that these fin whales might represent an isolated population.

Threats to the Species

Natural Threats. Natural sources and rates of mortality are largely unknown, but Aguilar and Lockyer (1987) suggest annual natural mortality rates may range from 0.04 to 0.06. These results are based on studies of fin whales in the northeast Atlantic; there are no comparable estimates for fin whales in the Pacific Ocean. The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in fin whales and may be preventing some fin whale stocks from recovering from whaling (Lambertsen 1992). Killer whale or shark attacks may injure or kill very young or sick whales (Perry et al. 1999a).

Anthropogenic Threats. Fin whales have undergone significant exploitation, but are currently protected under the IWC's global moratorium on whaling. Fin whales are still hunted in subsistence fisheries off West Greenland. In 2004, five males and six females were killed, and two other fin whales were struck and lost. In 2003, two males and four females were landed and two others were struck and lost (IWC 2005). Between 2003 and 2007, the IWC set a catch limit of up to 19 fin whales in this subsistence fishery. However, the scientific recommendation was to limit the number killed to four individuals until accurate populations could be produced (IWC 2005). In the Antarctic Ocean, fin whales are hunted by Japanese whalers who have been allowed to kill up to 10 fin whales each ear for the 2005-2006 and 2006-2007 seasons under an Antarctic Special Permit. The Japanese whalers plan to kill 50 whales per year starting in the 2007-2008 season and continuing for the next 12 years (IWC 2006; Nishiwaki et al. 2006).

Fin whales experience significant injury and mortality from fishing gear and ship strikes (Carretta et al. 2007; Douglas et al. 2008; Lien 1994; Perkins and Beamish 1979; Waring et al. 2007). Between 1969 and 1990, 14 fin whales were captured in coastal fisheries off Newfoundland and Labrador; of these seven are known to have died because of capture (Lien 1994; Perkins and Beamish 1979). In 1999, one fin whale was reported killed in the Gulf of Alaska pollock trawl fishery and one was killed the same year in the offshore drift gillnet fishery (Angliss and Outlaw 2005; Carretta and Chivers. 2004). According to Waring et al. (2007), four fin whales in the western North Atlantic died or were seriously injured in fishing gear, while another five were killed or injured as a result of ship strikes between January 2000 and December 2004. Jensen and Silber (2004) review of the NMFS' ship strike database revealed fin whales as the most frequently confirmed victims of ship strikes (26 percent of the recorded ship strikes [n = 75/292 records]), with most collisions occurring off the east coast, followed by the west coast of the U.S. and Alaska/Hawaii. Between 1999-2005, there were 15 reports of fin whales strikes by vessels along the U.S. and Canadian Atlantic coasts (Cole et al. 2005; Nelson et al. 2007). Of these, 13 were confirmed, resulting in the deaths of 11 individuals. Five of seven fin whales stranded along Washington State and Oregon showed evidence of ship strike with incidence increasing since 2002 (Douglas et al. 2008). Similarly, 2.4 percent of living fin whales from the Mediterranean show ship strike injury and 16 percent of stranded individuals were killed by vessel collision (Panigada et al. 2006). There are also numerous reports of ship strikes off the Atlantic coasts of France and England (Jensen and Silber 2004).

Management measures aimed at reducing the risk of ships hitting right whales should also reduce the risk of collisions with fin whales. In the Bay of Fundy, recommendations for slower vessel speeds to avoid right whale ship strike appear to be largely ignored (Vanderlaan et al. 2008). However, new rules for seasonal (June through December) slowing of vessel traffic to 10 knots and changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are predicted to be capable of reducing ship strike mortality by 27 percent in the Bay of Fundy region.

The organochlorines DDE, DDT, and PCBs have been identified from fin whale blubber, but levels are lower than in toothed whales due to the lower level in the food chain that fin whales feed at (Aguilar and Borrell 1988; Borrell 1993; Borrell and Aguilar 1987; Henry and Best 1983; Marsili and Focardi 1996). Females contained lower burdens than males, 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).

Climate change also presents a potential threat to fin whales, particularly in the Mediterranean Sea, where fin whales appear to rely exclusively upon northern krill as a prey source. These krill occupy the southern extent of their range and increases in water temperature could result in their decline and that of fin whales in the Mediterranean Sea (Gambaiani et al. 2009).

Status

Fin whales were listed as endangered under the ESA in 1970. In 1976, the IWC protected fin whales from commercial whaling. Fin whales are listed as endangered on the IUCN Red List of Threatened Animals (IUCN 2010). They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for fin whales.

It is difficult to assess the current status of fin whales because (1) there is no general agreement on the size of the fin whale populations prior to whaling and (2) estimates of the current size of the different fin whale populations vary widely (NMFS 2006). We may never know the size of the fin whale populations prior to whaling. The most current estimate of the population size of fin whales in the Pacific Ocean is 85,200 (no coefficient of variance or confidence interval was provided) based on the history of catches and trends in catches per unit of effort (IWC 1979). Based on surveys conducted south of 30°S latitude between 1978 and 1988, fin whales in the Southern Ocean were estimated to number about 400,000 (IWC 1979), no coefficient of variance or confidence interval was provided).

Chapman (1976) estimated the "original" population size of fin whales off Nova Scotia as 1,200 and 2,400 off Newfoundland, although he offered no explanation or reasoning to support that estimate. Sergeant (1977) suggested that between 30,000 and 50,000 fin whales once populated the North Atlantic Ocean based on assumptions about catch levels during the whaling period. Sigurjónsson (1995) estimated that between 50,000 and 100,000 fin whales once populated the North Atlantic, although he provided no data or evidence to support that estimate. More recently, Palumbi and Roman (2006) estimated that about 360,000 fin whales (95 percent confidence interval = 249,000 - 481,000) populated the North Atlantic Ocean before whaling based on mutation rates and estimates of genetic diversity.

Similarly, estimates of the current size of the different fin whale populations and estimates of their global abundance also vary widely. The draft recovery plan for fin whales accepts a minimum population estimate of 2,362 fin whales for the North Atlantic Ocean (NMFS 2006); however, the recovery plan also states that this estimate, which is based on shipboard and aerial surveys conducted in the Georges Bank and Gulf of St. Lawrence in 1999 is the “best” estimate of the size of this fin whale population (NMFS 2010c). However, based on data produced by surveys conducted between 1978-1982 and other data gathered between 1966 and 1989, Hain et al. (1992) estimated that the population of fin whales in the western North Atlantic Ocean (specifically, between Cape Hatteras, North Carolina, and Nova Scotia) numbered about 1,500 whales in the winter and 5,000 whales in the spring and summer. Because authors do not always reconcile “new” estimates with earlier estimates, it is not clear whether the current “best” estimate represents a refinement of the estimate that was based on older data or whether the fin whale population in the North Atlantic has declined by about 50 percent since the early 1980s. The 2010 U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Report indicates the best abundance estimate for the western North Atlantic fin whale stock is 3,985 (cv=0.24) based on 2006 Gulf of Maine surveys and 2007 northern Labrador to Scotian Shelf surveys (Waring et al. 2011).

The East Greenland-Iceland fin whale population was estimated at 10,000 animals (95 percent confidence interval = 7,600 - 14,200), based on surveys conducted in 1987 and 1989 (Buckland et al. 1992). The number of eastern Atlantic fin whales, which includes the British Isles-Spain-Portugal population, has been estimated at 17,000 animals (95 percent confidence interval = 10,400 -28,900; (Buckland et al. 1992). These estimates are both more than 15 years old and the data available do not allow us to determine if they remain valid.

Forcada et al. (1996) estimated there were 3,583 fin whales in the western Mediterranean (standard error = 967; 95 percent confidence interval = 2,130 - 6,027), which is similar to an estimate published by Notarbartolo-di-Sciara et al. (2003). In the Mediterraneans’ Ligurian Sea (which includes the Pelagos Whale Sanctuary and the Gulf of Lions), Forcada et al. (1995) estimated there were 901 fin whales (standard error = 196.1).

Regardless of which of these estimates, if any, come closest to actual population sizes, these estimates suggest that the global population of fin whales consists of tens of thousands of individuals. Based on ecological theory and demographic patterns derived from several hundred imperiled species and populations, fin whales appear to exist at population sizes that are large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as “small” populations (that is, “small” populations experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their population size to become a threat in and of itself). As a result, we assume that fin whales are likely to be threatened more by exogenous threats such as anthropogenic activities (primarily whaling, entanglement, and ship strikes) or natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) than endogenous threats caused by the small size of their population.

Nevertheless, based on the evidence available, the number of fin whales that are recorded to have been killed or injured in the past 20 years by human activities or natural phenomena, does not appear to be increasing the extinction probability of fin whales, although it may slow the rate at which they recover from population declines that were caused by commercial whaling.

Critical Habitat

Critical habitat has not been designated for fin whales.

Humpback Whale

Humpback whales are well known for their long "pectoral" fins, which can be up to 15 feet (4.6 m) in length. Their scientific name, *Megaptera novaeangliae*, means "big-winged New Englander" as the New England population was the one best known to Europeans. These long fins give them increased maneuverability; they can be used to slow down or even go backwards. Similar to all baleen whales, adult females are larger than adult males, reaching lengths of up to 60 feet (18 m). Their body coloration is primarily dark grey, but individuals have a variable amount of white on their pectoral fins and belly. This variation is so distinctive that the pigmentation pattern on the undersides of their "flukes" is used to identify individual whales, similar to a humans fingerprint.

Humpback whales are the favorite of whale watchers, as they frequently perform aerial displays, such as breaching (jumping out of the water), or slap the surface with their pectoral fins, tails, or heads.

Distribution

Humpback whales are a cosmopolitan species that occur in the Atlantic, Indian, Pacific, and Southern Oceans. Humpback whales migrate seasonally between warmer, tropical or sub-tropical waters in winter months (where they reproduce and give birth to calves) and cooler, temperate or sub-Arctic waters in summer months (where they feed). In their summer foraging areas and winter calving areas, humpback whales tend to occupy shallower, coastal waters; during their seasonal migrations, however, humpback whales disperse widely in deep, pelagic waters and tend to avoid shallower coastal waters (Winn and Reichley 1985).

In the North Pacific Ocean, the summer range of humpback whales includes coastal and inland waters from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Johnson and Wolman 1984; Nemoto 1957; Tomilin 1967). These whales migrate to Hawai'i, southern Japan, the Mariana Islands, and Mexico during the winter.

In the Atlantic Ocean, humpback whales range from the mid-Atlantic bight, the Gulf of Maine, across the southern coast of Greenland and Iceland, and along the coast of Norway in the Barents Sea. These humpback whales migrate to the western coast of Africa and the Caribbean Sea during the winter (Boye et al. 2010; Katona and Beard 1990; Smith et al. 1999b).

In the Southern Ocean, humpback whales occur in waters off Antarctica. These whales 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. 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; Rasmussen et al. 2007).

Population Structure

Descriptions of the population structure of humpback whales differ depending on whether an author focuses on where humpback whales winter or where they feed. During winter months in northern or southern hemispheres, adult humpback whales migrate to specific areas in warmer, tropical waters to reproduce and give birth to calves. During summer months, humpback whales migrate to specific areas in northern temperate or sub-arctic waters to forage. In summer months, humpback whales from different "reproductive areas" will congregate to feed; in the winter months, whales will migrate from different foraging areas to a single wintering area. In either case, humpback whales appear to form "open" populations; that is, populations that are connected through the movement of individual animals.

<u>North Pacific Ocean</u>. NMFS' Stock Assessment Reports recognize four "stocks" of humpback whales in the North Pacific Ocean, based on genetic and photo-identification studies: two Eastern North Pacific stocks, one Central North Pacific stock, and one Western Pacific stock (Hill and DeMaster 1998). The first two of these "stocks" are based on where these humpback whales winter: the central North Pacific "stock" winters in the waters around Hawai'i while the eastern North Pacific "stock" (also called the California-Oregon-Washington-Mexico stock) winters along coasts of Central America and Mexico. However, Calambokidis et al. (1997) identified humpback whales from Southeast Alaska (central North Pacific), the California-Oregon-Washington (eastern North Pacific), and Ogasawara Islands (Japan, Western Pacific) groups in the Hawai'ian Islands during the winter; humpback whales from the Kodiak Island, Southeast Alaska, and British Columbia groups in the Ogasawara Islands; and whales from the British Columbia, Southeast Alaska, Prince William Sound, and Shumagin-Aleutian Islands groups in Mexico.

Herman (1979), however, presented extensive evidence and various lines of reasoning to conclude that the humpback whales associated with the main Hawaiian Islands immigrated to those waters only in the past 200 years. Winn and Reichley (1985) identified genetic exchange between the humpback whales that winter off Hawai'i and those that winter off Mexico (with further mixing on feeding areas in Alaska) and suggested that the humpback whales that winter in Hawai'i may have emigrated from wintering areas in Mexico. Based on these patterns of movement, we conclude that the various "stocks" of humpback whales are not true populations or, at least, they represent populations that experience substantial levels of immigration and emigration.

Between 2004 and 2006, an international group of whale researchers coordinated their surveys to conduct a comprehensive assessment of the population structure, levels of abundance, and status of humpback whales in the North Pacific (Calambokidis et al. 2008). That effort identified a total of 7,971 unique individuals from photographs taken during close approaches.

<u>North Atlantic Ocean</u>. In the Atlantic Ocean, humpback whales aggregate in four feeding areas in the summer months: (1) Gulf of Maine, eastern Canada, (2) west Greenland, (3) Iceland and

(4) Norway (Katona and Beard 1990; Smith et al. 1999a). The principal breeding range for these whales lies from the Antilles and northern Venezuela to Cuba (Balcomb III and Nichols Jr. 1982; Whitehead 1982; Winn et al. 1975). The largest contemporary breeding aggregations occur off the Greater Antilles where humpback whales from all of the North Atlantic feeding areas have been identified from photographs (Katona and Beard 1990; Smith et al. 1999a) (Clapham 1993; Mattila et al. 1994; Palsbøll et al. 1997; Stevick et al. 2003). Historically, an important breeding aggregation was located in the eastern Caribbean based on the important humpback whale fisheries this region supported (Mitchell and Reeves 1983; Reeves et al. 2001; Smith and Reeves 2003). Although sightings persist in those areas, modern humpback whale abundance appears to be low (Levenson and Leapley 1978; Swartz et al. 2003; Winn et al. 1975). Winter aggregations also occur at the Cape Verde Islands in the Eastern North Atlantic (Reiner et al. 1996) (Reeves and Smith. 2002). In another example of the "open" structure of humpback whale populations, an individual humpback whale migrated from the Indian Ocean to the South Atlantic Ocean and demonstrated that individual whales may migrate from one ocean basin to another (Pomilla and Rosenbaum 2005).

