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

Title:	Biological and Conference Opinion on the Issuance of a Scientific Research Permit Nos. 19674 to Scott Kraus, New England Aquarium, and 19315 to the Center for Coastal Studies for Research on North Atlantic Right Whales Pursuant to Section 10(a) of the Endangered Species Act of 1973
Consultation Conducted By:	Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
Action Agency:	Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service
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Action Agency: Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service

Activities Considered: Issuance of a Scientific Research Permit Nos. 19674 to Scott Kraus, New England Aquarium, and 19315 to the Center for Coastal Studies for research on North Atlantic Right Whales pursuant to Section 10(a) of the Endangered Species Act of 1973.

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

Approved: Donna S. Wieting

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1 INTRODUCTION

The Endangered Species Act (ESA) of 1973, as amended (16 USC 1531 et seq.) establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat they depend on. Section 7(a)(2) of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with the National Marine Fisheries Service (NMFS) the United States Fish and Wildlife Service (USFWS) or both (the Services), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action. If a Federal agency's action may affect a listed species or designated critical habitat, the agency must consult with the NMFS, the USFWS, or both (50 CFR §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and the NMFS, the USFWS, or both concur with that determination, consultation concludes informally (50 CFR §402.14(b)).

The Federal action agency shall confer with the NMFS, the USFWS, or both, on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat (50 CFR §402.10). If requested by the Federal agency and deemed appropriate, the conference may be conducted in accordance with the procedures for formal consultation in §402.14.

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, or conference if combined with a formal consultation, the NMFS, the USFWS, or both provide a biological opinion (opinion) stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify their designated critical habitat. If either Service determines that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, that Service provides a reasonable and prudent alternative that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If an incidental take is expected, section 7(b)(4) requires the Services to provide an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts and terms and conditions to implement the reasonable and prudent measures.

The action agency for this consultation is the NMFS, Office of Protected Resources, Permits and Conservation Division (hereafter the Permits Division). The agency proposes to issue two scientific research permits pursuant to the ESA and the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 USC 1361 et seq.) to the following applicants:

- Permit No. 19674: Scott Kraus, New England Aquarium, Edgerton Research Lab, Central Wharf, Boston, Massachusetts 02110.
- Permit No. 19315: Center for Coastal Studies, Right Whale Ecology Program, Provincetown, Massachusetts 02657

The purpose of the proposed permits is to allow an exception to the moratoria and prohibition on takes established under the ESA and MMPA in order to allow the applicants to conduct scientific research on North Atlantic right whales (*Eubalaena glacialis*), and in doing so, incidentally harass several non-target cetacean and pinniped species. Take is defined under the MMPA as "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 USC 1361 et seq.) and further defined by regulation (50 CFR 216.3) as "to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal. This includes, without limitation, any of the following:

- the collection of dead animals, or parts thereof
- the restraint or detention of a marine mammal, no matter how temporary
- tagging a marine mammal
- the negligent or intentional operation of an aircraft or vessel
- the doing of any other negligent or intentional act which results in disturbing or molesting a marine mammal
- feeding or attempting to feed a marine mammal in the wild"

Under the ESA take "is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." Harm is further defined by regulation (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."

Consultation in accordance with section 7(a)(2) of the statute (16 USC 1536 (a)(2)), associated implementing regulations (50 CFR §402), and agency policy and guidance (USFWS and NMFS 1998) was conducted by the NMFS Office of Protected Resources' ESA Interagency Cooperation Division (hereafter we). This biological and conference opinion (opinion) and incidental take statement were prepared by the NMFS Office of Protected Resource's ESA Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 CFR §402.

This document represents the NMFS' opinion on the effects of these actions on endangered and threatened species and designated critical habitat for those species. A complete record of this consultation is on file at the NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

The Permits Division has consulted with us on previous scientific research permits for Scott Kraus and the Center for Coastal Studies regarding North Atlantic right whale research. In 2004, we entered into formal consultation with the Permits Division concerning the issuance of a five-year permit (No. 655-1652) to Scott Kraus for research on North Atlantic right whales. In the resulting biological opinion issued on March 1, 2004, we concluded that the issuance of this permit was not likely to jeopardize the continued existence of ESA-listed species, nor adversely modify designated critical habitat (NMFS 2004). In 2005, we entered into formal consultation with the Permits Division regarding the issuance of a five-year permit (No. 633-1763) to the Center for Coastal Studies for research on North Atlantic right whales. In the resulting biological opinion issued on March 11, 2005, we concluded that the issuance of this permit was not likely to jeopardize the continued existence of ESA-listed species, nor adversely modify designated critical habitat (NMFS 2005a).

On April 16, 2010, we entered into formal consultation with the Permits Division regarding their proposed issuance of two new five-year permits for these applicants for continuation of their research on North Atlantic right whales (Permit No. 14233 to Scott Kraus and Permit No. 14603 to the Center for Coastal Studies). In the resulting biological opinion issued on September 1, 2010, we concluded that the issuance of both permits was not likely to jeopardize the continued existence of ESA-listed species, nor adversely modify designated critical habitat (NMFS 2010a). This biological opinion was then subsequently corrected on January 5, 2011, in order to include an analysis of effects on North Atlantic right whale designated critical habitat, and our conclusions remained unchanged (NMFS 2011a). In accordance with the National Environmental Policy Act, the Permits Division also prepared a batched Environmental Assessment (EA) analyzing the impacts on the human environment associated with the issuance of these two permits (NMFS 2010b). Based on the analysis in this EA, it was determined that the issuance of Permit Nos. 14233 and 14603 would not significantly impact the quality of the human environment (NMFS 2010d).

Since both applicants are conducting long-term research on North Atlantic right whales, which in some cases has been ongoing for over 30 years, many of the activities that would be authorized under the permits being considered in this consultation, including aerial and vessel surveys, photography and videography, biopsy sampling, sloughed skin sampling, fecal sampling, passive acoustic recording, suction-cup tagging, and prey mapping and sampling, are the same as those that were considered in the previously mentioned consultations and EA. New research activities that would be authorized under Permits Nos. 19674 and 19315 include thermal imaging, exhaled breath sampling, and underwater photography.

1.2 Consultation History

This opinion is based on information provided in the applicants' permit applications, correspondence and discussions with the Permits Division and the applicants, the Permit Division's EA on issuance of the previous research permits for these applicant (NMFS 2010b), previous biological opinions for these applicants (NMFS 2004; NMFS 2005a; NMFS 2010a; NMFS 2011a) and for other similar research activities (NMFS 2016a), annual reports from the applicants on previous research activities, and the best scientific and commercial data available. Our communication with the Permits Division regarding this consultation is summarized as follows:

- On May 12 and 17, 2016, the Permits Division requested technical assistance from us on the applications for Permit Nos. 19315 and 19674 respectively.
- On June 13, 2016, the Permits Division deemed the application for Permit No. 19674 complete.
- On June 16, 2016, we provided comments to the Permits Division on the application for Permit No. 19674 and on June 20, 2016, we received a response from the applicant to our comments. We had no other comments at that time.
- On June 21, 2016, the Permits Division requested technical assistance from us on the application for Permit No. 18059, a permit that will not be included in this consultation as noted below.
- On June 29 and 30, 2016, we provided comments to the Permits Division on the applications for Permit Nos. 19315 and 18059 respectively, which were passed on to the applicants.
- On July 26, 2016, the applicant for Permit No. 19315 responded to our comments and we had no other comments at that time.
- On July 27, 2016, the Permits Division sent us memorandum and initiation package requesting formal consultation on the proposed issuance of Permit Nos. 19674, 19315, and 18059.
- On August 3, 2016, we met with the Permits Division to discuss the initiation package and requested additional information, much of which was received by following day.
- On August 5, 2016, we informed the Permits Division that there was sufficient information to initiate formal consultation on Permit Nos. 19674 and 19315, but not 18059 as this permit application was not complete and the applicant had not responded to any of our comments. As a result, that day we sent the Permits Division a memorandum initiating formal consultation on the issuance of Permit Nos. 19674 and 19315.
- On August 8, 2016, we requested additional information on the applicants past research permits, which was received the same day.
- On August 10, 2016, we received the final piece of information that was requested from the Permits Division in our meeting on August, 3, 2016.
- On August 11, 2016, we provided the Permits Division a summary of our *Exposure Analysis* (see Section 6.3 below) detailing the ESA-listed species and number of individuals we determined would likely be exposed to the stressors associated with the research activities.
- On August 18, 2016, the Permits Division provided an updated draft of Permit No. 19315 including additional terms and conditions that were missing in the version included in the initiation package.
- On August 19, 2016, we provided the Permits Division with a document detailing our *Description of the Proposed Action* (see Section 2 below), including several minor questions about the action. We received comments back the same day, followed by responses from the applicants on August 22, 2016.

2 DESCRIPTION OF THE PROPOSED ACTION

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies. The proposed action for this consultation is the Permits Division's issuance of two scientific research permits pursuant to the ESA and MMPA to the following applicants:

- Permit No. 19674: Scott Kraus, New England Aquarium, Edgerton Research Lab, Central Wharf, Boston, Massachusetts 02110.
- Permit No. 19315: Center for Coastal Studies, Right Whale Ecology Program, Provincetown, Massachusetts 02657

The permits would authorized directed research on North Atlantic right whales, opportunistic research on bowhead whales (*Balaena mysticetus*) and incidental harassment of blue (*Balaenoptera musculus*), fin (*Balaenoptera physalus*), humpback (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*), and sperm (*Physeter macrocephalus*) whales, as well as other marine mammals currently not listed under the ESA but protected under the MMPA. For each permit, the Permits Division proposes to authorize the applicants to carry out a variety of research activities that may result in take of ESA-listed species, which are further described below.

2.1 Permit No. 19674

The Permits Division proposes to issue scientific research Permit No. 19674 to Scott Kraus of the New England Aquarium to conduct research on North Atlantic right whales. The purpose of the research is to assess, quantify, and track trends in North Atlantic right whale demographics and to identify, quantify, and monitor long-term trends in human impacts on the species. The permit would authorize the permit holder to take the following ESA-listed species: North Atlantic right whales (Endangered range-wide), humpback whales (Endangered Cape Verde Islands/Northwest Africa Distinct Population Segment [DPS]), and fin whales (Endangered range-wide). Table 1 below displays the annual takes of ESA-listed species that would be authorized under the proposed permit. Activities that would be authorized include aerial surveys, vessel surveys, photography and videography (including thermal imaging), biopsy sampling, sloughed skin sampling, exhaled breath sampling, fecal sampling, passive acoustic recording, and the import and export of parts. Each of these activities is described in more detail below. All research activities would be directed at North Atlantic right whales. The proposed takes for non-target species would authorize the permit holder to harass other ESA-listed large whale species while conducting North Atlantic right whale research. Consequently, the takes that would be authorized for non-target species as listed in Table 1 would result in similar or less harassment than described below for North Atlantic right whales and as such, they are not individually described in further detail.

Table 1: Proposed annual take of Endangered Species Act listed species under Permit No. 19674

Species	Listing Unit/Status	Life Stage	Annual No. Animals	Takes Per Animal	Take Action	Observe/Collect Method	Procedures	Details
Whale, right, North Atlantic	Range-wide Endangered	All	500	10	Harass/Sampling	Survey, vessel	Acoustic, passive recording; Collect, sloughed skin; Count/survey; Imaging, thermal; Observation, monitoring; Observations, behavioral; Photo-id; Photogrammetry; Photograph/Video; Sample, exhaled air; Sample, fecal	Up to 10 takes per animal - not all animals are likely to be seen in any given year.
		Non-neonate	50	1	Harass/Sampling	Survey, vessel	Observations, behavioral; Photo-id; Sample, skin biopsy	
		All	50	1	Import/export/ receive, parts	Other	Import/export/receive, parts	
Whale, humpback	Cape Verde Islands/Northwest Africa DPS Endangered	All	20	1	Harass	Survey, vessel	Incidental harassment	
Whale, fin	Range-wide Endangered)		20	1				

2.1.1 Aerial Surveys

Aerial surveys are a commonly used method for collecting data on cetacean abundance and distribution, as well as for photographing whales for individual identification based on natural markings. To comply with regulations (50 CFR 224.103) prohibiting approaches within 500 yards of North Atlantic right whales without a permit, the Permits Division proposes to authorize the applicant for Permit No. 19674 to conduct aerial surveys to collect photographic, abundance, and spatial data on North Atlantic Right whales. However, given the high altitude of these surveys, take numbers are not required. Aerial surveys would be conducted using high-wing twin-engine aircraft (e.g., Cessna 337, DeHaviland Twin Otters, Vulcanair Twin) at an altitude of approximately 1,000 feet with brief circling no lower than 900 feet to allow for photographic data collection, and a speed of approximately 100 knots along pre-determined track-lines. Additional flights following the same specifications may occur off track-lines to investigate unusual whale sightings. The flight crew would consist of two pilots and two trained cetacean observers, and there would be an onboard electronic data logger. When a whale is sighted, the aircraft would break away from the track-line, circle back to the whale, record the location, and take photographs for individual identification (see Section 2.1.3 below). Once adequate photographs have been obtained and the location recorded, the aircraft would return to the track-line at the point of departure and resume the survey.