Indian Ocean. As discussed previously, 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).

Threats to the Species

Natural Threats. There is limited information on natural phenomena that kill or injure humpback whales. We know that humpback whales are killed by orcas (Florezgonzalez et al. 1994; Whitehead and Glass. 1985) and are probably killed by false killer whales and sharks. Because 7 female and 7 male humpback whales stranded on the beaches of Cape Cod and had died from toxin produced by dinoflagellates between November 1987 and January 1988, we also know that adult and juvenile humpback whales are killed by naturally-produced biotoxins (Geraci et al. 1989).

Other natural sources of mortality, however, remain largely unknown. Similarly, we do not know whether and to what degree natural mortality limits or restricts patterns of growth or variability in humpback whale populations.

Anthropogenic Threats. Three human activities are known to threaten humpback whales: whaling, commercial fishing, and shipping. Historically, whaling represented the greatest threat to every population of humpback whales and was ultimately responsible for listing humpback whales as an endangered species. From 1900 to 1965, nearly 30,000 whales were taken in modern whaling operations of the Pacific Ocean. Prior to that, an unknown number of humpback whales were taken (Perry et al. 1999a). In 1965, the International Whaling Commission banned commercial hunting of humpback whales in the Pacific Ocean. As its legacy, whaling has reduced humpback whales to a fraction of their historic population size and, as a result, makes it easier for other human activities to push these whales closer to extinction.

Humpback whales are also killed or injured during interactions with commercial fishing gear. Like fin whales, humpback whales have been entangled by fishing gear off Newfoundland and Labrador, Canada: a total of 595 humpback whales are reported to have been captured in coastal fisheries in those two provinces between 1969 and 1990 (Lien 1994; Perkins and Beamish 1979). Of these whales, 94 are known to have died as a result of that capture, although, like fin whales, most of the animals that died were smaller (less than 12 meters in length) (Lien 1994). These data suggest that, despite their size and strength, humpback whales are likely to be entangled and, in some cases, killed by gear used in modern fisheries.

There are also reports of entangled humpback whales from the Hawaiian Islands. In 1991, a humpback whale was observed entangled in longline gear and released alive (Hill et al. 1997). 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. Also in 1996, a vessel from Pacific Missile Range Facility in Hawai'i rescued an entangled humpback, removing two crab pot floats from the whale. From 2001 through 2006, there were 23 reports of entangled humpback whales in Hawaiian waters; 16 of these reports were from 2005 and 2006.

Many of the entangled humpback whales observed in Hawaiian waters brought the gear with them from higher latitude feeding grounds; for example, the whale the U.S. Navy rescued in 1996 had been entangled in gear that was traced to a recreational fisherman in southeast Alaska. Thus far, 6 of the entangled humpback whales observed in the Hawaiian Islands have been confirmed to have been entangled in gear from Alaska. Nevertheless, humpback whales are also entangled in fishing gear in the Hawaiian Islands. Since 2001, there have been 5 observed interactions between humpback whales and gear associated with the Hawai'i-based longline fisheries (NMFS 2008d). In each instance, however, all of the whales were disentangled and released or they were able to break free from the gear without reports of impairment of the animal's ability to swim or feed.

Along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada, there were 160 reports of humpback whales being entangled in fishing gear between 1999 and 2005 (Cole et al. 2005; Nelson et al. 2007). Of these reports, 95 entanglements were confirmed resulting in the injury of 11 humpback whales and the death of 9 whales. No information is available on the number of humpback whales that have been killed or seriously injured by interactions with fishing fleets outside of U.S. waters.

The number of humpback whales killed by ship strikes is exceeded only by fin whales (Jensen and Silber 2003). On the Pacific coast, a humpback whale is killed about every other year by ship strikes (Barlow et al. 1997). The humpback whale calf that was found stranded on Oahu with evidence of vessel collision (propeller cuts) in 1996 suggests that ship collisions might kill adults, juvenile, and calves (NMFS unpublished data). Of 123 humpback whales that stranded along the Atlantic Coast of the U.S. between 1975 and 1996, 10 (8.1 percent) showed evidence of collisions with ships (Laist et al. 2001). Between 1999 and 2005, there were 18 reports of humpback whales being struck by vessels along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada (Cole et al. 2005; Nelson et al. 2007). Of these reports, 13 were confirmed as ship strikes which were reported as having resulted in the death of 7 humpback whales. Despite several literature searches, we did not identify information on the number of humpback whales killed or seriously injured by ship strikes outside of U.S. waters.

In addition to ship strikes in North America and Hawai'i, there are several reports of humpback whales being injured as a result of ship strikes off the Antarctic Peninsula, in the Caribbean Sea, the Mediterranean Sea, off Australia, Bay of Bengal (Indian Ocean), Brazil, New Zealand, Peru, and South Africa.

Status

Humpback whales were listed as endangered under the ESA in 1973. Humpback whales are listed as a species of least concern on the IUCN Red List of Threatened Animals (IUCN 2010). They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for humpback whales. It is difficult to assess the current status of humpback whales for the same reasons that it is difficult to assess the status of fin whales: (1) there is no general agreement on the size of the humpback whale population prior to whaling and (2) estimates of the current size of the different humpback whale populations vary widely and produce estimates that are not always comparable to one another, although robust estimates of humpback whale populations in the western North Atlantic have been published. We may never know the size of the humpback whale population prior to whaling.

Winn and Reichley (1985) argued that the global population of humpback whales consisted of at least 150,000 whales in the early 1900s, with the largest population historically occurring in the Southern Ocean. Based on analyses of mutation rates and estimates of genetic diversity, Palumbi and Roman (2006) concluded that there may have been as many as 240,000 (95 percent confidence interval = 156,000 – 401,000) humpback whales in the North Atlantic before whaling began. In the western North Atlantic between Davis Strait, Iceland and the West Indies, Mitchell and Reeves (1983) estimated there were at least 4,685 humpback whales in 1865 based on available whaling records (although the authors note that this does not represent a "pre-exploitation estimate" because whalers from Greenland, the Gulf of St. Lawrence, New England, and the Caribbean Sea had been hunting humpback whales before 1865).

Estimates of the number of humpback whales occurring in the different populations that inhabit the Northern Pacific population have risen over time. In the 1980s, the size of the North Pacific humpback whale population was estimated to range from 1,407 to 2,100 (Baker 1985; Baker and Herman. 1987; Calambokidis et al. 1997; Darling and Morowitz 1986). By the mid-1990s, the population was estimated to consist of about 6,000 whales (standard error = 474) in the North Pacific (Calambokidis et al. 1997; Cerchio 1998; Mobley et al. 2001).

As discussed previously, between 2004 and 2006, an international group of whale researchers coordinated their surveys to conduct a comprehensive assessment of the population structure, levels of abundance, and status of humpback whales in the North Pacific (Calambokidis et al. 2008). That effort identified a total of 7,971 unique individuals from photographs taken during close approaches. Of this total, 4,516 individuals were identified at wintering regions in at least one of the three seasons in which the study surveyed wintering area and 4,328 individuals were identified at least once at feeding areas in one of the two years in which the study surveyed feeding areas. 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 whales, not counting calves. Almost half of the humpback whales that were estimated to occur in wintering areas, or about 8,000 humpback whales, occupy the Hawaiian Islands during the winter months.

In the North Atlantic, Stevick et al. (2003) estimated the size of the humpback whale population between 1979 and 1993 by applying statistical analyses that are commonly used in capture-recapture studies to individual humpback whales that were identified based on natural markings. Between 1979 and 1993, they estimated that the North Atlantic populations (what they call the "West Indies breeding population") consisted of between 5,930 and 12,580 individual whales. The best estimate they produced (11,570; 95 percent confidence interval = 10,290 -13,390) was based on samples from 1992 and 1993. If we assume that this population has grown according to the instantaneous rate of increase Stevick et al. (2003) estimated for this population ($r = 0.0311$), this would lead us to estimate that this population might consist of about 18,400 individual whales in 2007-2008.

Regardless of which of these estimates, if any, most closely correspond to the actual size and trend of the humpback whale population, all of these estimates suggest that the global population of humpback whales consists of tens of thousands of individuals, that the North Atlantic population consists of at least 2,000 individuals and the North Pacific population consists of about 18,000 individuals. Based on ecological theory and demographic patterns derived from several hundred imperiled species and populations, humpback whales appear to exist at population sizes that are large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as "small" populations (that is, "small" populations experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their population size to become a threat in and of itself). As a result, we assume that humpback whales will have elevated extinction probabilities because of exogenous threats caused by anthropogenic activities (primarily whaling, entanglement, and ship strikes) and natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) rather than endogenous threats caused by the small size of their population.

Critical Habitat
Critical habitat has not been designated for humpback whales.

Sei Whale
Sei whales (pronounced "say" or "sigh") are members of the baleen whale family and are considered one of the "great whales" or rorquals. Two subspecies of sei whales are recognized, *B. b. borealis* in the Northern Hemisphere and *B. B. schlegellii* in the Southern Hemisphere. These large animals can reach lengths of about 40-60 ft (12-18 m) and weigh 100,000 lbs (45,000 kg). Females may be slightly longer than males. Sei whales have a long, sleek body that is dark bluish-gray to black in color and pale underneath. The body is often covered in oval-shaped scars (probably caused from cookie-cutter shark and lamprey bites) and sometimes has subtle "mottling". This species has an erect "falcate", "dorsal" fin located far down (about two-thirds) the animals back. They often look similar in appearance to Bryde's whales, but can be distinguished by the presence of a single ridge located on the animal's "rostrum". Bryde's whales, unlike other rorquals, have three distinct prominent longitudinal ridges on their rostrum. Sei whales have 219-410 baleen plates that are dark in color with gray/white fine inner fringes in

their enormous mouths. They also have 30-65 relatively short ventral pleats that extend from below the mouth to the naval area. The number of throat grooves and baleen plates may differ depending on geographic population.

When at the water's surface, sei whales can be sighted by a columnar or bushy blow that is about 10-13 feet (3-4 m) in height. The dorsal fin usually appears at the same time as the blowhole, when the animal surfaces to breathe. This species usually does not arch its back or raise its flukes when diving.

Sei whales are usually observed singly or in small groups of 2-5 animals, but are occasionally found in larger (30-50) loose aggregations. Sei whales are capable of diving 5-20 minutes to opportunistically feed on plankton (e.g., copepods and krill), small schooling fish, and cephalopods (e.g., squid) by both gulping and skimming. They prefer to feed at dawn and may exhibit unpredictable behavior while foraging and feeding on prey. Sometimes seabirds are associated with the feeding frenzies of these and other large whales.

Sei whales become sexually mature at 6-12 years of age when they reach about 45 ft (13 m) in length, and generally mate and give birth during the winter in lower latitudes. Females breed every 2-3 years, with a gestation period of 11-13 months. Females give birth to a single calf that is about 15 ft (4.6 m) long and weighs about 1,500 lbs (680 kg). Calves are usually nursed for 6-9 months before being weaned on the preferred feeding grounds. Sei whales have an estimated lifespan of 50-70 years.

Distribution

Sei whales occur in every ocean except the Arctic Ocean. The migratory pattern of this species is thought to encompass long distances from high-latitude feeding areas in summer to low-latitude breeding areas in winter; however, the location of winter areas remains largely unknown (Perry et al. 1999a). Sei whales are often associated with deeper waters and areas along the continental shelf edge (Hain et al. 1985); however, this general offshore pattern of sei whale distribution is disrupted during occasional incursions into more shallow and inshore waters (Waring et al. 2011; Waring et al. 2004).

In the western Atlantic Ocean, sei whales occur from Labrador and Nova Scotia, in the summer months and migrate south to Florida, and the northern Caribbean (Gambell 1985b; Mead 1977). In the eastern Atlantic Ocean, sei whales occur in the Norwegian Sea (as far north as Finnmark in northeastern Norway), occasionally occurring as far north as Spitsbergen Island, and migrate south to Spain, Portugal, and northwest Africa (Jonsgård and Darling 1974, (Gambell 1985a). Sei whales have been reported with about the same frequency as fin whales in the Gulf of Mexico, although there are still only five reliable records of sei whales from the Gulf. Like blue and fin whales, sei whales are assumed to occur only extralimitally in the Gulf of Mexico.

In the north Pacific Ocean, sei whales occur from the Bering Sea south to California (on the east) and the coasts of Japan and Korea (on the west). During the winter, sei whales are found from 20°□□□23°N (Masaki 1977 (1977); Gambell (1985a). Harwood (1987) reported that 75 – 85 percent of the North Pacific population of sei whales resides east of 180° longitude.

Sei whales occur throughout the Southern Ocean during the summer months, although they do not migrate as far south to feed as blue or fin whales. During the austral winter, sei whales occur off Brazil and the western and eastern coasts of Southern Africa and Australia.

Population Structure

The population structure of sei whales is largely unknown because there are so few data on this species. The International Whaling Commission's Scientific Committee groups all of the sei whales in the entire North Pacific Ocean into one population (Donovan 1991). However, some mark-recapture, catch distribution, and morphological research suggest more than one "stock" of sei whales may exist in the Pacific: one between 175°W and 155°W longitude, and another east of 155°W longitude (Masaki 1977); however, the amount of movement between these "stocks" suggests that they probably do not represent demographically-isolated populations as we use this concept in this Opinion.

Mitchell and Chapman (1977) divided sei whales in the western North Atlantic in two populations, one that occupies the Nova Scotian Shelf and a second that occupies the Labrador Sea. Sei whales are most common on Georges Bank and into the Gulf of Maine and the Bay of Fundy during spring and summer, primarily in deeper waters. There are occasional influxes of sei whales further into Gulf of Maine waters, presumably in conjunction with years of high copepod abundance inshore. Sei whales are occasionally seen feeding in association with right whales in the southern Gulf of Maine and in the Bay of Fundy.