2.1.2 Vessel Surveys

Vessel surveys are the primary means by which cetacean researchers collect data on large whale species as they provide a platform for researchers to collect a wealth of information on whale biology. The Permits Division proposes to authorize the applicant for Permit 19674 to take up to 500 North Atlantic right whales ten times annually by harassment and up to 20 humpback and 20 fin whales once annually by incidental harassment during vessel surveys in order to collect information on the distribution, abundance, age, sex, health, reproduction, survival, and genetics of North Atlantic right whales. For all species, both male and female individuals of any age would be taken. Researchers would only be authorized to approach an animal by vessel up to three times in one day. In addition to the take that would result from the close vessel approach and behavioral data collection, vessel surveys would always include take in the form of photography and/or videography for individual identification (see Section 2.1.3 below), and may also include take in the form of biopsy sampling, sloughed skin sampling, exhaled breath sampling, fecal sampling, and passive acoustic recordings depending on the location and circumstances (see individual sections below for more detail on these activities). These vessel survey activities would take place on several different types of vessels, including a 26 foot center console Mako with an outboard Honda engine, a 30 foot Dyer Bass boat with an inboard diesel engine, and a 46 foot Jarvis Newman with an inboard diesel engine. Other vessels from 20-80 feet in length would also be used, including vessels with either inboard or outboard engines, depending upon locations and circumstances. Similar to aerial surveys, vessel surveys would usually take place along pre-determined track-lines. During vessel surveys, at least two trained cetacean observers with electronic data loggers would be on watch. When a whale is spotted, the vessel would break from the track-line to approach the whale and begin data collection (at least behavioral and photographic). Details on the approaches are given under each specific research activity below.

2.1.3 Photography and Videography

Photographic identification (photo-ID) is a widely used method for identifying individual cetaceans, allowing researchers to track individuals, monitor reproduction and mortality, identify migrations, follow age and sex dependent behavior and habitat use patterns, and monitor health (Hammond et al. 1990). The Permits Division proposes to authorize the applicant take up to 500 North Atlantic right whales (both male and female, of any age) up to ten times annually by photography and/or videography. Photographs/video of the callosity patterns (raised epithelium or patches of hardened skin) on the heads of North Atlantic right whales would be used to identify individuals following methods described by Hamilton et al. (2007) and Kraus et al. (1986). Photographs/video of North Atlantic right whale tails and bodies, as well as any unusual scars or markings, would be used to maintain a database of annual human interactions (Knowlton et al. 2016) and health assessments (Hamilton and Marx 2005; Pettis et al. 2004). All photographic data would be added to the North Atlantic right whale catalog (Hamilton et al. 2007), and entered into the North Atlantic Right Whale Consortium (NARWC) database curated by Dr. Robert Kenney at the University of Rhode Island (Kenney 2001). Photographs/video would be collected during both vessel and aerial surveys. Since identification of individuals from photographs and/or video requires high quality images, the researchers would minimize their impact on whale behavior during the approach so as not to cause the whale to swim away.

During vessel surveys, a slow (2-3 knots), converging course technique would be used to come within 20-100 meters alongside a whale(s) to take photographs/video. If a whale(s) responds to or avoids an approach, the researchers would observe the whale(s) for three consecutive breathing sequences and if the whale(s) demonstrates avoidance on all three sequences, the researchers would cease photograph/video data collection. This methodology has been successfully used by the applicant for many years as part of his long-term research program and would generally limit photography/videography encounters to less than 30 minutes per day.

For aerial surveys, the aircraft would circle over a whale(s) at an altitude of approximately 1,000 feet (but no lower than 900 feet as specified by the Terms and Conditions of the proposed permit) for photography/videography purposes, until high quality photographs/videos are obtained. In addition to observer operated photography equipment, on occasion a camera may be mounted to the underside of the aircraft to supplement data collection. As with vessel surveys, researchers would cease attempting to collect photographs/video if a whale(s) demonstrates avoidance on three consecutive breathing sequences, resulting in encounters that would typically be limited to less than 30 minutes.

As noted earlier, a new technology that would be authorized under the proposed permit is the use of thermal imaging. In addition to allowing the researchers to detect North Atlantic right whales at a relatively long range (approximately one kilometer), thermal imaging would provide data on "hotspots" on animals which appear to represents areas of healing from injuries or skin lesions. Thermal imaging would also allow for detection feeding near the surface, since large whales leave "tracks" which consist of colder water upwellings created by the flukebeats of each whale as it travels through warmer surface waters. Finally, thermal imaging cameras can detect oceanographic fronts, which can be correlated with whale movements.

During thermal imaging data collection the researcher would use infrared (8-14 micron wavelengths or "far infrared") detectors which depend upon emitted infrared light, reflected infrared light, and temperature differentials between animals and background. The infrared equipment used would be an Electrophysics Corporation's Atom 1024 camera, an infrared microbolometer with 1024 by 768 pixels resolution, combined with a 25-225 millimeter zoom lens. No external infrared light source would be used. Instead, the detectors would rely on naturally occurring infrared light sources (e.g., the sun, natural reflectance, heat from the animal). Other than this change in imaging technology and gear, thermal imaging data collection would follow the same methods as described above more generally for photography/videography data collection.

2.1.4 Biopsy Sampling

Biopsy sampling of cetaceans can be used to collect skin and blubber samples for studies on genetics, contaminants, and disease. Genetic studies include determining carcass identity, developing a full family tree for a population, determining the genetic constraints on reproduction and survival, and clarifying the evolutionary features of the North Atlantic right whale mating system (Schaeff et al. 1997). Non-genetic biopsy samples can be used for health studies if animals have skin lesions or a history of disease (Wise et al. 2008). Additionally, blubber samples collected with each biopsy can be archived for contaminant content studies (Woodley et al. 1991). The Permits Division proposes to authorize the applicant to biopsy sample up to 50 North Atlantic right whales (both male and female), including non-neonate calves and females accompanied by these calves, once per year during vessel surveys. Neonate calves, which are identifiable by the presence of fetal folds, a small size (less than 16 feet in length), and their consistently close (less one body length) proximity to a cow, would not be biopsy sampled. As specified in the Terms and Conditions of the proposed permit, researchers would, if possible, sample the non-neonate calf first to minimize the mother’s reaction when sampling mother/calf pairs. The targeted whales for biopsy would be determined a priori through the creation of a biopsy priority list based on historic biopsy sampling. In most cases (except for unidentifiable juveniles) the researcher would know the whale’s identity prior to biopsy sampling. To minimize unneeded resampling, researchers would focus on obtaining biopsy samples from whales that have not been previously biopsied (by the applicant or other researchers in the NARWC), except in cases where new biopsy samples are required for specific non-genetic studies (e.g., health studies).

To collect biopsies, vessel approaches would be made at a slow (2-3 knots), idling speed on a converging course (never directly toward or from behind the whale) designed to minimize disturbance to the whale. Early in the approach, researchers would attempt to identify the individual North Atlantic right whale to determine if the whale is on the biopsy priority list. If the whale has been previously biopsied, no biopsy attempt would be made for genetic purposes. If the whale is on the list, or there is a desire to sample the whale for other purposes (e.g., health studies), then biopsy attempts would be made from distances of 5-15 meters using crossbows and small diameter darts fitted with biopsy tips (Figure 1A). The biopsy tips, which are made of surgical stainless steel, 0.7 millimeters in diameter and 2.5 centimeters deep, and fitted with a stop-collar backing to prevent deeper penetration, would be only used once per day, disinfected prior to each use in a 30 second bath of 5.25 percent sodium hypochlorite, and steam autoclaved between each field season. Whales would be darted on the dorsal side posterior to the pectoral fin (Figure 1B). Darting would always follow photo-ID and biopsy sample labeling would be integrated with the photo-ID labeling system to ensure the animal is identified in any future analysis, and to reduce unnecessary darting of previously sampled individuals. In his prior research, the applicant has well over 90 percent success rate in collecting biopsy samples with a single attempt. However, as specified in the Terms and Conditions of the proposed permit, if a biopsy attempt is missed, researchers would be authorized to attempt to biopsy the same whale up to two more times on that day (for a total of three attempts per day), but all attempts must be discontinued if a whale exhibits repetitive, strong, adverse reactions to the activity or the vessel. Skin biopsies would be immediately preserved in a saturated brine solution and dimethyl sulfoxide. For certain pathological or contaminant sampling, samples may be frozen or stored on ice. Where possible, the researchers would subsample each biopsy sample, allowing them to be used in multiple studies and reduce the need to biopsy an animal more than once.

Figure 1: (A) Loaded biopsy crossbow, (B) Biopsy dart sampling of a North Atlantic right whale

2.1.5 Sloughed Skin Sampling

Many cetacean species naturally slough skin which can be collected by researchers and analyzed for genetic purposes (Amos et al. 1992). The collection of sloughed skin may or may not be associated with any particular whale, as it is often visible after aggregations of whales are active at the surface. As such, the collection of sloughed skin may not result in an approach to a whale(s). However, in the event that sloughed skin sampling does take place in the vicinity of a whale(s), the Permits Division proposes to authorize the applicant to collect sloughed skin samples in the vicinity of North Atlantic right whales during vessel surveys. When sloughed skin is observed in the water, researchers would approach the sample (not the whale) and collect it with a small hoop net. As no particular whale is expected to be "taken" during sloughed skin sampling, there is no limit on the number of samples that can be taken, but the researcher would only be authorized to take up to 500 North Atlantic right whales (both male and female, of any age) up to ten times annually as a result of the close approaches that may occur during sloughed skin sampling.

2.1.6 Exhaled Breath Sampling

A relatively new noninvasive methodology that the applicant has not been previously authorized for, but that would be authorized under Permit 19674, is that of exhaled breath sampling. Analysis of the exhaled breath from cetaceans can be used to assess reproductive and stress hormones (Hunt et al. 2014), genetics (Frere et al. 2010), disease (Acevedo-Whitehouse et al. 2010), and likely other aspects of cetacean biology (reviewed in Hunt et al. 2013). The Permits Division proposes to authorize the applicant to collect exhaled breath from up to 500 North Atlantic right whales (both male and female, of any age) up to ten times annually during vessel surveys. To collect exhaled breadth samples from whales, the researchers would approach whales in an identical fashion as that described above during vessel surveys for photography/videography. However, an available smaller vessel would be used as this type of sampling requires the vessel to be within approximately 10 meters of the whale. A 10-meter swiveling carbon-fiber pole equipped one of several types of non-invasive sample collectors (nylon fabric or small plastic plates) at the end of the pole would be attached to the bow of the vessel via a cantilever system and used for sample collection (Figure 2A). Similar to biopsy sampling, whales would be approached at slow (2-3 knots), near idle speeds, concurrent with photo-ID sampling. When a whale exhales, the sample collector at the end of the pole would be waved through the resulting cloud of respiratory droplets (Figure 2B). While possible, no contact with the animal is expected during this procedure. The droplets that adhere to the sampler would then be retrieved and stored on the boat in a manner appropriate to the specific analysis to be conducted. Researcher would only remain close to the whale for the minimal time required to obtain a sample, and in accordance with the Terms and Conditions of the proposed permit, only three attempts to collect exhaled breath per whale would be allowed per day. As with biopsying, all attempts would be discontinued if an animal exhibits repetitive, strong, adverse reactions to the activity or the vessel.

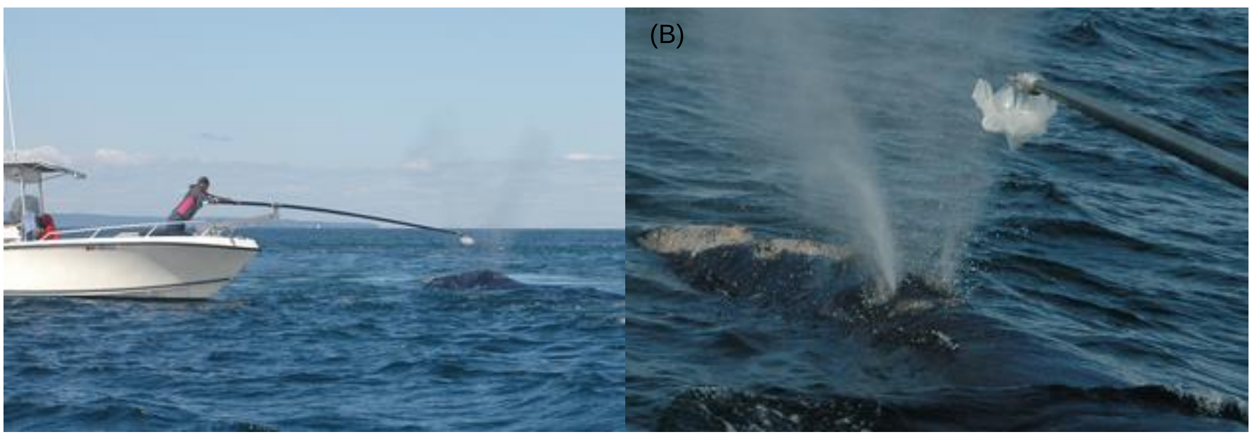

Figure 2: (A) Exhaled breath sampling methodology, (B) Close up of exhaled breadth sampler over a North Atlantic right whale, Photos taken from (Hunt et al. 2014)

2.1.7 Fecal Sampling

Fecal sampling is a well-established noninvasive sample collection method that can be used to assess reproductive hormones, stress, parasites, red tide effects, diet composition, energetics, and nutrition (reviewed in Hunt et al. 2013). It does not usually require approaching animals directly, as the fecal matter is often left floating at the surface after the whale is gone. However, fecal sampling could take place in the vicinity of whales, and occasionally within 100 yards of whales, particularly if a known individual has defecated nearby. Due to this potential for close proximity during fecal sample collection, the Permits Division proposes to authorize the applicant to collect fecal samples in the vicinity of North Atlantic right whales during vessel surveys. When fecal matter is observed in the water, researchers would approach the sample (not the whale) and collect it with a handheld 333 micron mesh dipnet. As no particular whale is expected to be "taken" during fecal sampling, there is no limit on the number of samples that can be taken, but the researcher would only be authorized to take up to 500 North Atlantic right whales (both male and female, of any age) up to ten times annually as a result of the close approaches that may occur during fecal sampling.

2.1.8 Passive Acoustic Recording

Passive acoustic recording of vocalizations can provide a wealth of knowledge on cetacean communication, mating, and foraging (Tyack 2000), as well as their response to anthropogenic noise (Parks et al. 2010). While the vocalizations of North Atlantic right whales have been previously studied, little information exists on their function, including whether or not there are context-specific sounds (Parks and Tyack 2005). The Permits Division proposes to authorize the applicant to take up to 500 North Atlantic right whales (both male and female, of any age) up to ten times annually through passive acoustic recording. Passive acoustic recordings would be conducted during vessel surveys and generally last less than an hour. During passive acoustic recording, researchers would submerge a small (2-5 centimeter diameter) hydrophone below the water to a depth of up to 20 meters to listen for and record North Atlantic right whale vocalizations and sounds associated with particular behaviors. To obtain high quality, clear recordings, it is essential that all external sounds other than those produced by the whale are minimized. As such, passive acoustic recordings would be conducted with the vessel engine shut off and the hydrophone and recording equipment would not produce any detectable noise.

2.1.9 Import and Export of Parts

Given the large, international ranges of many cetacean species, it is common for cetacean researchers to import and export biological samples in order to provide a global understanding of the species and maximize the information that can be gained from any given sample. The Permits Division proposes to authorize the application to import and/or export up to 50 biological samples taken from North Atlantic right whales annually. These samples may include but are not limited to biopsy samples, exhaled breath samples, fecal samples, and tissues collected from dead North Atlantic right whales both within the action area and other areas of the world. These samples would be used to test hypotheses concerning the potential links between contaminants, biotoxins, food supply, nutrition, global warming, acoustic disturbance, sub-lethal entanglement and ship-strike injuries, and the decline in reproduction of North Atlantic right whales. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) permits would be applied for as needed to export or import samples, but CITES permits require that the applicant already have a permit from the NMFS. Samples would be stored in sterile airtight containers for shipment and storage. After use, samples would either be archived in -80 ºCelsius freezers for future work, or destroyed. No introduction or spread of non-native species is expected.

2.2 Permit No. 19315

The Permits Division proposes to issue scientific research Permit No. 19315 to the Center for Costal Studies to conduct research on North Atlantic right whales. Dr. Charles Mayo would be the primary individual conducting research under this permit. The purpose of the research is to gain a better understanding of North Atlantic right whale's population status, relationship to habitat conditions, distribution and abundance, movement patterns, and interactions with human activities. The permit would authorize the Center for Coastal Studies to take the following ESA-listed species: North Atlantic right whales (Endangered range-wide), fin whales (Endangered range-wide), sei whales (Endangered range-wide), bowhead whales (Endangered range-wide), blue whales (Endangered range-wide), and sperm whales (Endangered range-wide). Table 2 displays the annual takes of ESA-listed species that would be authorized under the proposed permit for research activities not involving suction-cup tagging, whereas Table 3 displays suction-cup tagging annual takes. Activities that would be authorized under this permit include aerial surveys, vessel surveys, photography and videography, prey mapping and sampling, and suction-cup tagging. Each of these activities is described in more detail below. As with Permit 19674, all research activities would be directed at North Atlantic right whales. In addition, some research activities would opportunistically involve bowhead whales. The proposed takes for all other non-target species would authorize the permit holder to harass other ESA-listed cetaceans while conducting these directed and opportunistic research activities. Consequently, the takes that would be authorized for non-target species as listed in Table 2 would result in similar or less harassment than described below for North Atlantic right whales and as such, they are not individually described in further detail.

Table 2: Proposed annual non-suction-cup take of Endangered Species Act listed species under Permit No. 19315

Species	Listing Unit/Status	Life Stage	Annual No. Animals	Observe/ Collect Method	Procedures	Details
Whale, right, North Atlantic	Range-wide Endangered	All	700	Survey, vessel	Acoustic, sonar for prey mapping; Count/survey; Incidental harassment; Observation, monitoring and behavioral; Photo-id; Photograph/Video; Underwater photo/videography	Habitat studies and photo-ID. Some animals may be taken up to 15 times per year.
			1,500	Survey, aerial	Count/survey; Incidental harassment; Observation, monitoring; Observations, behavioral ; Photo-id; Photograph/Video	Photo-ID and distribution study. Some animals may be taken up to 15-20 times per year.
Whale, fin	Range-wide Endangered	All	50	Survey, vessel	Incidental harassment; Photograph/Video	
			300	Survey, aerial		
Whale, sei	Range-wide Endangered	All	100	Survey, vessel	Incidental harassment; Photograph/Video	
			300	Survey, aerial		
Whale, bowhead	Range-wide Endangered	All	50	Survey, vessel	Acoustic, sonar for prey mapping; Incidental harassment; Observations, behavioral; Photo-id; Photograph/Video	Opportunistic study
			50	Survey, aerial	Incidental harassment; Observations, behavioral; Photo-id; Photograph/Video	
Whale, blue	Range-wide Endangered	All	5	Survey, vessel	Incidental harassment; Photograph/Video	
			15	Survey, aerial		
Whale, sperm	Range-wide Endangered	All	5	Survey, vessel	Incidental harassment; Photograph/Video	
			10	Survey, aerial		
Whale, unidentified baleen	NA	All	100	Survey, vessel	Incidental harassment; Photograph/Video	
			200	Survey, aerial		

Species	Listing Unit/Status	Life Stage	Annual No. Animals	Observe/ Collect Method	Procedures	Details
Cetacean, unidentified	NA	All	100	Survey, vessel	Incidental harassment; Photograph/Video	
			200	Survey, aerial		

Table 3: Proposed annual suction-cup take of Endangered Species Act listed species under Permit No. 19315

Species	Stock/Listing Unit	Life Stage	No. Animals	Takes Per Animal	Take Action	Observe/ Collect Method	Procedures	Details
Whale, right, North Atlantic	Range-wide Endangered	Adult/ Juvenile	10	3	Harass/ Sampling	Survey, vessel	Count/survey; Incidental harassment; Instrument, suction-cup (e.g., VHF, TDR); Observations, behavioral; Photo-id; Photograph/Video; Underwater photo/videography	D-tagging; Whales may be tagged up to three times a year on separate days.

2.2.1 Aerial Surveys

As noted above, aerial surveys are commonly used in cetacean research. The Permits Division proposes to authorize the applicant for Permit No. 19315 to take 1,500 North Atlantic right whales (both male and female, of any age) up to 20 times annually by harassment during aerial surveys to collect photographic, abundance, and spatial data. In addition, up to 50 bowhead whales would be taken opportunistically by harassment during aerial surveys. Finally, takes by incidental harassment during aerial surveys for non-target species that would be authorized include 300 humpback, fin, and sei whales, 15 blue whales, 10 sperm whales, and 200 unidentified baleen whales and cetaceans (both male and female, of any age). These aerial surveys are similar to those previously described for Permit 19674, but flown at a slightly lower altitude and thus result in takes that require authorization. Aerial surveys would be primarily conducted from a Cessna 337 Skymaster, but airplane type would vary with availability. Surveys would be flown along pre-determined track-lines at a minimum altitude of 750 feet and a speed of approximately 100 knots (CETAP 1982; Scott and Gilbert 1982). This altitude coincides with the applicant's historical data set (1998-2010) and would improve entanglement detection and documentation, photograph quality, and safety by allowing for a separation in altitude from commercial and recreational aircraft. Survey track lines would typically be spaced 2.8 kilometer apart to provide 100 percent coverage of the action area (see Section 2.3.2). The flight crew would consist of two pilots and two observers equipped with an electronic data logger. While all sightings of marine animals except birds would be recorded, only at sightings identified as North Atlantic right whales and bowhead whales (or other large whales not immediately identified to species) would the aircraft break from the track-line and circle over the animal(s) to collect data on abundance, behavior, and take photographs (Kraus et al. 1986). Occasionally large whales would be flown over to confirm species identity, but most of these sightings would not involve an approach or circling as species identity can be determined from afar. Once data collection is complete, the aircraft would return to the track-line and resume the survey.

All aerial survey data would be submitted to the NARWC database (Kenney 2001) and promptly entered in to the NMFS Sighting Advisory System, which provides near real-time sighting data to mariners on the location of North Atlantic right whales in an effort to reduce ship strikes. The applicant's data have and would provide the majority of the sighting data for the Sighting Advisory System during the winter months, as there are few other, if any, dedicated surveys in the action area during this time of year.

2.2.2 Vessel Surveys

As noted previously, vessel surveys are commonly used by cetacean researchers to collect a variety of data on baleen whales. The Permits Division proposes to authorize the applicant for Permit No. 19315 to take up to 700 North Atlantic right whales up to 15 times annually by harassment, up to 50 bowhead whales opportunistically by harassment, and 50 humpback and fin, 100 sei, five blue, and 10 sperm whales, and 100 unidentified baleen whales and cetaceans (both male and female, of any age) by incidental harassment during vessel surveys. Researchers would only be authorized to approach an animal by vessel up to three times in one day. In addition to the take that would result from the close vessel approach and behavioral data collection, vessel surveys would include take in the form of photography and/or videography, prey mapping and sampling, and suction-cup tagging (each described below in more detail) depending on the location and circumstances. Surveys would be conducted from one of several vessel (all outfitted with global positioning systems and full safety features) including the 40 foot twin diesel engine research vessel (R/V) Shearwater, the 40 foot twin outboard engine R/V Ibis, twin engine outboard 15-30 foot vessels, and single or twin inboard diesel vessels up to 60 feet in length. Shore launched inflatables might also be used to access aggregation of whales sighted off beaches. However, the R/V Shearwater is anticipated to be the primary vessel for all research activities. Vessel surveys would be conducted along pre-determined track-lines at a speed of 10 knots or less in sea state of Beaufort four or less and visibility of greater than two kilometers. The vessel survey team would consist of three to five experienced right whale researchers on watch and equipped with an electronic data logger and an experienced captain to operate the vessel. While all sightings of marine animals are recorded, the vessel would only break from the track-line and approach North Atlantic right whales and opportunistically bowhead whales (or whales suspected to be North Atlantic right whales) for further data collection (as described below in Sections 2.2.3 and 2.2.5). Once a whale is sighted, the vessel would approach on a converging course at a slow or idling speed (less than four knots) with no sudden changes in vessel speed or direction, and begin taking photographs/video (as described below) and recording behavioral observations. As with aerial surveys, all vessel survey data would be submitted to the NARWC database and entered in to the NMFS Sighting Advisory System. All vessel survey activities (photography and videography and basic behavioral documentation, prey mapping and sampling, and suction-cup tagging) would potentially take place during the same vessel survey. While photography and videography and prey mapping and sampling efforts may be conducted in parallel, suction-cup tagging would involve a more concentrated effort nested within a vessel survey, as described below.

2.2.3 Photography and Videography

As noted for Permit 19674, with the collection of photographs/video researchers can track individual whales, providing invaluable information on their ecology, life history, and population dynamics. The Permits Division proposes to authorize the applicant take up to 1,500 North Atlantic right whales up to 20 times annually, up to 50 bowhead whales opportunistically, and 300 humpback, fin, and sei whales, 15 blue whales, 10 sperm whales, and 200 unidentified baleen whales and cetaceans (both male and female, of any age) annually by photography and/or videography during aerial surveys. For vessel surveys, the Permits Division proposes to authorize the applicant take up to 700 North Atlantic right whales up to 15 times annually, 50 bowhead whales opportunistically, and 50 humpback, fin whales, 100 sei whales, five blue and 10 sperm whales, and 100 unidentified baleen whales and cetaceans (both male and female, of any age) annually by photography and/or videography. During aerial surveys, researchers would photograph individual and groups of whales during aerial circling at an altitude no less than 750 feet. During vessel surveys, researchers would take photographs from a distance between 10-100 meters, depending on the circumstances. All photographic data would be used to identify whales and in photo-ID studies as described for Permit No. 19674. When possible, photographs would be taken of both sides of the head/body. The amount of time taken to photograph a whale during a vessel survey would be limited to the minimum time required to secure photographs of sufficient quality for individual identification but is expected to not take longer than 20 minutes on average. Similarly, the average amount of time the aircraft would circle an individual whale for photo-ID would typically range from 15-20 minutes. Usually after about 30 minutes of circling an individual whale would be left, regardless of whether or not researchers obtained photographs of high enough quality for identification.

New underwater photography and videography methods for which the researcher has not been previously permitted would also be authorized. This underwater photography would be used in combination with prey sampling and mapping (Section 2.2.4 below) in an effort to document the distribution and density of zooplankton in surface patches among foraging right whales. The camera, a GoPro Hero 3®, would be contained in a laminar flow flume box scaled to permit enumeration and deployed from the side of the research vessel from a hand held extendable pole to a maximum depth of two meters. Because of the opacity of the water in Cape Cod Bay it is unlikely but possible that an underwater image of a whale would be captured during these efforts, however the goal would be the documentation of the patches that attract North Atlantic right whales to the bay.