Threats to the Species

Natural Threats. Sei whales appear to compete with blue, fin, and right whales for prey and that competition may limit the total abundance of each of the species (Rice 1974; Scarff 1986). As discussed previously in the narratives for fin and right whales, the foraging areas of right and sei whales in the western North Atlantic Ocean overlap and both whales feed preferentially on copepods (Mitchell 1975b).

Anthropogenic Threats. Two human activities are known to threaten sei whales: whaling and shipping. Historically, whaling represented the greatest threat to every population of sei whales and was ultimately responsible for listing sei whales as an endangered species. From 1910 to 1975, approximately 74,215 sei whales were caught in the entire North Pacific Ocean (Perry et al. 1999a). From the early 1900s, Japanese whaling operations consisted of a large proportion of sei whales: 300 - 600 sei whales were killed per year from 1911 to 1955. The sei whale catch peaked in 1959, when 1,340 sei whales were killed. In 1971, after a decade of high sei whale catch numbers, sei whales were scarce in Japanese waters.

In the North Atlantic Ocean, sei whales were hunted from land stations in Norway and Iceland in the early- to mid-1880s, when blue whales started to become scarcer. In the late 1890s, whalers began hunting sei whales in Davis Strait and off the coasts of Newfoundland. In the early 1900s, whalers from land stations on the Outer Hebrides and Shetland Islands started to hunt sei whales. Between 1966 and 1972, whalers from land stations on the east coast of Nova Scotia engaged in extensive hunts of sei whales on the Nova Scotia shelf, killing about 825 sei whales (Mitchell and Chapman 1977).

Sei whales are occasionally killed in collisions with vessels. Of three sei whales that stranded along the Atlantic Coast of the U.S. between 1975 and 1996, two showed evidence of collisions with ships (Laist et al. 2001). Between 1999 and 2005, there were 3 reports of sei whales being struck by vessels along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada (Cole et al. 2005; Nelson et al. 2007). Two of these ship strikes were reported as having resulted in the death of the sei whale.

Status
Sei whales were listed as endangered under the ESA in 1973. In the North Pacific, the International Whaling Commission began management of commercial taking of sei whales in 1970, and sei whales were given full protection in 1976. Sei whales are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the Marine Mammal Protection Act. They are listed as endangered under the IUCN Red List of Threatened Animals (IUCN 2010; Reilly et al. 2008). Critical habitat has not been designated for sei whales.

Prior to commercial whaling, sei whales in the north Pacific are estimated to have numbered 42,000 individuals (Tillman 1977), although Ohsumi and Masaki (Ohsumi and Masaki 1975) estimated that sei whales in the North Pacific numbered about 49,000 whales in 1963, had been reduced to 37,000 or 38,000 whales by 1967, and reduced again to 20,600 to 23,700 whales by 1973. Japanese and Soviet catches of sei whales in the North Pacific and Bering Sea increased from 260 whales in 1962 to over 4,500 in 1968 and 1969, after which the sei whale population declined rapidly (Mizroch et al. 1984). When commercial whaling for sei whales ended in 1974, the population of sei whales in the North Pacific had been reduced to between 7,260 and 12,620 animals (Tillman 1977). In the same year, the north Atlantic population of sei whales 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).

About 50 sei whales are estimated to occur in the North Pacific “stock” with another 77 sei whales in the Hawaiian “stock” (Lowry et al. 2007). The abundance of sei whales in the Atlantic Ocean remains unknown (Lowry et al. 2007). In California waters, only one confirmed and five possible sei whale sightings were recorded during 1991, 1992, and 1993 aerial and ship surveys (Carretta and Forney. 1993) (Mangels and Gerrodette. 1994). No sightings were confirmed off Washington and Oregon during recent aerial surveys. Several researchers have suggested that the recovery of right whales in the northern hemisphere has been slowed by other whales that compete with right whales for food. Mitchell (Mitchell 1975b) analyzed trophic interactions among baleen whales in the western north Atlantic and noted that the foraging grounds of right whales overlapped with the foraging grounds of sei whales and both preferentially feed on copepods.

Like blue whales, the information available on the status and trend of sei whales do not allow us to reach any conclusions about the extinction risks facing sei whales as a species, or particular populations of sei whales. With the limited data available on sei whales, we do not know whether these whales exist at population sizes large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as “small” populations (that is, “small” populations experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their population size to become a threat in and of itself) or if sei whales are threatened more by exogenous threats such as anthropogenic activities (primarily whaling, entanglement, and ship strikes) or natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate). However, sei whales have historically exhibited sudden increases in abundance in particular areas followed by sudden decreases in number.

With the evidence available, we do not know if this year-to-year variation still occurs in sei whales. However, if sei whales exist as a fraction of their historic population sizes, large amounts of variation in their abundance would increase the extinction probabilities of individual populations (Fagan et al. 1999; Fagan et al. 2001).

Critical Habitat

Critical habitat has not been designated for sei whales.

Sperm Whale

Sperm whales (*Physeter macrocephalus*) are the largest of the odontocetes (toothed whales) and the most sexually dimorphic cetaceans, with males considerably larger than females. Adult females may grow to lengths of 36 feet (11 m) and weigh 15 tons (13607 kg). Adult males, however, reach about 52 feet (16 m) and may weigh as much as 45 tons (40823 kg).

The sperm whale is distinguished by its extremely large head, which takes up to 25 to 35 percent of its total body length. It is the only living cetacean that has a single blowhole asymmetrically situated on the left side of the head near the tip. Sperm whales have the largest brain of any animal (on average 17 pounds (7.8 kg) in mature males); however, compared to their large body size, the brain is not exceptional in size.

There are between 20-26 large conical teeth in each side of the lower jaw. The teeth in the upper jaw rarely erupt and are often considered to be vestigial. It appears that teeth may not be necessary for feeding, since they do not break through the gums until puberty, if at all, and healthy sperm whales have been caught that have no teeth.

Sperm whales are mostly dark gray, but oftentimes the interior of the mouth is bright white, and some whales have white patches on the belly. Their flippers are paddle-shaped and small compared to the size of the body, and their flukes are very triangular in shape. They have small dorsal fins that are low, thick, and usually rounded.

Distribution

Sperm whales occur in every ocean except the Arctic Ocean. Sperm whales are found throughout the North Pacific and are distributed broadly from tropical and temperate waters to the Bering Sea as far north as Cape Navarin. Mature, female, and immature sperm whales of both sexes are found in more temperate and tropical waters from the equator to around 45˚ N throughout the year. These groups of adult females and immature sperm whales are rarely found at latitudes higher than 50˚ N and 50˚ S (Reeves and Whitehead 1997). Sexually mature males join these groups throughout the winter. During the summer, mature male sperm whales are thought to move north into the Aleutian Islands, Gulf of Alaska, and the Bering Sea.

In the western Atlantic Ocean, sperm whales are distributed in a distinct seasonal cycle, concentrated east-northeast of Cape Hatteras in winter and 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 summer and then south of New England in fall, back to the Mid-Atlantic Bight.

In the eastern Atlantic Ocean, mature male sperm whales have been recorded as far north as Spitsbergen (Oien 1990). Recent observations of sperm whales and stranding events involving sperm whales from the eastern North Atlantic suggest that solitary and paired mature male sperm whales predominantly occur in waters off Iceland, the Faroe Islands, and the Norwegian Sea (Christensen et al. 1992; Gunnlaugsson and Sigurjonsson 1990; Oien 1990).

In the Mediterranean Sea sperm whales are found from the Alboran Sea to the Levant Basin, mostly over steep slope and deep offshore waters. Sperm whales are rarely sighted in the Sicilian Channel, and are vagrant in the northern Adriatic and Aegean Seas (Notarbartolo Di Sciara and Gordon 1997). In the Italian seas sperm whales are more frequently associated with the continental slope off western Liguria, western Sardinia, northern and eastern Sicily, and both coasts of Calabria.

Sperm whales commonly concentrate around oceanic islands in areas of upwelling, and along the outer continental shelf and mid-ocean waters. Because they inhabit deeper pelagic waters, their distribution does not include the broad continental shelf of the Eastern Bering Sea and these whales generally remain offshore in the eastern Aleutian Islands, Gulf of Alaska, and the Bering Sea.

Sperm whales have a strong preference for the 3,280 feet (1,000 meters) depth contour and seaward. Berzin (1971) reported that they are restricted to waters deeper than 300 meters (984 feet), while Watkins (1977) and Reeves and Whitehead (1997) reported that they are usually not found in waters less than 1,000 meters (3,281 feet) deep. While deep water is their typical habitat, sperm whales have been observed near Long Island, New York, in water between 41-55 meters Scott and Sadove (135-180 ft; 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 a good food supply (Clarke 1956).

Population Structure

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 and no clear geographic structure, but strong differentiation between social groups (Lyrholm and Gyllensten 1998; Lyrholm et al. 1996; Lyrholm et al. 1999). 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). The NMFS recognizes six stocks under the MMPA- three in the Atlantic/Gulf of Mexico and three in the Pacific (Alaska, California-Oregon-Washington, and Hawaii; (Perry et al. 1999a; Waring et al. 2004). Genetic studies indicate that movements of both sexes through expanses of ocean basins are common, and that males, but not females, often breed in different ocean basins than the ones in which they were born (Whitehead and Mesnick 2003). Sperm whale populations appear to be structured socially, at the level of the clan, rather than geographically (Whitehead 2003; Whitehead 2008).

Several investigators have suggested that the sperm whales that occupy the northern Gulf of Mexico are distinct from sperm whales elsewhere in the North Atlantic Ocean (Fritts et al. 1983; Hansen et al. 1995; Schmidly 1981), although the International Whaling Commission does not recognize these sperm whales as a separate population or “stock.”

Atlantic Ocean

Based on harvests of tagged sperm whales or sperm whales with other distinctive marking, sperm whales in the North Atlantic Ocean appear to represent a single population, with the possible exception of the sperm whales that appear to reside in the Gulf of Mexico. Mitchell (1975a) reported one sperm whale that was tagged on the Scotian Shelf and killed about 7 years later off Spain. Donovan (Donovan 1991) reported five to six handheld harpoons from the Azore sperm whale fishery that were recovered from whales killed off northwest Spain, with another Azorean harpoon recovered from a male sperm whale killed off Iceland (Martin 1982). These patterns suggest that at least some sperm whales migrate across the North Atlantic Ocean. 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).

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Indian Ocean

In the Northern Indian Ocean the International Whaling Commission recognized differences between sperm whales in the northern and southern Indian Ocean (Donovan 1991). Little is known about the Northern Indian Ocean population of sperm whales (Perry et al. 1999b).

Pacific Ocean

Several authors have proposed population structures that recognize at least three sperm whales populations in the North Pacific for management purposes (Bannister and Mitchell 1980; Kasuya 1991). At the same time, the IWC's Scientific Committee designated two sperm whale stocks in the North Pacific: a western and eastern stock or population (Donovan 1991). The line separating these populations has been debated since their acceptance by the IWC's Scientific Committee. For stock assessment purposes, NMFS recognizes three discrete population centers of sperm whales in the Pacific: (1) Alaska, (2) California-Oregon-Washington, and (3) Hawai'i.

Sperm whales are widely distributed throughout the Hawaiian Islands throughout the year and are the most abundance large whale in waters off Hawai'i during the summer and fall (Lee 1993; Mobley et al. 2000; Shallenberger et al. 1981). Sperm whale clicks recorded from hydrophones off Oahu confirm the presence of sperm whales near the Hawaiian Islands throughout the year (Thompson and Friedl 1982). The primary area of occurrence for the sperm whale is seaward of the shelf break in the Hawaiian Islands.

Sperm whales have been sighted in the Kauai Channel, the Alenuihaha Channel between Maui and the island of Hawai'i, and off the island of Hawai'i (Lee 1993; Mobley et al. 2000). Additionally, the sounds of sperm whales have been recorded throughout the year off Oahu (Thompson and Friedl 1982). Twenty-one sperm whales were sighted during aerial surveys conducted in Hawaiian waters conducted from 1993 through 1998. Sperm whales sighted during the survey tended to be on the outer edge of a 50 - 70 km distance from the Hawaiian Islands, indicating that presence may increase with distance from shore. However, from the results of these surveys, NMFS has calculated a minimum abundance of sperm whales within 46 km of Hawai'i to be 43 individuals (Forney et al. 2000).

Southern Ocean
Sperm whales south of the equator are generally treated as a single "population," although the International Whaling Commission divides these whales into nine different divisions that are based more on evaluations of whaling captures than the biology of sperm whales (Donovan 1991). Several authors, however, have argued that the sperm whales that occur off the Galapagos Islands, mainland Ecuador, and northern Peru are geographically distinct from other sperm whales in the Southern Hemisphere (Dufault and Whitehead 1995; Wade and Gerrodette 1993).

Threats to the Species
Natural Threats. Sperm whales are hunted by killer whales (*Orcinus orca*), false killer whales (*Pseudorca crassidens*), and short-finned pilot whales (*Globicephala melas*) (Arnbom et al. 1987; Palacios and Mate. 1996; Weller et al. 1996). Sperm whales have been observed with bleeding wounds their heads and tail flukes after attacks by these species (Arnbom et al. 1987; Palacios and Mate. 1996; Weller et al. 1996). In October 1997, 25 killer whales were documented to have attacked a group of mature sperm whales off Point Conception, California (personal communication from K Roberts cited in Perry et al. 1999) and successfully killing one of these mature sperm whales. Sperm whales have also been reported to have papilloma virus (Lambertsen et al. 1987).

Studies on sperm whales in the North Pacific and North Atlantic Oceans have demonstrated that sperm whales are infected by calciviruses and papillomavirus (Lambertsen et al. 1987; Smith and

Latham 1978). In some instances, these diseases have been demonstrated to affect 10 percent of the sperm whales sampled (Lambertsen et al. 1987).

Anthropogenic Threats. Three human activities are known to threaten sperm whales: whaling, entanglement in fishing gear, and shipping. Historically, whaling represented the greatest threat to every population of sperm whales and was ultimately responsible for listing sperm whales as an endangered species. Sperm whales were hunted all over the world during the 1800s, largely for its spermaceti oil and ambergris. Harvesting of sperm whales subsided by 1880 when petroleum replaced the need for sperm whale oil (Whitehead 2003).