2.2.4 Prey Mapping and Sampling

The action area for Permit No. 19315 (see Section 2.3.2 below) purposely overlaps with critical foraging habitat for North Atlantic right whales (81 FR 4837, Figure 6), and studying the foraging ecology of these whales is a research focus of the applicant. Accordingly, the Permits Division proposes to authorize the applicant to take up to 700 North Atlantic right whales up to 15 times annually and 50 bowhead whales (both male and female, of any age) by prey mapping and sampling during vessel surveys. These efforts would be directed at sampling zooplankton in the Cape Cod Bay area and can be divided into two categories based on the location in which they occur: mapping and sampling at fixed stations, and mapping and sampling near whales, although on occasion whales may be in the vicinity of the fixed stations. Within these two data sets, the following sampled variables would be used to characterize patterns of habitat use and to forecast exposure of whales to anthropogenic risk (e.g., ship strikes and entanglement):

- Zooplankton counted to lowest taxon (prey data)
- Conductivity, Temperature, and Depth (oceanographic conditions data)
- North Atlantic right whale behavior and distribution (foraging and habitat use data)

Fixed Station

The primary focus of prey mapping and sampling efforts is to assess the quality of the food resource that dictates where whale are or will be. Data to support this focus would be collected at up to 18 fixed sampling stations that have been sampled since 1984 (Leeney et al. 2009). These stations are positioned along pre-determined track-lines on which the research vessel would travel while mapping and sampling prey. During prey mapping and sampling at these fixed stations, and during transit between stations, vessel speeds would be held to 10 knots or less. However, if whales appear on or near the track-lines, researchers would slow the vessel to below five knots and avoid the whales, as they are not the focus of this particularly research activity. To further avoid interactions with whales, early on in consultation we shared our conservation recommendation with the Permits Division and applicant that at least three dedicated observers be on watch for whales during all prey mapping and sampling at all times (both at fixed stations and near whales), to which they agreed.

A variety of traditional and modern oceanographic and food resource sampling techniques would be used depending on the circumstances. These may include the use of Conductivity, Temperature, and Depth recorders, plankton nets, a vertical plankton pump, fish finders, and a remote sampling sensor package. Conductivity, Temperature, and Depth recorders would be used to collect basic oceanographic data on conductivity, temperature, and depth and would be deployed on their own or in combination with other sampling equipment attached to tow-body (see description of remote sampling sensor package). Plankton nets would be 30 and/or 50 centimeters in diameter with a 333 micrometer mesh and a ratio of 3:1 or 5:1 towed and tended by a ½ inch nylon line behind the research vessel for no more than five minutes during each deployment. The resulting samples would be preserved using standard techniques (Johnson and Allen 2005), with preservation in 10 percent formalin. A vertical plankton pump consisting of a 1.5 inch hose hung from the vessel with a Conductivity, Temperature, and Depth recorder attached would pump water at 15 gallons/minute into collection nets on deck to sample the vertical characteristics of the zooplankton (Jaquet et al. 2006). The pump would be belt driven off the main vessel engine while in idle, and thus no sound other than that of the vessel engine would be generated. Fish finders operating at 38 and 200 kilohertz (kHz), and on occasion 120 and 710 kHz, would also be used to assess the distribution of zooplankton (Johnson and Allen 2005). The remote sampling sensor package would be used to widely to document conditions in the upper 50 meters of the water column. This remote sampling sensor package would be composed of a Sea-Bird Electronics 19 SeaCAT Profiler (Figure 3A) equipped with a Conductivity, Temperature, and Depth recorder, a fluorometer, and an incident light Photosynthetically Active Radiation meter package, multiplexed with an Optical Plankton Counter attached to a Sea Science Inc. Acrobat II tow-body (Figure 3B). The remote sampling sensor package would be towed at 2-6 knots behind the vessel, with the depth of the sampling controlled by computer commands from the vessel.

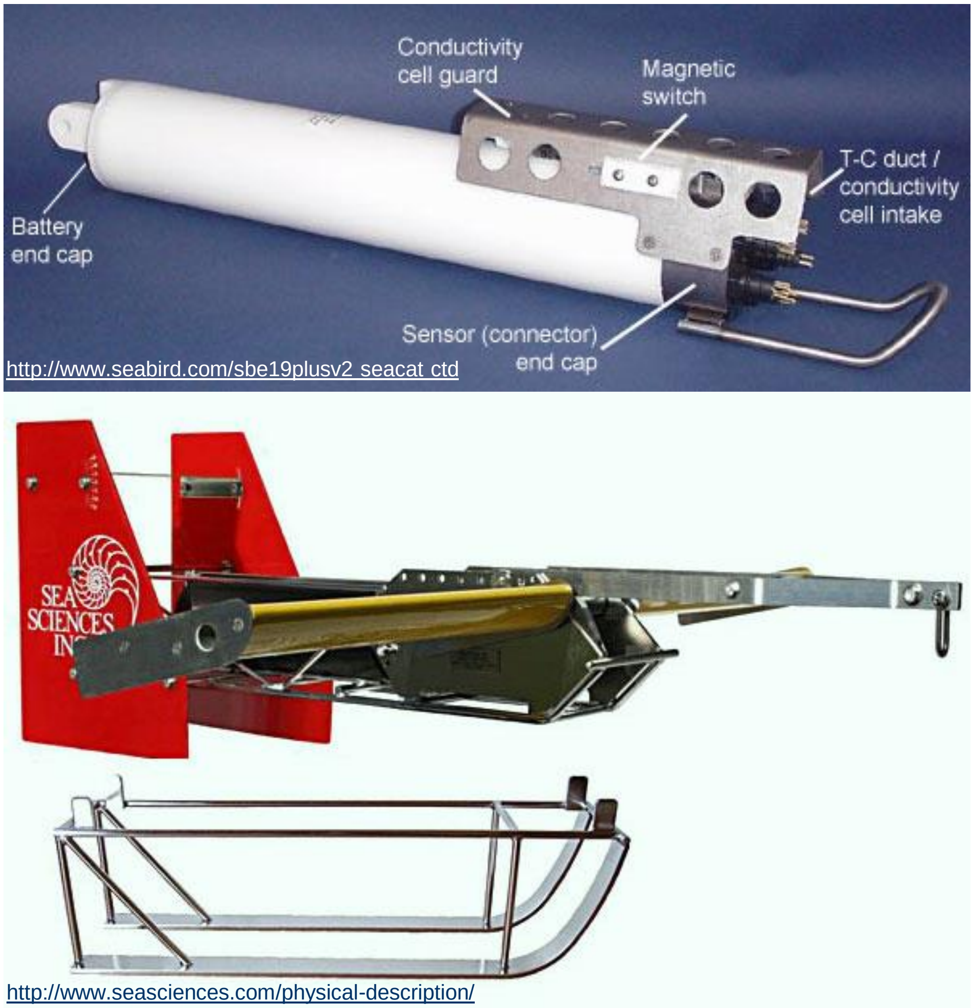

Figure 3: (A) Sea-Bird Electronics 19plus V2 SeaCAT Profiler, similar to version 19 that would be used, (B) Sea Science Inc. Acrobat II tow-body

Near Whales

Given one of the aims of the applicant’s research is to better understand North Atlantic right whale foraging ecology, some prey mapping sampling would be directed at locations where whales are located. The same techniques as described for fixed stations would be used with slight modifications, with the specific technique(s) and modification(s) determined by whale behavior. As before, at least there dedicated observers would be on watch for whales at all times. All sampling near whales would typically be greater than 100 meters from any whale (often greater than one kilometer) and vessel speeds would be held to under six knots (usually zero to three knots), as not to disturb the whales foraging behavior, which is the focus of the research. Traditional plankton net sampling on rare occasion (estimated less than 10 per year) would occur behind a whale (50 to 100 meters or more) as it feeds or travels, with sampling taking place at the edge of the water previously passed through by the whale’s open mouth. Fish finders would be used to assess zooplankton abundance but always at distances greater than one kilometer from whales. Similarly, the remote sampling sensor package may be used to collect data but it would generally not be towed within one kilometer of whales. Pump sampling would also be conducted in the regions where whales are aggregated, but again, this sampling would generally take place more than one kilometer from the whales. However, if during the course of pump sampling a whale(s) approached the vessel, the pump hose would be lifted aboard.

In addition to collecting data on food resources and oceanographic conditions, during prey mapping and sampling the researchers would opportunistically collect photography, videography, and behavioral data when near whales as described previously. The encounter time with whales during these efforts would be determined by the whales approaching the vessel, rather than the reverse as in dedicated photo-ID efforts.

2.2.5 Suction-cup Tagging

Recent advances in tagging technologies have provided unprecedented detail on cetacean biology, allowing researchers to better understand their physiology, foraging, ranging, diving, and sociality, and can greatly improve efforts to protect and conserve these species (Nowacek et al. 2016). For North Atlantic right whales, tagging data have provided much needed information on foraging and diving behavior, improving our ability to assess the vulnerability of right whales to ship strikes and entanglement (Nowacek et al. 2004; Parks et al. 2011). The Permits Division proposes to authorize the applicant to take 10 adult or juvenile (no calves or associated mothers) North Atlantic right whales up to three times annually for the purposes of suction-cup tagging during vessel surveys. No whale would be tagged more than once on any given day, although researchers could attempt to tag a whale up to three times per day. Before attempting to tag an individual, researchers would be required to take reasonable measures (e.g., compare photo-identifications) to avoid unintentional repeated tagging of any individual. These tags would allow the researchers to determine (1) the vertical and horizontal movement patterns of North Atlantic right whales in the water column to assess their vulnerability to ship strikes (upper portion of the water column) and gear entanglement (primarily near-bottom usage of the water column) and (2) vocalization behavior of individual whales to assess individual detectability through passive acoustic monitoring.

The specific tags that would be used are Digital Acoustic Recording Tags (DTAG3, Woods Hole Oceanographic Institution), hereafter DTAGs, measuring 6.74 inches by 4.00 inches by 2.28 inches in their deployment housing, which provides a low drag hydrodynamic attachment (Figure 1A). The weight of the tags, including attachment, is approximately 300 grams in air, and it is slightly buoyant in water. The DTAG includes sensors for acoustic recordings, pressure, pitch, roll, heading, surfacing events, and temperature, as well as a very high frequency (VHF) antenna which transmits at 220 Megahertz (MHz) to aid in tag retrieval.

DTAG suction-cup attachment would be performed in three stages:

1. Identification and assessment of an individual right whale as a suitable tagging candidate (i.e., juvenile or adult, not currently injured or entangled, and not a mother of a calf less than six months of age)

2. Careful small vessel maneuvering for a close approach (to within five meters) of the individual whale for tag attachment
3. Small vessel follow of the tagged whale to monitor behavior and assess prey field dynamics near the tagged whale

The first stage would take place as part of the researchers' standard vessel survey operations aboard the "observation vessel", whereas the second stage would involve the use of a smaller (less than eight meters) maneuverable "tagging vessel" with an outboard engine to tag the whale. The third stage would involve following the whale with both vessels. After, identifying a suitable whale in stage one, researchers on the observer vessel would monitor the whale's behavior before and during tagging for any effects of the tagging process on the whale. Aboard the tagging vessel, a pole delivery system similar to that developed by Moore et al. (2001) for North Atlantic right whale blubber thickness measurement would be used for tag attachment. A 10-20 meter pole cantilevered from the bow of a small boat or a long 7-10 meter hand-held pole would be used to attach the tag to the dorsal surface of the animal, posterior to the blowhole and the pectoral fins to minimize the potential for the tag to disturb the whale during the attachment period (Johnson and Tyack 2003). If at any point during stage one or two the whale exhibits repetitive, strong, adverse reactions to the activity or the vessel, the tagging attempt would be discontinued.

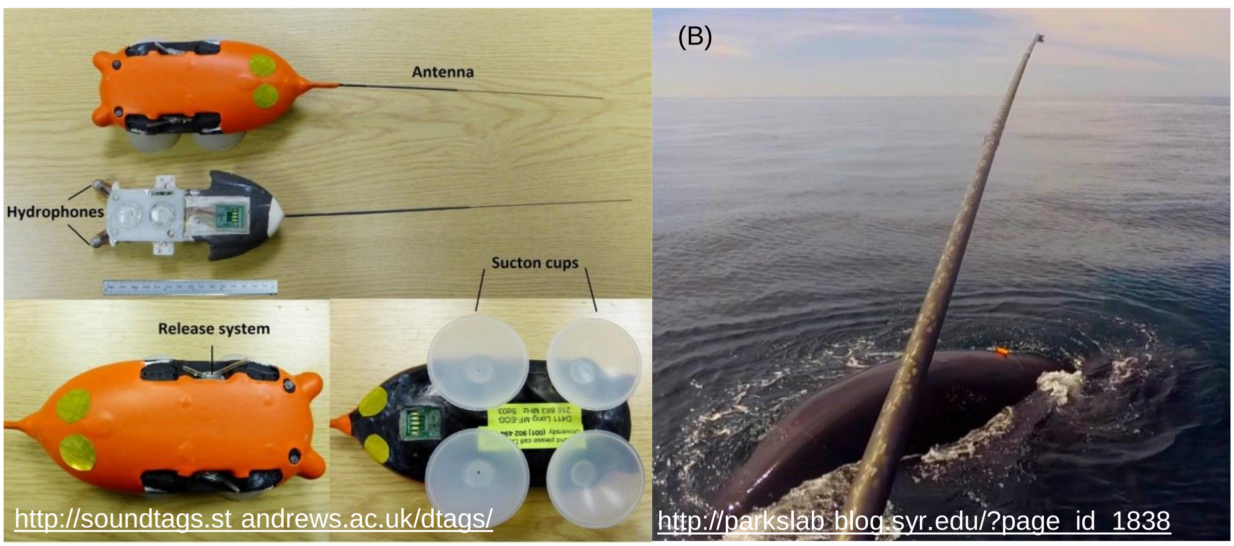

Figure 4: (A) Digital Acoustic Tag Recorder (Version 3), (B) Tag attachment methodology

Once a tag is attached, the whale would be followed (by way of the VHF beacon) by both the tagging and observation vessels at a distance of more than 300 meters until tag separation, which usually occurs after several minutes to six hours (maximum 24 hours). During this time, photography, videography, and behavioral data would be collected using the techniques described above. After tag separation, the researchers would locate and retrieve the tag. Data collected from DTAGs would be analyzed in the laboratory and information on foraging movements and behavior would be combined with data from prey mapping and sampling to yield a detailed perspective on the depth of feeding, allowing an analysis of the exposure of whales to ship strikes and entanglement throughout the water column.

2.3 Action Area

Action area means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 CFR 402.02). The action areas for Permit Nos. 19674 and 19315 occur in the North Atlantic Ocean. The specific boundaries of each action area, including a detailed map, are described below.

2.3.1 Permit No. 19674

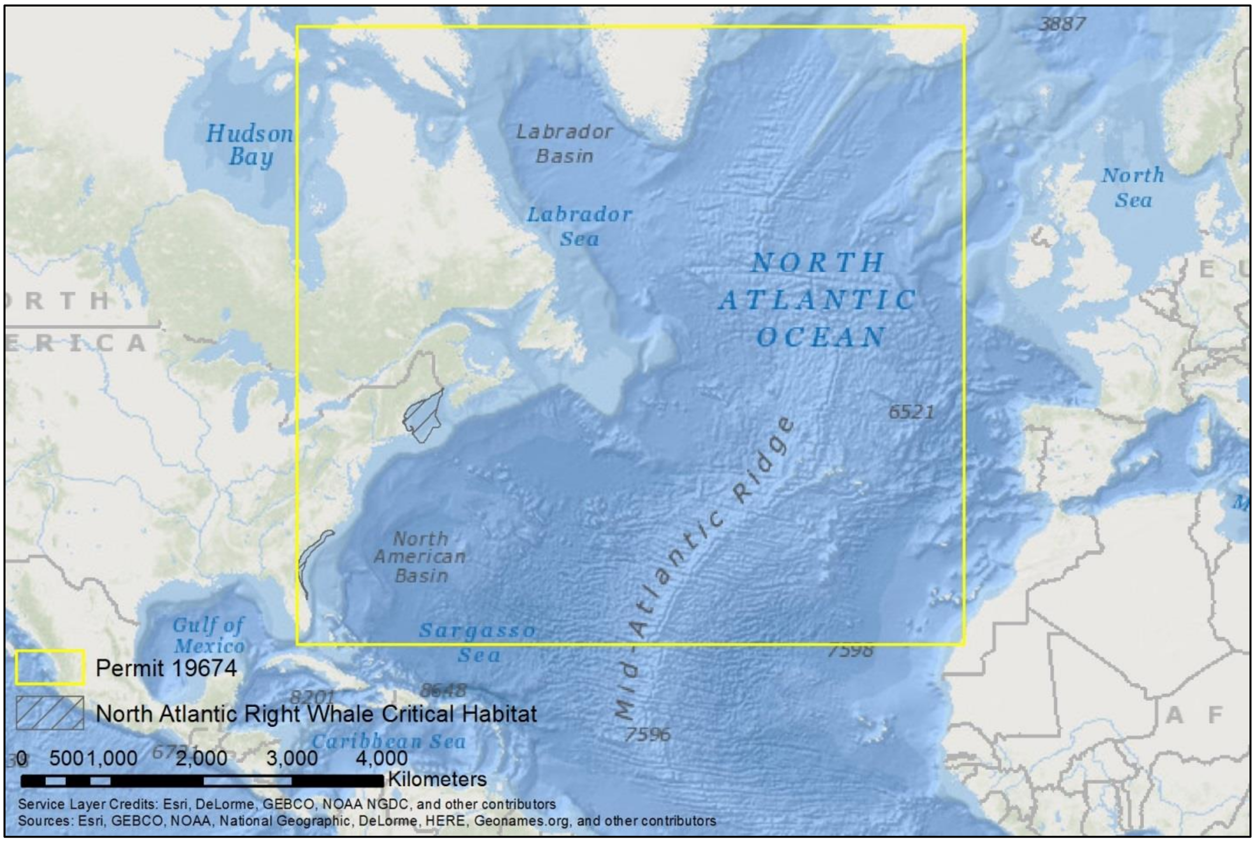

Figure 5: Action area for Permit No. 19674 outlined in yellow and North Atlantic right whale critical habitat denoted by the black diagonal lines

The research that would be authorized under Permit No. 19674 would occur year-round over the course of five years in all Atlantic United States (U.S.) and international waters from Florida to Iceland (Figure 5 above). The majority of the research would occur in designated North Atlantic right whale critical habitat areas (Southeastern U.S., and all Gulf of Maine habitats including the Great South Channel, Jordan Basin, Jeffreys Ledge, and Cape Cod Bay, (Figure 5 and Figure 6), but may extend elsewhere within this region as animals turn up in unusual areas due to shifts in habitat use. In total, the applicant anticipates conducting research at sea (both aerial and vessel surveys) on approximately 60 days per year.

2.3.2 Permit No. 19315

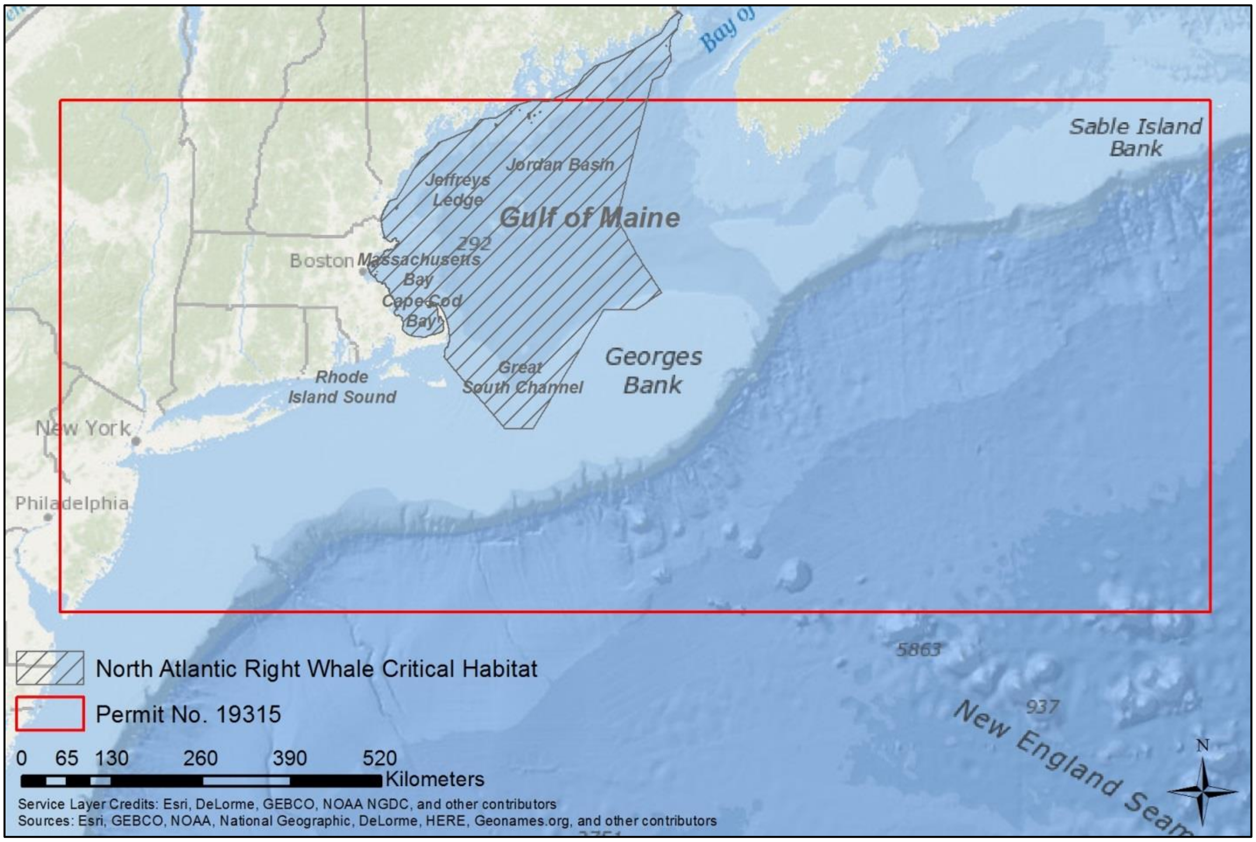

Figure 6: Action area for Permit No. 19315 outlined in red and North Atlantic right whale critical habitat denoted by the black diagonal lines

The research that would be authorized under Permit No. 19315 would occur year-round over the course of five years in all Atlantic U.S. waters from Maine to New Jersey (Figure 6). Research would primarily be in the Gulf of Maine, with focus on Cape Cod Bay and occasional surveys as the distribution of North Atlantic right whales dictates in adjacent waters including but not limited to the Great South Channel, Massachusetts Bay, Jeffreys Ledge, and Rhode Island Sound. Efforts would also focus on conducting research during the season of North Atlantic right whale residency in these areas, from October-June, but may occur outside of this season as dictated by whale behavior. During this focal season, the researcher anticipates conducting up to two vessel surveys and three aerial surveys per week. Outside of the focal season, the number of vessel and aerial surveys would depend on the specific circumstances (risk to whale [e.g., fishing gear entanglement], weather, monitoring needs of state and federal agencies, etc.).

2.4 Interrelated and Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on that action for their justification. *Interdependent* actions are those that do not have independent use, apart from the action under consideration. For this consultation, we determined that there are no interrelated or interdependent actions outside the scope of directed research activities described above.

3 The Assessment Framework

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

"To jeopardize the continued existence of an ESA-listed species" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). The jeopardy analysis considers both survival and recovery of the species.

Section 7 assessment involves the following steps:

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

2) We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time.

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

4) We identify the number, age (or life stage), and gender of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. We also consider whether the action "may affect" designated critical habitat. This is our exposure analysis.

5) We evaluate the available evidence to determine how individuals of those ESA-listed species are likely to respond given their probable exposure. We also consider how the action may affect designated critical habitat. This is our response analyses.

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

7) The adverse modification analysis considers the impacts of the proposed action on the essential habitat features and conservation value of designated critical habitat.

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

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

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

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

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

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

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

To comply with our obligation to use the best scientific and commercial data available we used several sources to identify information relevant to the species that may be affected by the proposed action to draw conclusions about the likely risks to the continued existence of these species and the conservation value of their critical habitat. We conducted electronic searches, using *google scholar* and the online database *web of science*, and considered all lines of evidence available through published and unpublished sources that represent evidence of adverse consequences or the absence of such consequences. We relied on information submitted by the Permits Division and the applicants, government reports (including previously issued NMFS biological opinions and stock assessment reports), NOAA technical memos, peer-reviewed scientific literature, and other information. We organized the results of electronic searches using commercial bibliographic software. We also consulted with subject matter experts, within the NMFS as well as the academic and scientific community. When the information presented contradictory results, we described all results, evaluated the merits or limitations of each study, and explained how each was similar or dissimilar to the proposed action to come to our own conclusion.

4 STATUS OF ENDANGERED SPECIES ACT LISTED RESOURCES

This section identifies the ESA-listed species that potentially occur within the action area (Figure 5 and Figure 6) that may be affected by the issuance of Permit Nos. 19674 and 19315. It then summarizes the biology and ecology of those species and what is known about their life histories in the action area. The ESA-listed species potentially occurring within the action area are given in Table 4, along with their regulatory status.