The actual number of sperm whales killed by whalers remains unknown and some of the estimates of harvest numbers are contradictory. Between 1800 and 1900, the International Whaling Commission estimated that nearly 250,000 sperm whales were killed globally by whalers. From 1910 to 1982, another 700,000 sperm whales were killed globally by whalers (IWC Statistics 1959-1983). These estimates are substantially higher than a more recent estimate produced by Caretta et al. (2005), however, who estimated that at least 436,000 sperm whales were killed by whalers between 1800 and 1987. Hill and DeMaster (1999) concluded that about 258,000 sperm whales were harvested in the North Pacific between 1947 and 1987 by commercial whalers. They reported that catches in the North Pacific increased until 1968, when 16,357 sperm whales were harvested, then declined after 1968 because of harvest limits imposed by the IWC. Perry et al. (1999a) estimated that, on average, more than 20,000 sperm whales were harvested in the Southern Hemisphere each year between 1956 and 1976.

These reports probably underestimate the actual number of sperm whales that were killed by whalers, particularly because they could not have incorporated realistic estimates of the number of sperm whales killed by Soviet whaling fleets, which often went unreported. Between 1947 and 1973, Soviet whaling fleets engaged in illegal whaling in the Indian, North Pacific, and southern Oceans. In the Southern Hemisphere, these whalers killed an estimated 100,000 whales that they did not report to the International Whaling Commission (Yablokov et al. 1998). Illegal catches in the Northern Hemisphere (primarily in the North Pacific) were smaller but still caused sperm whales to disappear from large areas of the North Pacific Ocean (Yablokov 2000).
In addition to large and illegal harvests of sperm whales, Soviet whalers had disproportionate effect on sperm whale populations because they commonly killed adult females in any reproductive condition (pregnant or lactating) as well as immature sperm whales of either gender.

When the International Whaling Commission (IWC) introduced the International Observer Scheme in 1972, the IWC relaxed regulations that limited the minimum length of sperm whales that could be caught from 11.6 meters to 9.2 meters out of a concern that too many male sperm whales were being caught so reducing this size limit would encourage fleets to catch more females. Unfortunately, the IWC's decision had been based on data from the Soviet fleets who commonly reported female sperm whales as males. As a result, the new regulations allowed the Soviet whalers to continue their harvests of female and immature sperm whales legally, with substantial consequences for sperm whale populations.

Although the International Whaling Commission protected sperm whales from commercial harvest in 1981, whaling operations along the Japanese coast continued to hunt sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). More recently, the Japanese Whaling Association began hunting sperm whales for research. In 2000, the Japanese Whaling Association announced that it planned to kill 10 sperm whales in the Pacific Ocean for research, which was the first time sperm whales have been hunted since the international ban on commercial whaling. Despite protests from the U.S. government and members of the IWC, the Japanese government harvested 5 sperm whales and 43 Bryde's whales in the last six months of 2000. According to the Japanese Institute of Cetacean Research (Institute of Cetacean Research undated), another 5 sperm whales were killed for research in 2002 – 2003.

Sperm whales are still hunted for subsistence purposes by whalers from Lamalera, Indonesia, which is on the south coast of the island of Lembata and from Lamakera on the islands of Solor. These whalers hunt in a traditional manner: with bamboo spears and using small wooden outriggers, 10–12 m long and 2 m wide, constructed without nails and with sails woven from palm fronds. The animals are killed by the harpooner leaping onto the back of the animal from the boat to drive in the harpoon. The maximum number of sperm whales killed by these hunters in any given year was 56 sperm whales killed in 1969.

In U.S. waters in the Pacific Ocean, sperm whales are known to have been incidentally captured only in drift gillnet operations, which killed or seriously injured an average of 9 sperm whales per year from 1991 - 1995 (Barlow 1997). Interactions between longline fisheries and sperm whales in the Gulf of Alaska have been reported over the past decade (Hill et al. 1999; Rice 1989). Observers aboard Alaskan sablefish and halibut longline vessels have documented sperm whales feeding on fish caught in longline gear in the Gulf of Alaska. During 1997, the first entanglement of a sperm whale in Alaska's longline fishery was recorded, although the animal was not seriously injured (Hill et al. 1999). The available evidence does not indicate sperm whales are being killed or seriously injured as a result of these interactions, although the nature and extent of interactions between sperm whales and long-line gear is not yet clear.

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).

Status

Sperm whales were listed as endangered under the ESA in 1973. Sperm whales have been protected from commercial harvest by the International Whaling Commission since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). They are also protected by the Convention on International Trade in Endangered Species of Wild Flora and Fauna as a vulnerable species (IUCN 2010) and the MMPA. Critical habitat has not been designated for sperm whales.

The status and trend of sperm whales at the time of this summary is largely unknown. Hill and DeMaster (1999) and Angliss and Lodge (2004) reported that estimates for population abundance, status, and trends for sperm whales off the coast of Alaska were not available when they prepared the Stock Assessment Report for marine mammals off Alaska. Similarly, no information was available to support estimates of sperm whales status and trends in the western North Atlantic Ocean (Waring et al. 2004), the Indian Ocean (Perry et al. 1999b), or the Mediterranean Sea.

Nevertheless, several authors and organizations have published “best estimates” of the global abundance of sperm whales or their abundance in different geographic areas. Based on historic whaling data, 190,000 sperm whales were estimated to have been in the entire North Atlantic, but the IWC considers data that produced this estimate unreliable (Perry et al. 1999b). Whitehead (2002) estimated that prior to whaling sperm whales numbered around 1,110,000 and that the current global abundance of sperm whales is around 360,000 (coefficient of variation = 0.36) whales. Whitehead’s current population estimate is about 20 percent of past global abundance estimates which were based on historic whaling data.

Waring et al. (2007) concluded that the best estimate of the number of sperm whales along the Atlantic coast of the U.S. was 4,029 (coefficient of variation = 0.38) in 1998 and 4,804 (coefficient of variation = 0.38) in 2004, with a minimum estimate of 3,539 sperm whales in the western North Atlantic Ocean.

Mark and recapture data from sperm whales led Whitehead and his co-workers to conclude that sperm whale numbers off the Galapagos Islands decreased by about 20 percent a year between 1985 and 1995 (Whitehead et al. 1997). In 1985 Whitehead et al. (1997) estimated there were about 4,000 female and immature sperm whales, whereas in 1995 they estimated that there were only a few hundred. They suggested that sperm whales migrated to waters off the Central and South American mainland to feed in productive waters of the Humboldt Current, which had been depopulated of sperm whales as a result of intensive whaling.

A mark recapture analysis using photo-identification images in the Gulf of Mexico resulted in a population estimate of 281 with 95 percent confidence intervals of 202-434 (Jochens et al. 2008). This is in general agreement with, though a little lower than, the population sizes indicated by visual surveys.

The information available on the status and trend of sperm whales do not allow us to make a definitive statement about the extinction risks facing sperm whales as a species or particular populations of sperm whales. However, the evidence available suggests that sperm whale populations probably exhibit the dynamics of small populations, causing their population dynamics to become a threat in and of itself. The number of sperm whales killed by Soviet whaling fleets in the 1960s and 1970s would have substantial and adverse consequence for sperm whale populations and their ability to recover from the effects of whaling on their population. The number of adult females killed by Soviet whaling fleets, including pregnant and lactating females whose death would also have resulted in the death of their calves, would have had a devastating effect on sperm whale populations. In addition to decimating their population size, whaling would have skewed sex ratios in their populations, created gaps in the age structure of their populations, and would have had lasting and adverse effect on the ability of these populations to recover (for example, see Whitehead and Mesnick 2003). Populations of sperm whales could not have recovered from the overharvests of adult females and immature whales in the 30 to 40 years that have passed since the end of whaling, but the information available does not allow us to determine whether and to what degree those populations might have stabilized or whether they have begun the process of recovering from the effects of whaling. Absent information to the contrary, we assume that sperm whales will have elevated extinction probabilities because of both exogenous threats caused by anthropogenic activities (primarily whaling, entanglement, and ship strikes) and natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) as well as endogenous threats caused by the legacy of overharvests of adult females and immature whales on their populations (that is, a population with a disproportion of adult males and older animals coupled with a small percentage of juvenile whales that recruit into the adult population).

A draft Recovery Plan written in 2006 was finalized in December 2010 (NMFS 2010d).

Critical Habitat

Critical habitat has not been designated for sperm whales.

ENVIRONMENTAL BASELINE

By regulation, environmental baselines for 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 *Environmental baseline* for this Opinion includes the effects of several activities affecting the survival and recovery of listed species of whales in the action area. The *Environmental baseline* focuses primarily on past and present impacts to these species.

A number of human activities have contributed to the current status of these species in the action area. Although some of those activities, such as commercial whaling, occurred extensively in the past, ceased, and no longer appear to affect these whale populations, the effects of these types of exploitation persist today. Other human activities, such as commercial fishing and vessel operations, are ongoing and continue to affect these species.

The following discussion summarizes the natural and human phenomena in the action area that may affect the likelihood these species will survive and recover in the wild. These include directed harvest, fisheries interactions, ship strikes, noise, predation, disease and parasitism, contaminants, and scientific research.

Climate change

In general, based on forecasts made by the Intergovernmental Panel on Climate Change (IPCC), climate change is projected to have substantial effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the near future (IPCC 2000; IPCC 2001a; IPCC 2001b; IPCC 2002). From 1906 to 2006, global surface temperatures have risen 0.74° C and continue to rise at an accelerating pace; 11 or the 12 warmest years on record since 1850 have occurred since 1995 and the past decade has been the warmest in instrumental history (Arndt et al. 2010; Poloczanska et al. 2009). Furthermore, the Northern Hemisphere (where a greater proportion of ESA-listed species occur) is warming faster than the Southern Hemisphere, although land temperatures are rising more rapidly than over the oceans (Poloczanska et al. 2009). Climate change will result in increases in atmospheric temperatures, changes in sea surface temperatures, patterns of precipitation, and sea level. Sea levels have risen an average of 1.7 mm/year over the 20th century and 3.3 mm/year between 1993 and 2006 due to glacial melting and thermal expansion of ocean water; this rate will likely increase, which is supported by the latest data from 2009 (Arndt et al. 2010; Hoegh-Guldberg and Bruno 2010; Wilkinson and Souter 2008). Oceanographic models project a weakening of the thermohaline circulation resulting in a reduction of heat transport into high latitudes of Europe, an increase in the mass of the Antarctic ice sheet, and a decrease in the Greenland ice sheet, although the magnitude of these changes remain unknown. Reductions in ozone and subsequent increases in ultraviolet radiation have been linked to possible skin damage and blistering in blue, fin, and sperm whales in the Gulf of California (Martinez-Levasseur et al. 2010).

Climate change has been linked to changing ocean currents as well. Rising carbon dioxide levels have been identified as a reason for a poleward shift in the Eastern Australian Current, shifting warm waters into the Tasman Sea and altering biotic features of the area (Poloczanska et al. 2009). Similarly, the Kuroshio Current in the western North Pacific (an important foraging area for juvenile sea turtles and other listed species) has shifted southward as a result of altered longterm wind patterns over the Pacific Ocean (Poloczanska et al. 2009).

Climate change would result in changes in the distribution of temperatures suitable for whale calving and rearing, the distribution and abundance of prey, and abundance of competitors or predators. For species that undergo long migrations, individual movements are usually associated with prey availability or habitat suitability. If either is disrupted by changing ocean temperature regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott. 2009). Climate change can influence reproductive success by altering prey availability, as evidenced by high survival of northern elephant seal pups during El Niño periods, when cooler, more productive waters are associated with higher first-year pup survival (McMahon and Burton. 2005). Reduced prey availability resulting from increased sea temperatures has also been suggested to explain reductions in Antarctic fur seal pup and harbor porpoise survival (Forcada et al. 2005; Macleod et al. 2007). Primary production is estimated to have declined by 6% between the early 1980s and 2010 partly as a result of climactic shifts, making foraging more difficult for marine species (Hoegh-Guldberg and Bruno 2010).

Polygamous marine mammal mating systems can also be perturbated by rainfall levels, with the most competitive grey seal males being more successful in wetter years than in drier ones (Twiss et al. 2007). Sperm whale females were observed to have lower rates of conception following unusually warm sea surface temperature periods (Whitehead 1997). Marine mammals with restricted distributions linked to water temperature may be particularly exposed to range restriction (Isaac 2009; Learmonth et al. 2006). MacLeod (2009) estimated that, based upon expected shifts in water temperature, 88% of cetaceans would be affected by climate change, 47% would be negatively affected, and 21% would be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters and preferences for shelf habitats, such as North Atlantic right whales (Macleod 2009). Variations in the recruitment of krill and the reproductive success of krill predators correlate to variations in sea-surface temperatures and the extent of sea-ice cover age during winter months. Although the IPCC (2001b) did not detect significant changes in the extent of Antarctic sea-ice using satellite measurements, Curran et al. (2003) analyzed ice-core samples from 1841 to 1995 and concluded Antarctic sea ice cover had declined by about 20% since the 1950s.

Foraging is not the only potential aspect that climate change could influence. Acevedo, Whitehouse and Duffus (2009) proposed that the rapidity of environmental changes, such as those resulting from global warming, can harm immunocompetence and reproductive parameters in wildlife to the detriment of population viability and persistence. Altered ranges can also result in the spread of novel diseases to new areas via shifts in host ranges (Simmonds and Eliott. 2009). It has been suggested that increases in harmful algal blooms could be a result of increases in sea surface temperature (Simmonds and Eliott. 2009). Warming temperatures are forecasted to open the Northwest Passage to shipping, introducing large amounts of shipping noise and potential for ship strike to arctic and subarctic regions that presently experience little vessel traffic (Alter et al. 2010).

Species that are shorter-lived, have larger body sizes, or are generalist in nature are liable to be better able to adapt to climate change over the long term versus those that are longer-lived, smaller-sized, or rely upon specialized habitats (Brashares 2003; Cardillo 2003; Cardillo et al. 2005; Isaac 2009; Purvis et al. 2000). Climate change is likely to have its most pronounced effects on species whose populations are already in tenuous positions (Isaac 2008). As such, we expect the risk of extinction to listed species to rise with the degree of climate shift associated with global warming.

Naturally-occurring climatic shifts, such as the Pacific Decadal Oscillation, El Niño, and La Niña can strongly influence marine productivity, including marine mammals and the prey they rely upon (Beamish et al. 1999; Benson and Trites. 2002; Francis et al. 1998; Hare et al. 1999; Mantua et al. 1997). Cooler periods appear to promote coastal biological productivity in the action area and warmer phases have the opposite effect (Hare et al. 1999; NMFS 2008e).