Table 4. Threatened and endangered species that may be affected by the Permit and Conservation Division's proposed action of the issuance of researcher Permit Nos. 19674 and 19315

Species	ESA Status	Critical Habitat	Recovery Plan
Marine Mammals – Cetaceans			
North Atlantic Right Whale (*Eubalaena glacialis*)	E – 73 FR 12024	59 FR 28805 and 81 FR 4837	70 FR 32293
Humpback Whale (*Megaptera novaeangliae*) – Cape Verde Islands/Northwest Africa DPS	E– 81 FR 62259	-- --	55 FR 29646
Fin Whale (*Balaenoptera physalus)*	E – 35 FR 18319	-- --	75 FR 47538
Sei Whale (*Balaenoptera borealis*)	E – 35 FR 18319	-- --	76 FR 43985
Bowhead Whale (*Balaena mysticetes*)	E – 35 FR 18319	-- --	-- --
Blue Whale (*Balaenoptera musculus)*	E – 35 FR 18319	-- --	07/1998
Sperm Whale (*Physeter macrocephalus*)	E – 35 FR 18319	-- --	75 FR 81584
Marine Reptiles			
Green Turtle, (*Chelonia mydas*) – North Atlantic DPS	T – 81 FR 20057	63 FR 46693	63 FR 28359
Hawksbill Turtle (*Eretmochelys imbricata)*	E – 35 FR 8491	63 FR 46693	57 FR 38818
Kemp's Ridley Turtle (*Lepidochelys kempii*)	E – 35 FR 18319	-- --	75 FR 12496
Leatherback Turtle (*Dermochelys coriacea*)	E – 61 FR 17	44 FR 17710 and 77 FR 4170	63 FR 28359

Species	ESA Status	Critical Habitat	Recovery Plan
Loggerhead Turtle, (*Caretta caretta*) – Northwest Atlantic Ocean DPS	T – 76 FR 58868	79 FR 39855	63 FR 28359
Olive Ridley Turtle (*Lepidochelys olivacea*) all non-Mexico's Pacific breeding colonies	T – 43 FR 32800	-- --	-- --
Fishes			
Atlantic sturgeon, (*Acipenser oxyrinchus oxyrinchus*) – Gulf of Maine DPS	T -- 77 FR 5880	81 FR 35701 (Proposed)	-- --
Atlantic sturgeon, (*Acipenser oxyrinchus oxyrinchus*) – New York Bight DPS	E -- 77 FR 5880	81 FR 35701 (Proposed)	-- --
Atlantic sturgeon, (*Acipenser oxyrinchus oxyrinchus*) – Chesapeake Bay DPS	E -- 77 FR 5880	81 FR 35701 (Proposed)	-- --
Atlantic sturgeon, (*Acipenser oxyrinchus oxyrinchus*) – Carolina DPS	E -- 77 FR 5880	81 FR 36077 (Proposed)	-- --
Atlantic sturgeon, (*Acipenser oxyrinchus oxyrinchus*) – South Atlantic DPS	E -- 77 FR 5880	81 FR 36077 (Proposed)	-- --
Atlantic Salmon, (*Salmo salar*) – Gulf of Maine DPS	E -- 74 FR 29344	74 FR 29300	Draft Recovery Plan (2016)

4.1 Species and Critical Habitat Not Likely to be Adversely Affected

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

The second criterion is the probability of a response given exposure. ESA-listed species or designated critical habitats that are exposed to potential stressors but are likely to be unaffected by the exposure are also not likely to be adversely affected by the proposed action. We applied these criteria to the ESA-listed species in Table 4 and we summarize our results below.

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

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

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

During this consultation, we determined that several ESA-listed species may be affected by the issuance of Permit Nos. 19674 and 19315 but are not likely to be adversely affected. These include the follow ESA-listed turtles: green turtles (North Atlantic DPS), hawksbill turtles, Kemp's ridley turtles, leatherback turtles, loggerhead turtles (Northwest Atlantic Ocean DPS), olive ridley turtles (all non-Mexico's Pacific breeding colonies), and the following ESA-listed fishes: Atlantic sturgeon (all DPSs), and Atlantic salmon (Gulf of Maine DPS).

We have determined that the proposed action is also not likely to adversely modify or destroy the following designated or proposed critical habitat: Atlantic Sturgeon (all DPSs) proposed critical habitat, and Atlantic salmon (Gulf of Maine DPS) and North Atlantic right whale designated critical habitat. While critical habitat has been designated for a number of ESA-listed turtle species that occur within the action area (Table 4), these critical habitats do not spatially overlap with the action areas for Permit Nos. 19674 and 19315, and thus they are not considered in this opinion.

4.1.1 Turtles

The proposed actions overlap spatially with the ranges of green turtles (North Atlantic DPS), hawksbill turtles, Kemp's ridley turtles, leatherback turtles, loggerhead turtles (Northwest Atlantic Ocean DPS), and olive ridley turtles (all non-Mexico's Pacific breeding colonies). Interactions with these turtle species could potentially involve disturbance, entanglement in prey mapping and sampling equipment, and ship strikes. However, the possibility of these interactions is considered remote because the proposed research activities are directed at cetaceans, specifically North Atlantic right whales, and in the case of Permit No. 19315, occasionally bowhead whales. Activities that have the potential to cause disturbance in sea turtles include aerial and vessel surveys. However, during neither survey type would researchers approach sea turtles, and thus, no disturbance is expected to occur. In support of this, while turtles have been seen in the action area by the researchers during past surveys, in no case did a turtle ever appear to be disturbed.

It is possible that turtles could become entangled in the equipment used during prey mapping and sampling. However, the relatively small size of the equipment, the slow speed at which it would be towed, and the fact that researchers would not target areas with high aggregations of sea turtles make any potential threats of entanglement very unlikely. Finally, the likelihood of ships strikes is also expected to be extremely low, given that the researchers will adhere to slow transit speeds, specifically designed to avoid ship strikes with whales, which have less maneuverability than sea turtles. In addition, observers would be on the lookout for marine animals at all times and direct vessel operators to avoid striking all marine animals. Therefore, we find that effects on these ESA-listed turtles are extremely unlikely to occur, and thus discountable. We conclude that the issuance of Permit Nos. 19674 and 19315 are not likely to adversely affect green turtles (North Atlantic DPS), hawksbill turtles, Kemp’s ridley turtles, leatherback turtles, loggerhead turtles (Northwest Atlantic Ocean DPS), and olive ridley turtles (all non-Mexico’s Pacific breeding colonies), and we will not discuss these species further in this opinion.

4.1.2 Fishes

The proposed actions overlap spatially with the ranges of Atlantic sturgeon (Permit No. 19315 – Gulf of Main and New York Bight DPS, Permit No. 19674 - all DPSs) and Atlantic salmon (both permits - Gulf of Maine DPS). Interactions with these fish could potentially involve the same stressors as identified for turtles: disturbance, entanglement in prey sampling and mapping equipment, and ship strikes. Again, the possibility of these interactions is considered remote because the proposed research activities are directed at cetaceans. Most research activities would occur at the surface, not underwater where these fish species primarily occur, and so would not disturb fish. One research activity that has the potential to disturb these species is underwater videography, if for example the researcher were to unintentionally film a fish. However, underwater videography would occur near the surface and the fish would be able to easily avoid the equipment. There is also a possibility that fish would become entangled in gear during prey mapping and sampling. While this activity would occur in deeper water, the relatively small gear is specifically targeted at zooplankton, and as such, is unlikely to interact with these fish species as being anadromous, they inhabit marine waters as larger adults, not juvenile or larvae. Furthermore, sampling equipment would be towed at very slow speeds, providing ample opportunity for fish to avoid the equipment if it were nearby. Finally, ships strikes are considered extremely unlikely given that the research vessels will adhere to slow speeds designed to minimize ship strikes to whales, which are generally less agile and slower moving than these fish species. To date, neither researcher, in their combined 60 plus years of research, has reported any interaction with an ESA-listed fish. Therefore, we find that effects on these ESA-listed fishes are extremely unlikely to occur, and thus discountable. We conclude that the issuance of Permit Nos. 19674 and 19315 are not likely to adversely affect Atlantic sturgeon (all DPSs) and Atlantic salmon (Gulf of Maine DPS), and we will not discuss these species further in this opinion.

4.1.3 Critical Habitats

The proposed actions overlap spatially with the recently proposed critical habitat for Atlantic Sturgeon (all DPSs) and designated critical habitat for Atlantic salmon (Gulf of Maine DPS) and North Atlantic right whales. However, given the nature of the activities, it is extremely unlikely that any of the physical and biological features essential to the conservation of these species found in these habitats would be altered, as outlined below.

In 2016 the NMFS proposed critical habitat for all DPSs of Atlantic sturgeon. The proposed areas include a variety of freshwater bodies of water along the east coast of the U.S. from Florida to Maine. The physical and biological features essential to the conservation of the species found in these waters include hard bottom substrate in low salinity waters; aquatic habitat with a gradual downstream salinity gradient of 0.5–30 parts per thousand and soft substrate; water of appropriate depth and absent physical barriers and; water, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support spawning, annual and inter-annual adult, sub-adult, larval, and juvenile survival, and larval, juvenile, and sub-adult growth, development, and recruitment. Given that the research activities would occur offshore, no interaction with these features would occur and any effects are discountable. Thus, we determined that the issuance of Permit Nos. 19674 and 19315 is not likely to adversely modify or destroy proposed Atlantic sturgeon (all DPSs) critical habitat and we will not discuss this proposed critical habitat further in this opinion.

In 2009 the NMFS designated critical habitat for the Gulf of Maine DPS of Atlantic salmon. The designated areas include many perennial rivers, streams, estuaries, and lakes connected to the marine environment within the state of Maine. The physical and biological features essential to the conservation of the species found in these waters include deep, oxygenated pools and cover; freshwater spawning sites with clean, permeable gravel, oxygenated, cool water, and diverse substrates; freshwater rearing sites with clean gravel, oxygenated water, diverse substrates, a combination of river, stream, and lake habitats, and space and diverse food to accommodate growth and survival; freshwater migratory sites free from barriers with native fish communities, sufficiently cool water and water flow, and water chemistry needed to support sea water adaptation; and marine sites with abundant native fish communities. As noted for the proposed critical habitat for Atlantic sturgeon, the research activities would occur offshore and so no interaction with these features would occur. Therefore, any effects to designated Atlantic salmon (Gulf of Maine DPS) critical habitat are discountable. We conclude that the issuance of Permit Nos. 19674 and 19315 is not likely to adversely modify or destroy designated Atlantic salmon (Gulf of Maine DPS) critical habitat, and we will not discuss this designated critical habitat further in this opinion.

In 1994 the NMFS designated critical habitat for North Atlantic right whales, which was expanded in 2016. As detailed further in Section 4.2.1, the designated areas include important foraging waters in the Gulf of Maine and Georges Bank Region and calving waters off the coast of North Carolina, South Carolina, Georgia, and Florida. The physical and biological features essential to the conservation of the species found in these waters include the physical oceanographic conditions and structures that distribute and aggregate zooplankton species *Calanus finmarchicus*, late stage *C. finmarchicus* in dense aggregations, diapausing *C. finmarchicus* in aggregations, and sea surface conditions associated with force four or less on the

Beaufort Scale, sea surface temperatures of 7-17 °Celsius, and water depths of 6-28 meters over contiguous areas of at least 231 nautical square-miles of ocean waters during the months of November through April. While the proposed research activities would directly overlap with these essential features, very few if any, effects are possible. The proposed activities would not significantly alter the physical or oceanographic conditions within the action area, as only very minor changes in water flow and current would be expected from vessel traffic and no changes in ocean bathymetry would occur. Furthermore, during daylight hours, when most research would occur, *C. finmarchicus* are often found below the surface, which would minimize disturbance from vessel traffic (Baumgartner et al. 2011). Thus, effects to these features are discountable. Vessel pollution, vessel noise, and prey sampling could also directly impact *C. finmarchicus*. However, vessel pollution would be minimal, diluted, and likely not reach them, and we could not find any evidence suggesting that sound alters the densities of copepods (Bennet et al. 1994). While prey sampling would reduce the available zooplankton food supply, such effects would be temporary and very minor given the equipment used. As such, there would be no measurable impact to whales' food resource, leading us to conclude that effects to this feature would be insignificant. Finally, the proposed activities would in no way alter the sea state, temperature, or water depth and so effects to these features are also deemed discountable. Thus, we conclude that the issuance of Permit Nos. 19674 and 19315 is not likely to adversely modify or destroy designated North Atlantic critical habitat.

4.2 Species Likely to be Adversely Affected

This opinion examines the status of each species that would be affected by the proposed action. The status is determined by the level of risk that the ESA-listed species face based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. More detailed information on the status, trends, biology, and ecology of these ESA-listed species can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on the NMFS Web site: http://www.nmfs.noaa.gov/pr/species/esa/listed.htm.

The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential physical and biological features that help to form that conservation value.

4.2.1 North Atlantic Right Whale

Table 5: Information bar provides species Latin name, common name, current and proposed Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat

Eubalaena glacialis	**North Atlantic right whale**	**None**	**Endangered:** range wide	2012	73 FR 12024	2005	81 FR 4837

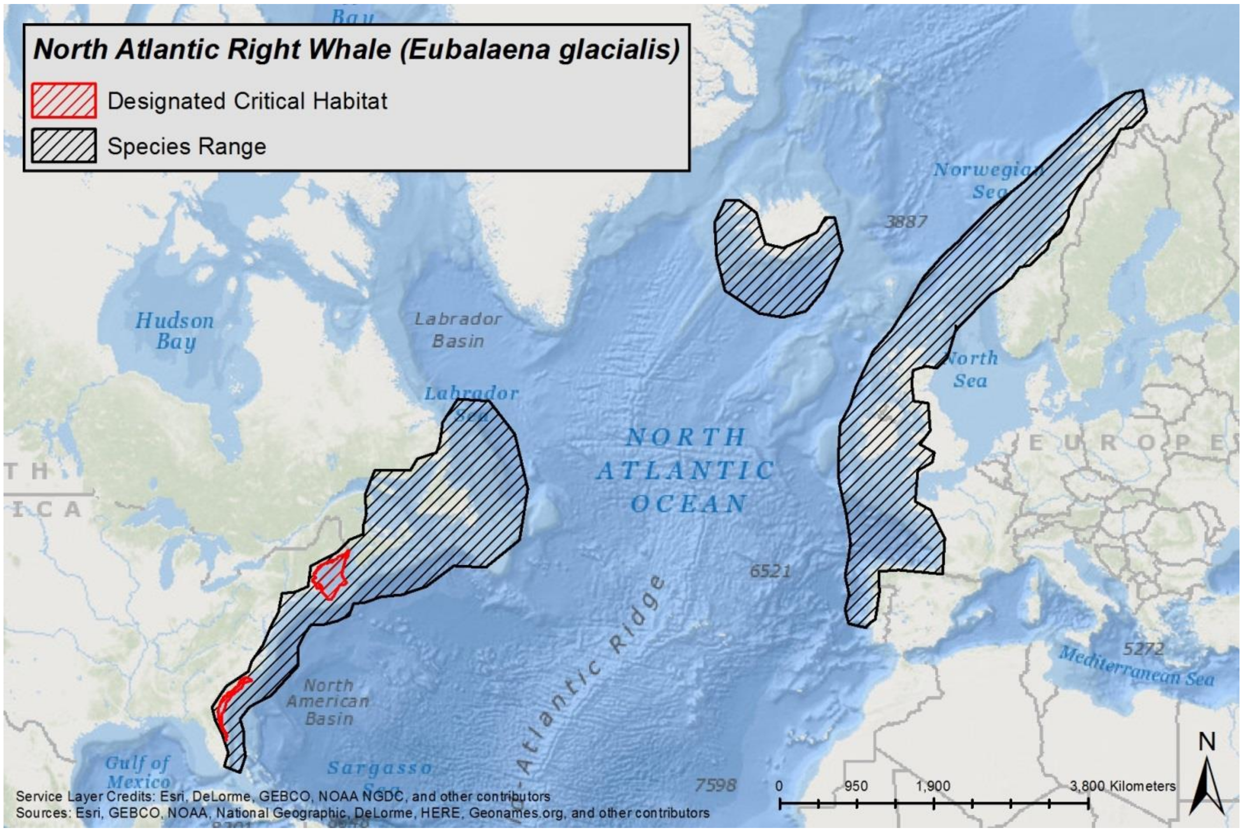

Figure 7: Map showing the range and designated critical habitat for North Atlantic right whales.