Habitat degradation

A number of factors may be directly or indirectly affecting listed marine species in the action area by degrading habitat; perhaps most significant among them is anthropogenic noise in the ocean. Natural sources of ambient noise include: wind, waves, surf noise, precipitation, thunder, and biological noise from marine mammals, fishes, and crustaceans. Anthropogenic noises that could affect ambient noise arise from the following general types of activities in and near the sea, any combination of which can contribute to the total noise at any one place and time. These noises include transportation and shipping traffic, dredging, construction activities; oil, gas, and mineral exploration in offshore areas; geophysical (seismic) surveys; sonars; explosions; and ocean research activities (Richardson et al., 1995).

Noise in the marine environment has received a lot of attention in recent years and is likely to continue to receive attention in the foreseeable future. Several investigators have argued that anthropogenic sources of noise have increased ambient noise levels in the ocean over the last 50 years (Jasny et al. 2005; NRC 2005b; Richardson et al. 1995a; Richardson et al. 1995b). In general, it has been asserted that ocean background noise levels have doubled every decade for the last six decades in some areas, primarily due to shipping traffic (IWC 2004).

The acoustic noise that commercial traffic contributes to the marine environment is a concern for listed species because it may impair communication between individuals (Hatch et al. 2008). Shipping and seismic noise generally dominates ambient noise at frequencies from 20 to 300 Hz (Andrew et al. 2002; Hildebrand 2009; Richardson et al. 1995). Background noise has increased significantly in the past 50 years as a result of increasing vessel traffic, and particularly shipping, with increases of as much as 12 dB in low frequency ranges and 20 dB versus preindustrial periods (Hildebrand 2009; McDonald et al. 2006; (Jasny et al., 2005; NRC, 1994, 2000, 2003, 2005; Richardson et al., 1995). Much of this increase is due to increased shipping as ships become more numerous and of larger tonnage (NRC, 2003). Over the past 50 years, the number of commercial vessels has tripled, carrying an estimated six times as much cargo (requiring larger, more powerful vessels) (Hildebrand 2009). Commercial fishing vessels, cruise ships, transport boats, airplanes, helicopters and recreational boats all contribute sound into the ocean (NRC 2003a). The military uses sound to test the construction of new vessels as well as for naval operations. In some areas where oil and gas production takes place, noise originates from the drilling and production platforms, tankers, vessel and aircraft support, seismic surveys, and the explosive removal of platforms (NRC 2003b).

Many researchers have described behavioral responses of marine mammals to the sounds produced by helicopters and fixed-wing aircraft, boats and ships, as well as dredging, construction, geological explorations, etc. (Richardson et al. 1995a). Most observations have been limited to short-term behavioral responses, which included cessation of feeding, resting, or social interactions. Several studies have demonstrated short-term effects of disturbance on humpback whale behavior (Baker et al. 1983; Bauer and Herman 1986; Krieger and Wing 1984), but the long-term effects, if any, are unclear or not detectable. Carretta (2001) and Jasny et al. (2005) identified the increasing levels of anthropogenic noise as a habitat concern for whales and other cetaceans because of its potential effect on their ability to communicate.

Surface shipping is the most widespread source of anthropogenic, low frequency (0 to 1,000 Hz) noise in the oceans (Simmonds and Hutchinson 1996). 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). The radiated noise spectrum of merchant ships ranges from 20 to 500 Hz and peaks at approximately 60 Hz. Ross (1976) has estimated that between 1950 and 1975 shipping had caused a rise in ambient ocean noise levels of 10 dB. He predicted that this would increase by another 5 dB by the beginning of the 21st century. The NRC (NRC 2005a) estimated that the background ocean noise level at 100 Hz has been increasing by about 1.5 dB per decade since the advent of propeller-driven ships.

Seismic signals also contribute significantly to the low frequency ambient sound field (Hildebrand 2009). Baleen whales may be more sensitive to sound at those low frequencies than are toothed whales. Dunlop et al. (2010) found that humpback whales shifted from using vocal communication (which carries relatively large amounts of information) to surface-active communication (splashes; carry relatively little information) when low-frequency background noise increased due to increased sea state. Sonars and small vessels also contribute significantly to mid-frequency ranges (Hildebrand 2009).

In-water construction activities (e.g., pile driving associated with shoreline projects) in both inland waters as well as coastal waters in the action area can produce sound levels sufficient to disturb marine mammals under some conditions. Pressure levels from 190-220 dB re 1 μPa were reported for piles of different sizes in a number of studies (NMFS 2006b). The majority of the sound energy associated with pile driving is in the low frequency range (<1,000 Hz) (Illingworth and Rodkin Inc. 2001; Illingworth and Rodkin Inc. 2004; Reyff 2003). Dredging operations also have the potential to emit sounds at levels that could disturb marine mammals. Depending on the type of dredge, peak sound pressure levels from 100 to 140 dB re 1 μPa were reported in one study (Clarke et al. 2003). As with pile driving, most of the sound energy associated with dredging is in the low-frequency range, <1000 Hz (Clarke et al. 2003).

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, a six inch block 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 2008e). 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 marine mammals or listed salmon may be present; monitoring for marine mammals during construction activities; and maintenance of a buffer zone around the project area, within which sound-producing activities would be halted when marine mammals enter the zone (NMFS 2008e).

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 right whales (Parks et al., 2009; Parks et al., 2007), blue whales (Di Iorio and Clark, 2009), and fin whales (Castelotte et al., 2012) 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 nursey 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.

Chronic exposure to the neurotoxins associated with paralytic shellfish poisoning from zooplankton prey has been shown to have detrimental effects on marine mammals. Estimated ingestion rates are sufficiently high to suggest that the PSP toxins are affecting marine mammals, possibly resulting in lower respiratory function, changes in feeding behavior and a lower reproduction fitness (Durbin et al. 2002).

Contaminants and Ocean Debris

Contaminants may be introduced by rivers, coastal runoff, wind, ocean dumping and disposal, discharges from wastewater systems by boats and various industrial activities, coastal development, aquaculture , and offshore oil and gas or mineral exploitation. Coastal runoff and river discharges carry large volumes of petrochemical and other contaminants from agricultural activities, cities and industries into the Gulf of Mexico. The coastal waters of the Gulf of Mexico have more sites with high contaminant concentrations than other areas of the coastal United States, due to the large number of waste discharge point sources. 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).

The impacts from these activities are difficult to measure. 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, NMFS, 2005; Waring et al., 2004). Studies of captive harbor seals have demonstrated a link between exposure to organochlorines (e.g., ddt, pcbs, and polyaromatic hydrocarbons) and immunosuppression (De Swart et al. 1996; Ross et al. 1995). Organochlorines are chemicals that tend to bioaccumulate through the food chain, thereby increasing the potential of indirect exposure to a marine mammal via its food source. Due to their large amount of blubber and fat, marine mammals readily accumulate lipid-soluble contaminants (O'Hara and Rice, 1996). During pregnancy and nursing, some of these contaminants can be passed from the mother to developing offspring. Contaminants like organochlorines do not tend to accumulate in significant amounts in invertebrates, but do accumulate in fish and fish-eating animals. Thus, contaminant levels in planktivorous mysticetes have been reported to be one to two orders of magnitude lower compared to piscivorous odontocetes (O'Hara et al. 1999; Oshea and Brownell 1994).

Humpback whale blubber has been shown to contain PCB and DDT (Gauthier et al., 1997). Contaminant levels are relatively high in humpback whales, compared to blue whales; humpback whales feed higher on the food chain, where prey carry higher contaminant loads than the krill that blue whales feed on.

Oil spills could have a significant deleterious effect on marine mammals that are exposed to them. Exposure can occur via skin contact, ingestion of oil directly or through contaminated prey, or inspired while at the surface (Geraci 1990). This exposure could result in displacement of marine mammals from an impacted area or produce toxic effects. Perhaps the most famous shipwreck of all time occurred in the Gulf of Alaska when, in 1989, the Exxon Valdez released at least 11 million gallons of Alaskan crude oil into one of the largest and most productive estuaries in North America. The spill was the worst in U.S. history until the Deepwater Horizon event in 2010. Oil spills, both small and large, occur widely along U.S. shores at refining and transfer facilities and extraction sites.

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. For instance, in 1989 a stranded sperm whale along the Mediterranean was found to have died from ingesting plastic that blocked its' digestive tract (Viale et al. 1992). A sperm whale examined in Iceland had a lethal disease thought to have been caused by the complete obstruction of the gut with plastic marine debris (Lambertsen 1990). The stomach contents of two sperm whales that stranded separately in California included extensive amounts of discarded fishing netting and another individual from the Pacific was found to contain nylon netting in its stomach when it washed ashore in 2004 (NMFS, 2009). Further incidents may occur but remain undocumented when carcasses do not strand.

Commercial Whaling

As discussed in the Status of the Species section of this Opinion, large whale populations occurring in the action area have historically been impacted by commercial exploitation (i.e. in the form of directed whaling). American whalers alone harvested 14,164-18,212 humpbacks in the North Atlantic between 1805-1909 (Best, 1987 as cited in NMFS, 1991) and fin whales also saw their populations drastically reduced from historical estimates. Prior to current prohibitions on whaling, such as the International Whaling Commission's 1966 moratorium, most large whale species had been depleted to the extent it was necessary to list them as endangered under the esa of 1966.

While commercial whaling no longer occurs in the action area due to the moratorium established in 1982, we acknowledge that heavy exploitation significantly reduced these species abundances in the Atlantic Oceans and many of the affected populations have yet to recover. 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. 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, significantly lowered population numbers decreases these species' resistance to the effects of deleterious phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, thereby greatly affecting the ability of these species to recover to pre-exploitation levels.

Fisheries interactions

Entrapment and entanglement in commercial fishing gear is a significant problem for several marine mammal species, and is a frequently documented source of human-caused mortality in large whale species (see Dietrich et al., 2007). Entrapment in fishing gear continues to impact listed cetaceans in the action area (particularly humpback whales). Robbins and Mattila (2001) studied entanglement-related scarring on 134 individual humpback whales and concluded that between 48 and 65 percent had experienced entanglements. An estimated 78 baleen whales were killed annually in the offshore southern California drift gillnet fishery during the 1980's (Heyning and Lewis, 1990) and 22 humpback whale entanglements were reported from 1996-2000 (Angliss and Lodge, 2004). Off the U.S. east coast, there were five humpback whales killed and an additional 11 sustaining serious injuries from entanglement during the same period (Glass et al., 2010).

Fin and sei whales also interact with fishing gear although reported takes are much lower than those reported for humpbacks. According to the most recent stock assessment reports for the western North Atlantic region, 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). During the period 2004-2008, there were 3 confirmed fin whale deaths and an additional 3 reports of fin whales sustaining serious injury as a result of entanglement while for sei whales, there was 1 confirmed mortality and 2 reports of serious injury as a result of entanglement (Glass et al., 2010).

Aside from the potential of entrapment and entanglement, there is also concern that 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 frequency of such mortalities. Entanglement may also make whales more vulnerable to additional dangers, such as 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.

Several commercial fisheries operate in the Action Area for this consultation. Portions of the Atlantic pelagic fisheries for swordfish, tuna, shark, and billfish also operate in the Action Area. These fisheries, which operate off the southeast coast of South Carolina, the coast of Georgia (with the exception of waters off Florida and southernmost Georgia that are closed to the longline component of these fisheries) and the Gulf of Mexico, include purse seine fisheries for tuna, harpoon fisheries for tuna and swordfish, commercial and recreational rod and reel fisheries, gillnet fisheries for shark, driftnet fisheries, pelagic longline fisheries, and bottom longline fisheries. Between 1986 and 1995, this fishery captured and killed one North Atlantic right whale, two humpback whales, and two sperm whales.

Sperm whales are known to have been incidentally taken in drift gillnet operations, which killed or seriously injured an average of nine sperm whales annually from 1991-1995 (Barlow et al. 1997). Sperm whales have been bycaught in pelagic drift gillnets along the U.S. east coast and in artisanal gillnets targeting sharks and large pelagic fishes off the Pacific coasts of northwestern South America, Central America, and Mexico (Gerrodette and Palacios 1996; Waring et al. 1997). An individual was caught and released from gillnetting, although injured, on Georges Bank during 1990. A second individual was freed, but injured, from gillnetting on George's Bank in 1995. In 1994, a sperm whale was disentangled from gillnet along the coast of Maine. Interactions between longline fisheries and sperm whales have been common over the past decade (Rice 1989; Hill and DeMaster 1999). In August 1993, a dead sperm whale, with longline gear wound tightly around the jaw, was found floating ~32 km off Maine.

Ship strikes

Collisions with commercial and military ships are an increasing threat to many large whale species, particularly as shipping lanes and naval operations cross important large whale breeding and feeding habitats or migratory routes. As discussed in the Status of the Species narratives for several of the whales that are considered in this Opinion, ship strikes pose significant threats to whales along the Atlantic coast, particularly North Atlantic right whales. Commercial and private vessels may affect humpback, fin, sperm and right whales. Ship-strike is a significant concern for the recovery of baleen whales in the region. We believe the vast majority of ship-strike mortalities go unnoticed, and that actual mortality is higher than currently documented (i.e., individuals not observed when struck and those who do not strand; Barlow et al. (1997)). More humpback whales are killed in collisions with ships than any other whale species except fin whales (Jensen and Silber 2003). Along the Pacific U.S. coast, a humpback whale is known to be killed about every other year by ship-strikes (Barlow et al. 1997). Jensen and Silber's (2004) review of the NMFS' ship strike database revealed fin whales as the most frequently confirmed victims of ship strikes (26% of the recorded ship strikes [n = 75/292 records]), with most collisions occurring off the east coast, followed by the west coast of the U.S. and Alaska/Hawaii. Worldwide, sperm whales are known to have been struck 17 times out of a total record of 292 strikes of all large whales, 13 of which resulted in mortality (Jensen and Silber 2003; Laist et al. 2001).

Despite the reports, the magnitude of the risks commercial ship traffic poses to large whales in the proposed action areas has been difficult to quantify or estimate. We struggle to estimate the number of whales that are killed or seriously injured in ship strikes within the U.S. Exclusive Economic Zone and have virtually no information on interactions between ships and commercial vessels outside of U.S. waters. With the information available, we know those interactions occur but we cannot estimate their significance to the endangered whales along the Atlantic coast.

The port of Jacksonville supports some of the country's strongest maritime economies. About 17 million tons of waterborne cargo pass through the Port of Jacksonville, Florida which receives about 1,600 vessels each year moving between the U.S. and South America, Europe, and the Caribbean Region. This amount of traffic increases the probability of collisions between commercial ships and whales.

Vessel approaches – commercial and private marine mammal watching

Although considered by many to be a non-consumptive use of marine mammals with economic, recreational, educational and scientific benefits, marine mammal watching is not without potential negative impacts. A recent study of whale watch activities worldwide has found that the business of viewing whales and dolphins in their natural habitat has grown rapidly over the past decade into a billion dollar ($US) industry involving over 80 countries and territories and over 9 million participants (Hoyt 2001). Whale watching has the potential to harass whales by altering feeding, breeding, and social behavior or even injure them if the vessel gets too close or strikes the whale. Another concern is that preferred habitats may be abandoned if disturbance levels are too high. In the Notice of Availability of Revised Whale Watch Guidelines for Vessel Operations in the Northeastern United States (64 FR 29270; June 1, 1999), NMFS noted that whale watch vessel operators seek out areas where whales concentrate, which has led to numbers of vessels congregating around groups of whales, increasing the potential for harassment, injury, or even the death of these animals. The interactions that individuals experience in these waters likely influence how they react to approaches by vessels in the future (Herman 1979).

NMFS has promulgated regulations at 50 CFR 224.103 that specifically prohibit: (1) 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; (2) feeding or attempting to feed a marine mammal in the wild; and (3) approaching humpback whales in Hawai'i and Alaska waters closer than 100 yards (91.4 m). In addition, NMFS launched an education and outreach campaign to provide commercial operators and the general public with responsible marine mammal viewing guidelines which in part state that viewers should: (1) remain at least 50 yards from dolphins, porpoise, seals, sea lions and sea turtles and 100 yards from large whales; (2) limit observation time to 30 minutes; (3) never encircle, chase or entrap animals with boats; (4) place boat engine in neutral if approached by a wild marine mammal; (5) leave the water if approached while swimming; and (6) never feed wild marine mammals. In January 2002, NMFS also published an official policy on human interactions with wild marine mammals which states that: "NOAA Fisheries cannot support, condone, approve or authorize activities that involve closely approaching, interacting or attempting to interact with whales, dolphins, porpoises, seals or sea lions in the wild. This includes attempting to swim with, pet, touch or elicit a reaction from the animals."

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 (NMFS 2006b). Responses appear to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity (Au and Green. 2000; Corkeron 1995; Erbe 2002; Magalhaes et al. 2002; Richter et al. 2003; Scheidat et al. 2004; Watkins 1986; Williams et al. 2002b; Williams et al. 2002d). Foote et al. (2004) reported that southern resident killer whale call duration in the presence of whale watching boats increased by 10-15% between 1989-1992 and 2001-2003 and suggested this indicated compensation for a noisier environment. Disturbance by whale watch vessels has also been noted to cause newborn calves to separate briefly from their mothers' sides, which leads to greater energy expenditures by the calves (NMFS 2006b). Although numerous short-term behavioral responses to whale watching vessels are documented, little information is available on whether long-term negative effects result from whale watching (NMFS 2006b). It is difficult to precisely quantify or estimate the magnitude of the risks posed to marine mammals in general and southern resident killer whales specifically (who possibly have the greatest exposure to whale watching activities of any listed marine mammal) by whale watching and recreational vessels (NMFS 2008e).

Naval activities

Naval activity, notably sonar use during training exercises, has gained notoriety for its coincidence with marine mammal strandings. However, other activities (also during training exercises in designated naval operating areas and training ranges) also have the potential to adversely impact marine mammals. The action area overlaps several naval training ranges or facilities listed below. Listed individuals travel widely in the Atlantic Ocean and the Gulf of Mexico and could be exposed to naval activities in several ranges.

- Atlantic Fleet Active Sonar Training Range
- Sonar Training (AFAST) Study Area
- Jacksonville (JAX) Range Complex
- Virginia Capes (VACAPES) Range Complex
- Cherry Point (CHPT) Range Complex
- Gulf of Mexico (GOMEX) Range Complex
- Naval Surface Warfare Center Panama City Division (NSWC PCD) Mission Activities

Naval activities to which individuals could be exposed include, among others, vessel and aircraft transects, munitions' detonation, and sonar use. Responses by marine mammals could include no response, short-term and long-term behavioral responses and changes (altered vocal activity, changes in swimming speed and direction, respiration rates, dive times, and social interactions), temporary or permanent hearing loss, debris ingestion, ship-strike injury, and death. Death or injury is not expected to occur as a result of exposure to naval activities.

Although naval vessels represent a small fraction of the total sound level and are designed to operate quietly, these ships are large and equipped with high-output sonar equipment such as ANISQS-53C tactical sonar, which produces signals at source levels of 235 dB re 1 µParms at 1 m. The signals emitted from these devices have the potential to affect marine mammals in the action area; however, empirical data are limited.

In 1997, NMFS issued a biological opinion on Navy training activities within and in the vicinity of the critical habitat that had been designated for North Atlantic right whales off of the coasts of Georgia and Florida (NMFS 1997). That Opinion concluded that the Navy‘s training activities were not likely to jeopardize the continued existence of North Atlantic right whales and other endangered or threatened species or result in the destruction or adverse modification of critical habitat that had been designated in the action area for that consultation.

In the late 1990s, the U.S. Navy implemented several new mitigation measures that were designed to protect right whales. Because of these mitigation measures, NMFS concluded that current Navy operations out of Mayport, Florida were not likely to jeopardize the continued existence of endangered or threatened species under NMFS' jurisdiction (NMFS 1997). Vessel operations and ordnance detonations adversely affect listed whales. The Navy ship-shock trials for the USS Winston S. Churchill was conducted in the Action Area for this consultation, although the U.S. Navy employed a suite of measures that appeared to protect marine mammals from being exposed to shock waves produced by the underwater detonations associated with the trial (Clarke and Norman 2005).

From early July through early August 2007, the U.S. Navy conducted a Composite Training Unit-Joint Task Force Exercise within and seaward of the Cherry Point and Jacksonville-Charleston Operating Areas located off South Carolina, North Carolina, Georgia, and Florida. These exercises included antisubmarine warfare training events that employed between 340 and 355 hours of mid-frequency active sonar and deployed 170 DICASS sonobuoys. The Navy reported that one group of dolphins had been observed during this exercise, resulting in a shut-down of active sonar usage. The actual number of marine animals that might have been exposed to mid-frequency active sonar during that exercise, and their responses to any exposure, remains unknown. In August and September 2008, the U.S. Navy conducted a ship shock trial on the mesa verde in waters east of Jacksonville, Florida, using High Blast Explosive (hbx-1) for the detonations. Surveys associated with the trial did not detect any dead or injured marine mammals during the shock trial event or during post-mitigation monitoring. In addition, no marine mammal stranding has been attributed to the shock trial.

In June 2009, NMFS issued a biological opinion on the Permits Division's proposal to promulgate regulations that would authorize the U.S. Navy to "take" marine mammals incidental to (1) the U.S. Navy's proposal to continue to conduct training activities within and adjacent to (a) waters off the Northeast coast of the United States, (b) the Virginia Capes Range Complex; (c) the Cherry Point Range Complex, and (d) the Charleston-Jacksonville Range Complex over a five-year period and the U.S. Navy's proposal to establish a transit protection system at Naval Submarine Base Kings Bay, Georgia, to escort nuclear powered ballistic submarines during transit between the Naval Submarine Base and the dive/surface site.

Each year, over the five-year period extending from 2009 through 2014, NMFS expected the U.S. Navy's training activities to harass blue, fin, humpback, North Atlantic right, sei whale, and sperm whales, by exposing them to sound fields produced by underwater detonations or ship noise at received levels that would cause individual animals to change their behavior from foraging, resting, milling, and other behavioral states that require lower energy expenditures to traveling, avoidance, and behavioral states that require higher energy expenditures (NMFS 2008a; NMFS 2008b; NMFS 2009; NMFS 2010d).

Between January and August 2009, the U.S. Navy conducted three Composite Training Unit Exercises and one Southeastern Anti-Submarine Warfare Integrated Training Initiative or SEASWITI. The U.S. Navy conducted three Integrated Anti-Submarine Warfare courses (IAC) in conjunction with three of the Composite Training Unit Exercises it conducted over this time interval: one on 11 and 13 January 2009; a second on 17 and 19 February 2009, and a third on 15 and 17 June 2009. The total numbers of sonar hours that were associated with each of these exercises are classified and are not reported here.

On 28 July 2009, NMFS issued a final biological opinion on the U.S. Navy's proposal to place a network of underwater transducer devices and undersea cables in a 1,713-km^2 (500 nautical $mile^2$) area of the ocean about 93 km (50 nautical miles) offshore of northeastern Florida, beginning in 2012 or 2013 with operations scheduled to begin in 2014 or 2015. The instrumented area, which would be called the Undersea Warfare Tracking Range (USWTR), would be connected by cable to a facility that would be located on shore where the data collected on the range would be used to evaluate the performance of participants in shallow water training exercises.

That biological opinion concluded that no blue, fin, or sei whales are likely to be exposed to active sonar associated with active sonar training activities on the Jacksonville Operating Area. That opinion also concluded that 106 humpback whales and 47 North Atlantic right whales might be exposed to active sonar operations conducted on USWTR at received levels that might result in behavioral harassment. However, the Opinion concluded that these exposures were not likely to jeopardize the continued existence of these species.

Natural Mortality

Natural mortality rates in cetaceans, especially large whale species, are largely unknown. Although factors contributing to natural mortality cannot be quantified at this time, there are a number of suspected causes, including parasites, predation, red tide toxins and ice entrapment. Urinary tract diseases and kidney failure caused by the giant spirurid nematode *Crassicauda boopis* could affect humpback whale populations (Lambertsen, 1986; Lambertsen, 1992), and several other species of large whale are known to carry similar parasites (Rice, 1977). Parasites and biotoxins from red-tide blooms are other potential causes of mortality of humpback whales (Perry et al., 1999).

A well-documented observation of killer whales attacking a blue whale off Baja, California, demonstrates that blue whales are at least occasionally vulnerable to these predators (Tarpy 1979). Other stochastic events, such as fluctuations in weather and ocean temperature affecting prey availability, may also contribute to large whale natural mortality.

Whales also appear to strand from natural (as compared with anthropogenic) causes. Nitta (1991) reported that between 1936 and 1988, 8 humpback whales, 1 fin whale, and 5 sperm whales stranded in the Hawaiian Archipelago. In a partial update of that earlier report, Maldini et al. (2005) identified 202 toothed cetaceans that had stranded between 1950 and 2002. Sperm whales represented 10 percent of that total. Although these two studies did not specify the cause or causes of death in these cases, we include these strandings in this discussion of sources of natural mortality because the causes of death remain unknown. Because most of these stranding events consisted of individual animals or because many of the multiple stranding events identified in these reports occurred prior to the mid-1960s (4 of the 8 multiple stranding events identified by Maldini et al. (2005) occurred between 1957 and 1959, 3 of 8 occurred in 1976, and 1 occurred in 1981).

Recovery Actions

Several agencies have engaged in a variety of actions that are designed to reduce the effects of human activities on endangered and threatened species in the Action Area. In 1993, NMFS formed the Southeast Implementation Team for the Right Whale Recovery Plan to address the goals of the Right Whale Recovery Plan within NMFS' Southeast Region. The recovery plan has identified entanglement in fishing gear and ship collisions as the two major direct human impacts affecting both species. Habitat degradation through pollution or other major habitat alteration processes caused by either human sources (discharge or disposal in the marine environment) or resource management activities (fishery or minerals management) is also identified as a major indirect impact requiring attention.

An Early Warning System for right whales has been operational in areas of the southeastern U.S. for several years. This system identifies the known location of right whales within and adjacent to the winter calving area from Savannah, Georgia, to Sebastian Inlet, Florida, from 1 December through 31 May (when right whales are assumed to occur in these waters) and provides this information to mariners. This system has successfully diverted shipping to avoid right whales on several occasions, thus decreasing the threat of vessel collisions.

Scientific research

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 are considered harassment or wounding (in the case of implantable tagging, dart tagging, and biopsy) but no serious injury is exempted and no mortalities are currently exempted. Since issuance of a permit is a federal activity, each scientific research permit currently authorized in the action area 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 show that humpback whales are the most heavily targeted for research.

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; Weinrich et al., 1992; Jahoda et al., 2003). Researchers operating in the action area are required to approach marine mammals 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.

A total of 18 permits authorize the harassment of one or more of the target species in the action area during research (Table 5). Permits in Table 5 are identified by ocean basin or area, but most permits authorize a smaller study area or region within an ocean basin, reducing the chance of repeated harassment of individual whales by researchers.

Table 5 – Active Scientific Research Permits and Letters of Confirmation authorizing the harassment of ESA-listed cetaceans in the action area of this Opinion.