Species Description

The North Atlantic right whale is a narrowly distributed baleen whale, distinguished by its stocky body and lack of a dorsal fin (Figure 8). The species was originally listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the five-year review (Colligan et al. 2012), the most recent stock assessment report (Waring et al. 2016), and the scientific literature to summarize the status of the species, as follows.

Figure 8: North Atlantic right whale (*Eubalaena glacialis*) Photo: NOAA

Life history

The lifespan of North Atlantic right whales is unknown, but some individuals appear to live to be at least 50 years old (Kenney 2009). Their gestation is 12-13 months, and calves are nursed for 8-17 months. The average calving interval is 3-5 years and they reach sexual maturity at nine years of age. They migrate to low latitudes during the winter to give birth in shallow, coastal waters and in summer, feed on large concentrations of copepods in the high latitudes (Colligan et al. 2012).

Population dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the North Atlantic right whale.

Abundance

There are currently two recognized populations of North Atlantic right whales, a western and an eastern population. There are at least 465 individuals in the western North Atlantic population (Waring et al. 2016). This estimate is based on a review of the photo-ID recapture database as it existed in October 2013 and represents a minimum population size. Less than 20 individuals exist in the eastern North Atlantic, and as such, this population may be functionally extinct (Colligan et al. 2012)**.** Pre-exploitation abundance is not available for the species. The western population may have numbered fewer than 100 individuals by 1935 when international protection for right whales came into effect (Kenney et al. 1995). Little is known about the population dynamics of right whales in the intervening years.

Population Growth Rate

In the western North Atlantic, the species demonstrated overall growth rates of 2.6 percent over the period 1990 to 2010, despite two periods of increased mortality during that time span

(Waring et al. 2016). However, in more recent years, photo-ID data indicate the population is now in decline (Kraus et al. 2016).

Genetic Diversity

Analysis of mitochondrial DNA (mtDNA) from North Atlantic right whales has identified seven mtDNA haplotypes in the western North Atlantic. This is significantly less diverse than southern right whales (*Eubalaena australis*) and may indicate inbreeding. While analysis of historic DNA taken from museum specimens indicates that the eastern and western populations were likely not genetically distinct, the lack of recovery of the eastern North Atlantic population indicates at least some level of population segregation. Overall, the species has low genetic diversity as would be expected based on its low abundance (Waring et al. 2016).

Distribution

Today North Atlantic right whales are primarily found in the western North Atlantic, from their breeding grounds in lower latitudes off the coast of the southeastern U.S. to their feeding grounds in higher latitudes off the coast of Nova Scotia (Waring et al. 2016). Very few, if any, individuals are thought to make up the population in the eastern Atlantic (Waring et al. 2016). However, in recent years a few known individuals from the western population have been seen in the eastern Atlantic, suggesting some individuals may have wider ranges than previously thought (Kenney 2009).

Status

The North Atlantic right whale is listed under the ESA as endangered. With whaling now prohibited, the two major threats to the survival and recovery of the species are ship strikes and entanglement in fishing gear. Substantial progress has been made in mitigating ship strikes by regulating vessel speeds (78 FR 73726) (Conn and Silber 2013; Waring et al. 2016), but entanglement in fishing gear remains a major threat (Kraus et al. 2016). In addition, while population trends have been positive since its original listing, the species may now be in decline and its resilience to future perturbations is low due to its small population size.

Status of Species within the Action Area

The action areas for Permit Nos. 19674 and 19315 overlap with the range of the western population of North Atlantic right whales. In addition, it is possible the action area for Permit No. 19674 may overlap with the remanent eastern North Atlantic population. Given that the eastern population is thought to be functionally extinct, the western population is likely the only remaining population of this species, and thus is vital to its recovery. The specific life stages likely to be present in the action area for Permit No. 19315 include adults, juveniles, and non-neonate calves since the research would be conducted on the northern feeding grounds. For Permit No. 19315, neonate calves may also be present since research activities would span both the southern breeding and the northern feeding grounds. Vital rates for the species within the action areas are identical to those noted for the species overall since the action areas overlap the only populations of this species.

Critical Habitat

Critical habitat for North Atlantic right whales was designated in 1994 (59 FR 28805) and expanded in 2016 (81 FR 4837). It includes two major units: Unit one located in the Gulf of Maine and Georges Bank Region and Unit two located off the coast of North Carolina, South Carolina, Georgia, and Florida (Figure 7). Unit one consists of important foraging area and contains the following physical and biological features essential to the conservation of the species: the physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate the zooplankton species *C. finmarchicus* for right whale foraging, namely prevailing currents and circulation patterns, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, and temperature regimes; low flow velocities in Jordan, Wilkinson, and Georges Basins that allow diapausing *C. finmarchicus* to aggregate passively below the convective layer so that the copepods are retained in the basins; late stage *C. finmarchicus* in dense aggregations in the Gulf of Maine and Georges Bank region; and diapausing *C. finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region. Unit two consist of important calving area and contains the following physical and biological features essential to the conservation of the species: sea surface conditions associated with force four or less on the Beaufort Scale, sea surface temperatures of seven to 17 °Celsius, and water depths of six to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 nautical square-miles of ocean waters during the months of November through April.

Recovery Goals

See the 2005 updated Recovery Plan for the North Atlantic right whale for complete down listing criteria for the following recovery goals:

1. The population ecology (range, distribution, age structure, and gender ratios, etc.) and vital rates (age-specific survival, age-specific reproduction, and lifetime reproductive success) of right whales are indicative of an increasing population;
2. The population has increased for a period of 35 years at an average rate of increase equal to or greater than two percent per year;
3. None of the known threats to Northern right whales are known to limit the population's growth rate; and
4. Given current and projected threats and environmental conditions, the right whale population has no more than a one percent chance of quasi-extinction in 100 years.

4.2.2 Humpback Whale (Cape Verde Islands/Northwest Africa Distinct Population Segment)

Table 6: Information bar provides species Latin name, common name, current and proposed Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Megaptera novaeangliae	**Humpback whale**	**Cape Verde Islands/North west Africa**	**Endangered**	2015	81 FR 62259	1991	None Designated

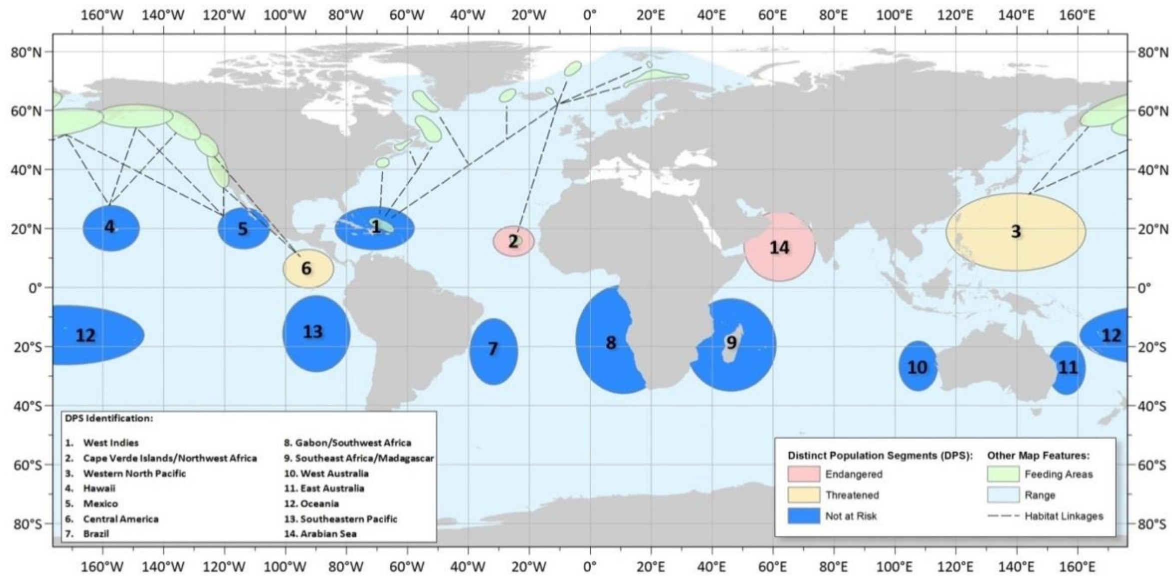

Figure 9: Map identifying 14 distinct population segments with one threatened and four endangered, based on primary breeding location of the humpback whale, their range, and feeding areas (Bettridge et al. 2015).

Species Description

The humpback whale is a widely distributed baleen whale found in all major oceans. Humpbacks are distinguishable from other whales by long pectoral fins and are typically dark grey with some areas of white (Figure 10). The humpback whale was originally listed as endangered on December 2, 1970 (35 FR 18319). Since then, NMFS has designated 14 DPSs with four identified as endangered (Cape Verde Islands/Northwest Africa, Western North Pacific, Central American, and Arabian Sea) and one as threatened (Mexico)(Figure 9) (81 FR 62259). The only ESA-listed DPS that occurs within the action area is the Cape Verde Islands/Northwest Africa DPS. Information available from the recovery plan (NMFS 1991), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016), the status review (Bettridge et al. 2015), and the final listing (81 FR 62259) were used to summarize the status of the species as follows.

Figure 10: Humpback whale (*Megaptera novaeangliae*) Photo: NOAA

Life History

Humpbacks can live, on average, 50 years. They have a gestation period of 11 to 12 months, and calves nurse for one year. Sexual maturity is reached between five to 11 years of age with an average calving interval of two to three years. Humpbacks mostly inhabit coastal and continental shelf waters. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed. Humpbacks exhibit a wide range of foraging behaviors and feed on a range of prey types, including: small schooling fishes, euphausiids, and other large zooplankton (Bettridge et al. 2015).

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the humpback whale.

Abundance

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). The current abundance of the Cape Verde Islands/Northwest Africa DPS is unknown (81 FR 62259).

Population Growth Rate

A population growth rate is currently unavailable for the Cape Verde Islands/Northwest Africa humpback whale DPS.

Genetic Diversity

For Humpback whales, distinct population segments that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Distinct population segments that have a total population 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Populations at low densities (less than 100) are more likely to suffer from the 'Allee' effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density. The population size of the Cape Verde Islands/Northwest Africa is unknown at this time and therefore evidence of genetic diversity (or lack of) cannot be determined (81 FR 62259, Bettridge et al. 2015).

Distribution

The Cape Verde Islands/Northwest Africa DPS consists of humpback whales whose breeding range includes waters surrounding the Cape Verde Islands as well as an undetermined breeding area in the eastern tropical Atlantic, and possibly the Caribbean. Its feeding range includes primarily Iceland and Norway (Figure 9). (81 FR 62259)

Status

Humpback whales were originally listed as endangered as a result of past commercial whaling, and the five DPSs that remain listed (Cape Verde Islands/Northwest Africa, Western North Pacific, Central American, Arabian Sea, and Mexico) have likely not yet recovered from this. Prior to commercial whaling, hundreds of thousands of humpback whales existed. Global abundance declined to the low thousands by 1968, the last year of substantial catches (IUCN 2012). Humpback whales may be killed under "aboriginal subsistence whaling" and "scientific permit whaling" provisions of the International Whaling Commission (IWC). Additional threats include ship strikes, fisheries interactions (including entanglement), energy development, harassment from whale watching, noise, harmful algal blooms, disease, parasites, and climate change. The species' large population size and increasing trends indicate that it is resilient to current threats, but the Cape Verde Islands/Northwest Africa DPS still faces a risk of extinction.

Status of Species within the Action Area

Most of the humpback whales that would occur in the action areas for both permits would be from the West Indies DPS, which is not listed under the ESA. The action area for Permit 19674 may overlap with the Cape Verde Islands/Northwest Africa DPS (Endangered), but given that most of the research would occur in the northwestern Atlantic, encountering humpbacks from this DPS is expected to be infrequent. Nonetheless, in this opinion we consider effects to the Cape Verde Islands/Northwest African DPS.