Expiration	Organization	Permit No.	Ocean Basin or Area
2012-06-30	*Center For Coastal Studies*	*633-1778*	*Atlantic Ocean / all U.S. waters of the North Atlantic Ocean (with the exception of the Gulf of Mexico, and waters off the U.S. Virgin Islands and Puerto Rico).*
2012-12-31	New Jersey Dept. of Environmental Protection	10014	Up to 20 nautical miles off shore in the Atlantic Ocean / NJ
2013-01-15	NMFS Northeast Fisheries Science Center (NEFSC)	775-1875	Atlantic Ocean / waters within or proximal to the US EEZ from Florida to Maine (and Canadian waters in the Bay of Fundy and Soctian Shelf)
2013-02-15	The Whale Center of New England	605-1904	Cape Code and VA to FL
2014-01-15	SUNY at Buffalo	1128-1922	Atlantic, Caribbean / Nearshore waters of Puerto Rico
2014-03-31	New England Aquarium	15415	Gulf of Maine, Cape Cod Bay, and New York Bight / Coastal waters out to 50 miles from New York Harbor to the Maine/Canadian border.
2015-07-30	Duke University	14791	Northwest Atlantic / Migratory, feeding and breeding grounds of North Atlantic right whales. Will work offshore in federal waters if applicable.
2015-07-31	University of Hawaii at Manoa	14451	N. Atlantic Ocean off shore waters / Federal and state waters off listed states including US Navy AUTEC, FACSFAC (VACAPES and Jacksonville), and USWTR; and Cherry Pt., Narrangansett Bay, Virginia Capes, and Key West Complexes, as well as the AFAST study area

Table 5 – Active Scientific Research Permits and Letters of Confirmation authorizing the harassment of ESA-listed cetaceans in the action area of this Opinion.			
Expiration	**Organization**	**Permit No.**	**Ocean Basin or Area**
2015-09-30	New England Aquarium	14233	The U.S. EEZ from the Hague Line to the Gulf of Mexico / The U.S. EEZ, bounded by the Hague Line in the north, the Gulf of Mexico to the south, and the coastline of the U.S to the west, and the boundary of the EEZ to the east.
2015-09-30	Center for Coastal Studies	14603	Gulf of Maine / Vessel operations will focus on the inshore waters of Cape Cod Bay while some air survey efforts may extend east and north to within 100 km of Cape Cod.
2015-11-30	Florida Atlantic University	14586	Atlantic Ocean, Southeast US Coast, Florida Straits & Gulf Stream Current / Surveys will be conducted off the coast of Florida.
2016-05-01	NMFS National Marine Mammal Laboratory (NMML)	14245	Gulf of Maine, mid-Atlantic and southeastern US.
2016-06-30	Georgia Department of Natural Resources	15488	Atlantic Ocean and Gulf of Mexico / Atlantic Ocean and Gulf of Mexico off of South Carolina, Georgia and Florida and out to the EEZ.
2016-10-31	Associated Scientists at Woods Hole	13927	Southeast US east coast, primarily off northeast Florida.
2016-12-31	Texas A&M University at Galveston	15682	Atlantic Ocean, Caribbean Sea / Waters surrounding Puerto Rico to the extent of the US EEZ
2017-04-30	Woods Hole Oceanographic Institution	14118	North Atlantic Ocean / Tagging will occur in N. Atlantic waters out to the US EEZ from Maine to Texas. Some tagging may occur in National Marine Sanctuaries such as Stellwagen Banks, Gray's Reef, Florida Keys, and Flower Garden Banks.
2017-05-15	Geo-Marine, Inc	16109	Atlantic OCS / Our Study Area extends from the shoreline to the 30 m isobath between southern New Jersey and the Virginia/North Carolina border.

Table 5 – Active Scientific Research Permits and Letters of Confirmation authorizing the harassment of ESA-listed cetaceans in the action area of this Opinion.			
Expiration	**Organization**	**Permit No.**	**Ocean Basin or Area**
2017-05-17	Riverhead Foundation for Marine Research and Preservation	15575	Atlantic Ocean / Focal area: New York Bight and surrounding waters; Research can occur off MA,RI, CT, NY, NJ, DE, MD, VA and NC.
2017-05-31	University of North Carolina Wilmington	16473	Atlantic Ocean / Extending 120 nm offshore, from Delaware Bay- Cape Canaveral, FL. Most effort from (1) northern NC to Delaware Bay, (2) NC and southern VA (focus at Cape Hatteras), and (3) proposed USWTR site off Jacksonville, FL.

Italicized row indicates the permit that would be replaced by the permit issued in this action

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 ACTIONS

Pursuant to Section 7(a)(2) of the ESA, federal agencies are required to ensure 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. The proposed permit by the Permits Division would expose Blue, Fin, Humpback, Sei, and Sperm whales to actions that constitute "take". In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed actions, the probability of individuals of listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. 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. The purpose of this assessment is to determine if it is reasonable to expect the proposed studies to have effects on listed species affected by this permit that could appreciably reduce the species' 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, and therefore species level, consequences. The proposed permit would authorize non-lethal "takes" by harassment of listed species during research activities. The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. However, the Marine Mammal Protection Act of 1972, as amended, 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)]. 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.

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 engine noise and the presence of the vessels themselves,
- Ship strikes during transit and during surveys,
- Disturbance due to close vessel approaches (both initial approach and revisits),
- Disturbance from photogrammetry,
- Disturbance from skin and blubber biopsy sampling,
- Disturbance from collection of exhaled air/mucosa, feces and sloughed skin.

Exposure analysis

Exposure analyses identify the co-occurrence of ESA-listed species with the action's effects in space and time, and identify the nature of that co-occurrence. The *Exposure analysis* identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the action's effects and the populations(s) or subpopulation(s) those individuals represent. The Permits Division proposes to issue a five-year permit for scientific research to Dr. J. Robbins. The activities would be conducted year-round in the waters of the western North Atlantic and eastern Gulf of Mexico, including the waters off the Northeast US (ME, NH, MA, RI), the US Mid-Atlantic States (NY, NJ, DE, MD, VA, NC), the southeast US (SC, GS, FL) and Puerto Rico.

Tables 1-4 identify the numbers ESA listed whales that Dr. Robbins would be authorized to approach, photograph from ships, collect exhaled air, fecal and sloughed skin samples, skin and blubber biopsy samples annually under the five-year permit. A total of 17 blue, 37 fin, 157 humback, 34 sei, and 17 sperm whales would be covered under the proposed permit annually.

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 species themselves. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal (or physiological), or behavioral responses that might reduce the fitness of individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

Evidence indicates that wild animals respond to human disturbance in the same way they respond to predators (Beale and Monaghan, 2004; Frid, 2003; Frid and Dill, 2002; Gill et al., 2001; Lima, 1998; Romero, 2004). These responses may manifest themselves as stress responses, interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill, 2002; Romero, 2004; Sapolsky et al., 2000; Walker et al., 2005).

Close approaches by research vessels and vessel noise

For all research activities, the presence of vessels has the potential to induce behavioral and physiological changes in individuals being targeted, although the animals' reactions are generally short term and low impact. The degree to which individuals are disturbed is highly variable. Whales may respond differently depending upon what behavior the individual or pod is engaged in before the vessel approaches (Hooker et al., 2001; Wursig et al., 1998) and the degree to which they have become accustomed to vessel traffic (Lusseau, 2004; Richter et al., 2006); reactions may also vary by species or individuals within a species (Gauthier and Sears, 1999). Overall, reactions range from little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation; diving; time spent submerged; foraging; and respiratory patterns. Responses may also include aerial displays like tail flicks and lobtailing and may possibly influence distribution (Baker et al., 1983; Bauer and Herman, 1986; Clapham et al., 1993; Jahoda et al., 2003; Watkins et al., 1981). The degree of disturbance by vessel approaches is highly varied. Whales may respond differently depending upon what behavior the individual or pod is engaged in before the vessel approaches (Wursig et al. 1998; Hooker et al. 2001)and the degree to which they have become accustomed to vessel traffic (Lusseau 2004; Richter et al. 2006); reactions may also vary by species or individuals within a species (Gauthier and Sears 1999). In addition, Baker et al. (1988) reported that changes in whale behavior corresponded to vessel speed, size, and distance from the whale, as well as the number of vessels operating in the proximity. Based on experiments conducted by Clapham and Mattila (1993), experienced, trained personnel approaching whales slowly would result in fewer whales exhibiting responses that might indicate stress. Jahoda et al. (2003) found effects of more than a few minutes, with fin whales failing to return to baseline behaviors after one hour of observation in some cases, in spite of the fact that Gauthier and Sears (1999) found fin whales to be less responsive than humpbacks.

Humpback whales have been the best-studied whale species in regards to responses to close approaches by vessels. For humpback whales, studies found patterns of disturbance in response to vessel activity, ranging from no response to approach to evasion (Goodyear 1993a; Salden 1993) which indicate such approaches are probably stressful to the humpback whales, but the consequences of this stress on the individual whales remains unknown (Baker and Herman 1989; Baker et al. 1983). In response to vessel approach, Felix (2001) found that 27 of 86 individuals approached resulted in avoidance of the vessel (50 were indifferent and 9 approached vessels), including long dive, change in heading, tail splashes, altered swimming speed or breathing frequency, and group structure disruption. Approaching vessels may instigate aerial behavior, such as fluke slapping and breaching, behavior recently suggested to be a switch in communication from vocal to surface active signaling (Baker et al. 1983a; Baker et al. 1983b; Baker et al. 1982; Dunlop et al. 2010; Holt et al. 2009). Hall (1982) did not find social or feeding behavior to be disturbed by vessel traffic or close approaches. However, there is the possibility that humpback whales may habituate to vessel noise if given sufficient time and exposure (Clapham and Mattila 1993; Watkins 1986). Goodyear (1993a) did not observe changes in behavior due to vessel approaches in most cases, although an increase in speed did occur on one occasion when a whale was approached within 10 m. Cantor et al. (2010) generally found resting or socializing whales to switch to traveling upon approach of their research vessels.

Baker et al. (1983) described two responses of whales to vessels: "horizontal avoidance" of vessels 2,000 to 4,000 meters away characterized by faster swimming and fewer long dives; and "vertical avoidance" of vessels from 0 to 2,000 meters away during which whales swam more slowly, but spent more time submerged. Watkins et al. (1981) found that humpback whales appeared to react to vessel approach by increasing swim speed, exhibiting a startle reaction, and moving away from the vessel with strong fluke motions. Baker and Herman (1989), Baker et al. (1982) and (1983a; 1983b), Bauer (1986), Bauer and Herman (1986), and Green and Green (1990) found that humpbacks spent less time at the surface and altered their direction of travel in response to approaching vessels. Increased time underwater and decreased swim speed persisted for up to 20 minutes after vessels left the area. Watkins and Goebel (1984) found humpbacks to be very difficult to approach, possibly due to physical ocean features in the area that likely altered sound properties such that vessel noise was difficult to detect except at close range, resulting in whales suddenly becoming aware of boats in close proximity and reacting strongly as a result. Norris (1994) documented changes in humpback song structure in response to passing vessels, with unit and phrase durations reduced versus control periods.

Other studies have found that humpbacks respond to the presence of boats by increasing swimming speed, with some evidence that swimming speed then decreased after boats left the area (Au and Green 2000; Scheidat et al. 2004). A number of studies involving the close approach of humpback whales by research vessels for biopsying and tagging indicate that responses are generally minimal to non-existent when approaches were slow and careful. When more pronounced behavioral changes occur, the responses appear to be short-lived (Gauthier and Sears 1999; Weinrich et al. 1992; Clapham and Mattila 1993; Weinrich et al. 1991). 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 and calf pairs. Smaller pods of whales and pods with calves also seem more responsive to approaching vessels (Bauer and Herman 1986; Bauer 1986). The more active the group, the more easily it was disturbed; however, Cantor et al. (2010) found structuring in the response rate of various individuals in mating groups, with male response becoming progressively less frequent with increasing degree of dominance in the mating group. Mother-calf pairs were the most easily disturbed group, followed by all adult groups, adult subadult mixes, and all subadult groups (Felix 2001). Weinrich et al. (1991) and (1992b), Cantor et al. (2010), as well as Krieger and Wing (1984) found feeding animals to be least responsive, although data from these studies was contradictory when evaluating responses while resting or on breeding grounds. The Weinrich studies also found that respiratory parameters are not good indicators of responsiveness due to the large natural variance associated with them. However, numerous studies have identified significant changes in respiration and diving in association with vessel traffic (see Bauer and Herman (1986) for a summary). On several occasions, research trips conducted by Krieger and Wing (1984) had to actively avoid collisions with humpbacks, although whales presumably were aware of the vessel's presence. Single or paired individuals may respond more than larger groups (Bauer and Herman 1986). Würsig et al. (1998) found milling or resting cetaceans to be more sensitive. Based on their experiments with different approach strategies, researchers concluded that experienced, trained personnel approaching humpback whales slowly would result in fewer whales exhibiting responses that might indicate stress.

Repeated exposure can have a cumulative effect that is greater than the sum of individual exposures, eliciting responses that are more significant for individuals and populations, although Cantor et al. (2010) did not find a difference in response based upon re-exposure. However, humpback whales have vacated areas where relatively high boat traffic and human activity occurs (Herman 1979). It should be noted that potentially reduced prey resources may also have been important in this redistribution (Bauer and Herman 1986). Matkin and Matkin (1981) did not find a correlation between humpback whale behavior and recreational vessels.

Responses can also change over long timeframes; Watkins (1986) looked at whale responses off Cape Cod over a several decade period and found that humpbacks shifted their general response from being generally evasive to a tendency to approach vessels. Mizroch et al. (2010) followed up on several humpback whales that were approached and radio tagged over the course of several decades. They found no basis for substantiating a long-term reaction to approach, including gross measures of growth and reproduction.

Other large whale species have also been investigated for their responses to close vessel approaches. For fin whales, 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 m (16-33 ft) for approximately one hour of photoidentification and biopsy sampling; a larger vessel used for observations was also present. As with humpback whales, fin whales have been found to respond by suspending feeding, rapid course change, accelerated dive, respiratory behavior, and speed increases to vessel noise, particularly throttle changes, such as reversing. The fin whales tended to reduce the time they spent at 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 whales to vessel disturbance cannot be ruled out, but concluded that approaching vessels maneuvering at low speeds were less likely to cause visible reactions in fin whales. Fin whales were particularly evasive in a study published by Ray et al. (1978), exhibiting high-speed swimming, frequent changes in heading, separation of groups, and irregular breathing patterns. Recognition (sensitization) of tagging vessels by both humpback and fin whales has not been seen to occur.

Sei and blue whales are thought to respond to approaching vessels in a similar manner as other baleen whales, with responses depending on whale behavior and the speed and direction of the approaching vessel (Perry et al. 1999). Sei whales are also reported to exhibit more avoidance behavior than fin whales during close approaches (Gunther 1949 as cited in Perry et al. 1999).

Several studies have suggested that stress can adversely impact female reproduction through alterations in the estrus cycle (Herrenkohl and Politch 1978; Moberg 1991; Mourlon et al. 2011). Komesaroff et al. (1998) found that estrus may inhibit the stress response to some extent, although several studies suggest estrus and particularly the follicular stage may be susceptible to stress-induced disruption (see (Rivier 1991) and (Moberg 1991) for reviews). Most of these studies were conducted with single or multiple highly invasive and frequent stress methodologies or chronic stress; we do not expect stressors associated with the proposed research to be nearly as stressful. Under less invasive and acutely stressful methods (but more invasive than those proposed by the applicant), Omsjoe et al. (2009a) found no impacts to the percentage of individuals with offspring the following year following chase, capture, and restraint of reindeer (ungulates in general tend to be prone to strong, potentially lethal stress responses). Overall, we do not expect reproduction to be impaired primarily due to the lack extreme stressors utilized by studies to induce adverse reproductive impacts and the acute nature of the stressors involved.

The close approach of vessels also presents the possibility that valuable acoustic information could be missed by the target individual(s) due to masking by the vessel's engines. The acoustic properties of vessels likely to be used by the applicant are similar to the frequency range utilized by target marine mammals during vocalization such that communication could be impaired (Clark et al. 2009; Dunlop et al. 2010). Parks et al. (2010) and Anonymous (2010) found that North Atlantic right whales temporarily modify the amplitude of their calls, making them louder with increased background noise (including noise from vessel traffic), as well as shifting call frequency over longer time frames. As a broader issue, increased anthropogenic noise in the marine environment has the potential to reduce the range over which individuals communicate, conceivably increasing calf mortality, altering ideal group or individual spacing, and making identification and selection of mates more difficult or impossible (Croll et al. 2001).

The applicant proposes to use one vessel per survey, and we do not anticipate masking will occur for several reasons. Operations would be conducted at low speed with a minimum of throttling and directional changes. Low vessel speed means that less cavitation will occur, which is the primary source of sound energy emitted by motorized vessels (Mazzuca et al. 2001; Ross 1976). Lower speed and fewer directional changes will also result in fewer changes in sound characteristics, which are believed to add to the significance of vessel noise and its impact to cetaceans. Most interactions with target individuals should be brief before the vessel breaks contact following photoidentification, biopsing, exhalation, fecal, and sloughed skin sampling, and/or behavioral documentation.

We would expect most listed whales exposed to close vessel approaches under the proposed permit to exhibit either no visible reaction or short-term low-level to moderate behavioral responses. Available evidence, including approaches of individuals of other species in a variety of locations, leads us to conclude there should be no strong behavioral responses to close approaches. Based upon the available literature and anticipated levels of future exposure, one to a few dozen blue, fin, sei, and sperm whales may also respond with low-to moderate-level behavioral responses described above for baleen whales. We expect that some, but not all, individuals may respond to re-exposures.

Although close approaches conducted under the proposed permit might still be stressful for some individuals, and might temporarily interrupt behaviors such as foraging, evidence from investigators and in the literature suggests that responses would be short-lived. Assuming an animal is no longer disturbed after it returns to pre-approach behavior, we do not expect a negative fitness consequence for the individuals approached.

Exhaled air/mucosa, sloughed skin and feces collection

The collection of exhaled air, sloughed skin and feces would not involve contact with the whale and would not be invasive. Collections could potentially be done in the vicinity of a whale, but we would not expect this to have any impact beyond the effect of the close approaches to whales assessed earlier.

Skin and blubber biopsy

Biopsy sampling has the potential to disrupt behavior and breach an individual's integument. Physiological, pathological, and behavioral responses are possible. We reviewed the literature assessing the impacts of biopsy sampling to various cetacean species. We know of only one published report of a cetacean death following biopsy sampling, when the dart penetrated the muscle mass of a female common dolphin (Delphinus delphis), which may have resulted invertebral trauma and severe shock (Bearzi 2000). The individual had relatively thin blubber, permitting deeper penetration than was desired and sticking of the dart. Apart from the one mortality, there is not even evidence of infection at the point of penetration or elsewhere among the many whales sighted in the days following biopsy sampling (Weller 2008). The risk of infection is thought to be minimized by sterilizing dart tips before sampling occurs. In general, healing is rapid (roughly one week, scarring thereafter)(Noren and Mocklin 2012).

Balaenopterids. Blue whale responses responded by submerging, accelerating, and/or diving (Gauthier and Sears 1999). Fin whales either do not respond at all, or exhibit low- to moderate-level behavioral responses (Marsili and Focardi 1996). Inadvertent repeated biopsy within a week did not appear to cause a difference in reaction in three blue whales and five fin whales (Gauthier and Sears 1999). Group size does not appear to impact the likelihood or severity of response (Gauthier and Sears 1999). Female fin whales appear to respond to biopsy more often than males (66% versus 44%) and more strongly. Individuals generally return to baseline behavior within a few minutes (Gauthier and Sears 1999). A biopsy miss that hit the water near a target fin whale apparently caused the fin whale to dive (Gauthier and Sears 1999).

Humpback whale. Many researchers claim that biopsy darts or sampling does not result in significant short-term or long-term behavioral disturbance to humpback whales. However, humpback whales do appear to be more reactive to biopsies than other baleen whale species. An IWC working group reviewed biopsy sampling and concluded long-term effects are unlikely, although short-term responses frequently occur (IWC 1991). Clapham and Mattila (1993) found 44% of humpback whales sampled showed no immediate response, while 22.5% reacted in subtle or minor ways. Cerchio (2003) found similar results in 350 biopsy events. Cantor et al. (2010) found that 46% of 542 biopsy attempts on adult or subadult humpback whales from 10-25 m away resulted in a behavioral response (most commonly fluke movement). Neither the use of a tether, the duration of vessel contact with the target individual, nor region of the body hit influenced the likelihood of response, although responses were more frequent and intense from smaller vessels (likely due to their additional noise) than from larger vessels. Weinrich et al. (1991) reached the same conclusions for humpback whales, although short-term disruption of foraging could occur as well as agonistic behavior and altered dive parameters. Gauthier and Sears (1999) found humpback whales to accelerate, change direction, dive, lobtail, exhale forcefully, submerge, and display tail and flipper movements (the most common response); "moderate" responses were the most common category of response. Weinrich et al. (1992) also found that of 71 humpback whales biopsied, 7% had no response, 27% exhibited a "low" response, 61% had a "moderate" response, and 6% had a "strong" response. Brown et al. (1994) found 41% of 203 humpbacks biopsied to respond in some way, including fluke movements, tail slaps, and disrupted dives. Humpbacks rarely display tail flicks, but frequently do so in response to biopsy (Weinrich et al. 1992). Repeated sampling was not found to influence the likelihood of subsequent biopsy responses (Brown et al. 1994).

The behavioral state of individuals pre-biopsy may also influence the probability of response, with foraging, traveling, or socializing individuals less likely to respond than resting individuals (Cantor et al. 2010; Weinrich et al. 1991), although this is confounded by data in other areas, possibly due to differences in vessels or methods used between studies (Brown et al. 1994). Clapham and Mattila (1993) found that evasion was the most common behavioral change and that response was less likely on breeding grounds. Unlike close approach, demographic factors do not appear to influence biopsy response in humpback whales; individual age, gender, group size, geographic location, and repeated sampling have not been found to influence the likelihood of biopsy responses (Cantor et al. 2010; Gauthier and Sears 1999; Weinrich et al. 1991). Brown et al. (1994) did find females to respond more frequently than males, although not significantly so. Of individuals that do respond, return to baseline behavior occurs within a few minutes (Gauthier and Sears 1999). Mothers and males in competitive groups reacted less frequently than other individuals (Cerchio 2003; Clapham and Mattila 1993). However, calves tend to be more evasive than any other group. Females with calves responded more frequently than did non-lactating females (60% versus 43%)(Cantor et al. 2010).

Biopsy misses can also cause behavioral responses (Gauthier and Sears 1999). Strong behavioral responses were found by Weinrich et al. (1992) and (1991) when a line attached to the biopsy dart snagged on an individual's flukes. Brown et al. (1994) reported that 16% of missed Australian humpbacks responded, suggesting that these animals reacted to the sound of the dart hitting the water. Similarly, Clapham and Mattila (1993) reported that a total of 375 (87.7%) of misses on breeding grounds involved no reaction. Gauthier and Sears (1999) found four out of five misses of individuals in a feeding area did not involve a response, although four out of five other individuals did respond until freed from biopsy darts that stuck in their blubber. Significantly stronger reactions were displayed when biopsy darts actually hit humpback whales than when they missed (Weinrich and Kuhlberg. 1991).

Sperm whales. We identified only one study that has reported on the response of sperm whales to biopsy attempts. Whitehead et al. (1990) reported responses from sperm whales off Nova Scotia as well as the Azores, finding that every biopsy hit and roughly half of the misses caused a startle response. Startling was associated with flexing the body, raising the back, and/or increasing swimming speed. Other responses occasionally observed included short dives of up to five minutes and defecation. In all cases, individuals were observed to return to baseline behavior within minutes. Discussions with experienced field biologists suggest these trends are generally accurate, although no response may also occur to biopsy hits (Greg Schorr, Cascadia Research, pers. comm.).

As with tagging activities, annual reports are unclear as to the number and types of responses target individuals exhibited upon biopsy. Therefore, we relied upon available literature and expert opinion to determine the number and types of responses under the proposed activities. Gauthier and Sears (1999) provide the only quantitative data available for balaenopterid response, as does Whitehead et al. (1990) for sperm whales. Humpback whale responses have been documented extensively. Of the available studies, Cantor et al. (2010) and Brown et al. (1994) provide the largest sample sizes and report similar response rates; we use these studies to determine humpback response rate and the entirety of the literature to inform the expected type of response. Data from Rossi (2009) are used to calculate bowhead response rate and Brown et al. (1991) was used for right whales. Overall, we do not expect sei whales to respond to biopsy, but 5 fin, 24 humpback, and 3 sperm whales are likely to respond behaviorally to biopsy activities as described above (mild- to moderate-behavioral responses). We also expect that one or a few blue whales may respond with low- to moderate-level behavioral responses over the life of the proposed permit. As previously mentioned, individuals re-exposed to proposed activities could also undergo additional responses.

We expect responses to consist of brief, low-level to moderate behavioral responses, consistent with findings of Noren and Mocklin (2011). These are likely to include increased swimming speed, diving, change in direction, lobtail, forceful exhalation, submergence, tail and flipper movements, agonistic behavior, twitches, back arches, and defecation. As a result, individuals may temporarily leave the area or cease feeding, breeding, resting, or other activities. However, we expect that individuals would return to baseline behavior within a few minutes.

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 by this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Sources queried include state legislature websites and Nexis. We reviewed bills passed from 2009-2011 and pending bills under consideration were included as further evidence that actions “are reasonably certain to occur.” State regulation is critical for future anthropogenic impacts in a region. Legislation by various Atlantic states and Puerto Rico, address maintaining healthy marine ecosystems with regulated development of industry, regulation of commercial and recreational use of ocean waters, controlling contaminants in agricultural, stormwater, and municipal effluents, resisting invasive species occurrence, and promotion of policies to decrease greenhouse gas emission and pollution, including alternative energy development.

After reviewing available information, NMFS is not aware of effects from any additional future non-federal activities in the action area that would not require federal authorization or funding and are reasonably certain to occur during the foreseeable future.

INTEGRATION AND SYNTHESIS OF THE EFFECTS

As explained in the *Approach to the Assessment* section, risks to listed individuals are measured using changes to an individual's "fitness" – i.e., the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When 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 population(s) those individuals represent or the species those populations comprise (Anderson, 2000; Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992). As a result, if the assessment indicates that listed plants or animals are not likely to experience reductions in their fitness, we conclude our assessment.
The NMFS Permits Division proposes to issue a scientific research permit to Dr. J. Robbins authorizing research on Blue, Fin, Humpback, Sei, and Sperm whales occurring waters of the western North Atlantic and Puerto Rico.

The *Status of listed resources* described the factors that have contributed to the reduction in population size for the species considered in this Opinion. Threats to the survival and recovery of Blue, Fin, Humpback, North Pacific right, Sei, and Sperm include directed harvest, fisheries interactions, ship strikes, noise, predation, disease and parasitism, contaminants, and scientific research. NMFS expects that the current natural and anthropogenic threats described in the *Environmental Baseline* will continue. Reasonably likely future actions described in the *Cumulative effects* section that could affect the species considered in this opinion include state legislation aimed at maintaining healthy marine ecosystems with regulated development of industry and regulation of commercial and recreational use of ocean waters, and others.

Under the proposed permit, listed whales would be exposed to close approaches by research vessels, photo-identification from ships, biopsy sampling, collection of fecal/expelled air/sloughed skin. For each year of the five-year proposed permit, we estimate that up to a total of 17 blue, 37 fin, 157 humback, 34 sei, and 17 sperm whales would be permitted to be exposed under the proposed permit annually.

We believe short-lived stress responses due to close approach by research vessels are possible for a few individuals, as are short-term interruptions in behaviors such as foraging; however, we do not expect these responses to lead to reduced opportunities for foraging or reproduction for targeted individuals. Collection of exhaled air/mucosa, sloughed skin and feces, even if done in the vicinity of a whale, would not have an effect beyond that of the close approach.

Overall, no individual whale is expected to experience a fitness reduction, and therefore no fitness consequence would be experienced at a population or species level.

CONCLUSION

After reviewing the current *Status of listed resources*; the *Environmental baseline* for the *Action area*; the anticipated effects of the proposed activities; and the *Cumulative effects*, it is NMFS' Opinion that the activities authorized by the proposed issuance of scientific research permit 16325, as proposed, is not likely to jeopardize the continued existence of endangered Blue, Fin, Humpback, Sei, and Sperm whales.

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.

As discussed in the accompanying Opinion, only the species targeted by the proposed research activities would be harassed as part of the intended purpose of the proposed action. Therefore, the NMFS does not expect the proposed action would incidentally take threatened or endangered species.

CONSERVATION RECOMMENDATIONS

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

We recommend the following conservation recommendations, which would provide information for future consultations involving the issuance of marine mammal permits that may affect endangered whales as well as reduce harassment related to authorized activities:

1. *Cumulative impact analysis.* The Permits Division should encourage the marine mammal research community, working with the Marine Mammal Commission as applicable, to identify a research program with sufficient power to determine cumulative impacts of existing levels of research on whales. This includes the cumulative sub-lethal and behavioral impacts of research permits on listed species.

2. *Coordination meetings*. The Permits Division should continue to work with NMFS' Regional Offices and Science Centers to conduct meetings among permit holders conducting research within a region and future applicants to ensure that the results of all research programs or other studies on specific threatened or endangered species are coordinated among the different investigators.

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

In order for the NMFS' 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. 16325. 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 incidental 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 NMFS Permits Division must immediately request reinitiation of Section 7 consultation.

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