Little is known about the Cape Verde Islands/Northwest Africa DPS, including its size, population trend, and vital rates. Threats to humpbacks in the Cape Verde Islands/Northwest Africa DPS include climate change, harmful algal blooms, disease, parasites, vessel collisions, and fishing gear entanglements, but the impact of each threat on the DPS remains unknown (Bettridge et al. 2015). Like other DPSs, the Cape Verde Islands/Northwest African DPS is thought to exhibit strong site fidelity to specific feeding grounds in the North Atlantic in spring, summer, and fall and breeding grounds in the Cape Verde Islands, an undetermined area in the eastern tropical Atlantic, and possibly the southeast Caribbean during winter months (81 FR 62259, Bettridge et al. 2015). Given this strong site fidelity, the DPS is considered significant to the species as it is unlikely that their specific feeding and breeding grounds would be repopulated on a reasonable time scale if the DPS were to be lost. Consequently, the loss of this DPS would result in loss of humpback whales from the some parts of North Atlantic and unique breeding grounds in the eastern Atlantic, which is considered a significant portion of the species population and range. The specific life stages that are likely to be present would only include adults and juveniles since the research under Permit 19674 would only overlap with the North Atlantic feeding grounds.

Critical Habitat

No critical habitat has been designated for humpback whales.

Recovery Goals

See the 2001 Final Recovery Plan for the Humpback whale for complete down listing/delisting criteria for each of the four following recovery goals:

1. Maintain and enhance habitats used by humpback whales currently or historically.
2. Identify and reduce direct human-related injury and mortality.
3. Measure and monitor key population parameters.
4. Improve administration and coordination of recovery program for humpback whales.

4.2.3 Fin Whale

Table 7: Information bar provides species Latin name, common name, current and proposed Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Balaenoptera physalus	**Fin whale**	**None**	**Endangered:** range-wide	2011	35 FR 18319	2010	None Designated

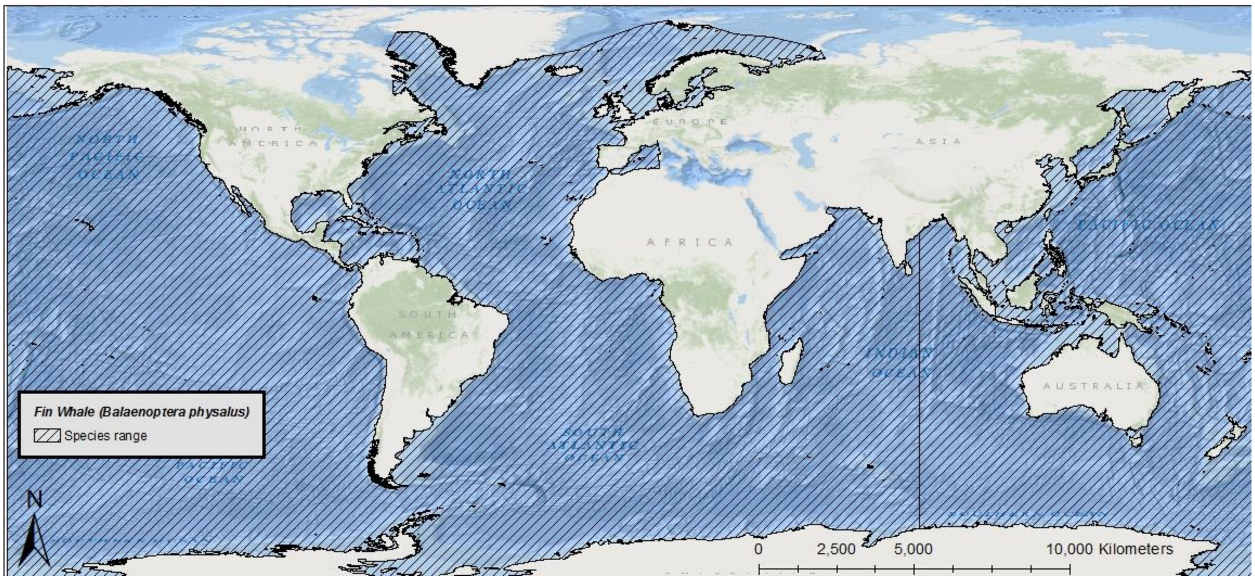

Figure 11: Map showing the range of the fin whale.

Species Description

The fin whale is a large, widely distributed baleen whale found in all major oceans and comprised of three subspecies: *B. p. physalus* in the Northern Hemisphere, and *B. p. quoyi* and *B. p. patachonica* (a pygmy form) in the Southern Hemisphere. Fin whales are distinguishable from other whales by a sleek, streamlined body with a V-shaped head, a tall, falcate dorsal fin, and a distinctive color pattern of a black or dark brownish-gray body and sides with a white ventral surface (Figure 12). The fin whale was originally listed as endangered on December 2, 1970 (35 FR 18319). Information available from the recovery plan (NMFS 2010g), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016), and status review (NMFS 2011b) were used to summarize the status of the species as follows.

Figure 12: Fin whale (*Balaenoptera physalus*). Photo: NOAA

Life History

Fin whales can live, on average, 80 to 90 years. They have a gestation period of less than one year, and calves nurse for six to seven months. Sexual maturity is reached between six to 10 years of age with an average calving interval of two to three years. They mostly inhabit deep, offshore waters of all major oceans. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed. Fin whales eat pelagic crustaceans (mainly euphausiids or krill) and schooling fish such as capelin, herring, and sand lice.

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the fin whale.

Abundance

The pre-exploitation estimate for the fin whale population in the North Pacific was 42,000 to 45,000 (Ohsumi and Wada 1974). In the North Pacific, at least 74,000 whales were killed between 1910 and 1975. In the North Atlantic, at least 55,000 fin whales were killed between 1910 and 1989. Approximately 704,000 whales were killed in the Southern Hemisphere from 1904 to 1975. Of the three to seven stocks in the North Atlantic (approximately 50,000 individuals), one occurs in U.S. waters, where the best estimate of abundance is 1,618 individuals (N_{min}=1,234); however, this may be an underrepresentation as the entire range of the stock was not surveyed (Palka 2012). There are three stocks in U.S. Pacific waters: Alaska (approximately 1,652 individuals (Zerbini et al. 2006)), Hawaii (approximately 58 individuals, N_{min}=27) and California/Oregon/Washington (approximately 3,051 individuals, N_{min}=2,598). Abundance data for the Southern Hemisphere stock are limited; however, there were an estimated 85,200 fin whales in 1970.

Population Growth Rate

Current estimates indicate approximately 9,000 fin whales in U.S. Pacific Ocean waters, with an annual growth rate of 4.8 percent in the Alaska stock and 3.5 percent in the

California/Oregon/Washington stock. Overall population growth rates and total abundance estimates for the Hawaii stock and western north Atlantic stock are not available at this time.

Genetic Diversity

Archer et al. (2013) recently examined the genetic structure and diversity of fin whales globally. Full sequencing of the mtDNA genome for 154 fin whales sampled in the North Atlantic, North Pacific, and Southern Hemisphere, resulted in 136 haplotypes, none of which were shared among ocean basins suggesting differentiation at least at least at this geographic scale. However, North Atlantic fin whales appear to be more closely related to the Southern Hemisphere population, as compared to fin whales in the North Pacific, which may indicate a revision of the subspecies delineations is warranted. Generally speaking haplotype diversity was found to be high both within ocean basins, and across. Such high genetic diversity and lack of differentiation within ocean basins may indicate that despite some population's having small abundance estimates, the species may persist long-term and be somewhat protected from substantial environmental variance and catastrophes.

Distribution

There are over 100,000 fin whales worldwide, occurring primarily in the North Atlantic, North Pacific, and Southern Hemisphere (Figure 11) where they appear to be reproductively isolated. The availability of sand lice, in particular, is thought to have had a strong influence on the distribution and movements of fin whales.

Status

The fin whale is endangered as a result of past commercial whaling. Prior to commercial whaling, hundreds of thousands of fin whales existed. Fin whales may be killed under "aboriginal subsistence whaling" in Greenland, under Japan's scientific whaling program, and Iceland's formal objection to the Commission's ban on commercial whaling. Additional threats include ship strikes, reduced prey availability due to overfishing or climate change, and noise. The species' large population size may provide some resilience to current threats, but trends are largely unknown.

Status of Species within the Action Area

Several subpopulations of fin whales are thought to exist within the North Atlantic, although some studies have found substantial gene flow between these populations and little genetic divergence suggesting there may only be one function population (excluding the Mediterranean). The primary stock found within the action area, and the only within U.S. waters, is the Western North Atlantic Stock, which as mentioned previously, is estimated to comprise 1,618 individuals (N_{min}=1,234), although this is likely and underestimate (Waring et al. 2016). Within the area, fin whales are the most abundant large cetacean during all seasons. Like many other baleen whales, fin whales exhibit strong site fidelity, and whales of the Western North Atlantic stock are no exception. Waters of New England represent an important feeding area for this stock, and similar to North Atlantic right whales, calving is thought to occur to the south, along the U.S. mid-Atlantic, although the exact location of breeding remains unknown. Thus, the life stages that would be present within the action area of Permit No. 19315 include adults, juveniles, and non-neonate calves whereas neonates have to potential to be found within the action area of Permit No. 19674. At this time, not enough data are available to estimate population trends, including mortality and reproductive rates for the Western North Atlantic stock.

Critical Habitat

No critical habitat has been designated for the fin whale.

Recovery Goals

See the 2010 Final Recovery Plan for the fin whale for complete down listing/delisting criteria for both of the following recovery goals:

1. Achieve sufficient and viable population in all ocean basins.
2. Ensure significant threats are addressed.

4.2.4 Sei Whale

Table 8: Information bar provides species Latin name, common name, current and proposed Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Balaenoptera borealis	**Sei whale**	**None**	**Endangered:** range-wide	2012	35 FR 18316	2011	None Designated

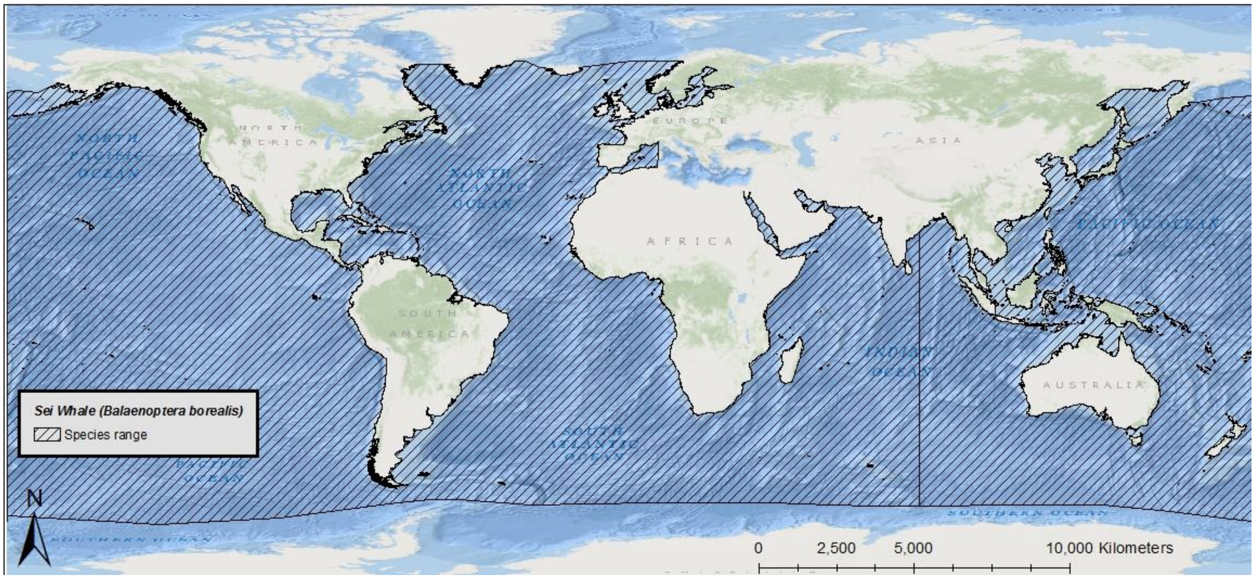

Figure 13: Map showing the range of the sei whale.

Species Description

The sei whale is a widely distributed baleen whale found in all major oceans. Sei whales are distinguishable from other whales by a long, sleek body that is dark bluish-gray to black in color and pale underneath, and a single ridge located on their rostrum (Figure 14). The sei whale was originally listed as endangered on December 2, 1970 (35 FR 18319). Information available from the recovery plan (NMFS 2011c), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016), and status review (NMFS 2012) were used to summarize the status of the species as follows.

Figure 14: Picture of sei whale (*Balaenoptera borealis*). Photo: NOAA

Life History

Sei whales can live, on average, between 50 to 70 years. They have a gestation period of 10 to 12 months, and calves nurse for six to nine months. Sexual maturity is reached between six and 12 years of age with an average calving interval of two to three years. Sei whales mostly inhabit continental shelf and slope waters far from the coastline. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed on a range of prey types, including zooplankton (copepods and krill), small schooling fishes, and cephalopods.

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the sei whale.

Abundance

Two subspecies of sei whale are recognized, *B. b. borealis* in the Northern Hemisphere and *B. b. schlegellii* in the Southern Hemisphere. There are no estimates of pre-exploitation abundance for sei whales in the North Atlantic. Models indicate that total abundance declined from 42,000 to 8,600 between 1963 and 1974 in the North Pacific. In the Southern Hemisphere, pre-exploitation abundance is estimated at 65,000 whales, with recent abundance estimated at 9,700. Three stocks occur in U.S. waters: Nova Scotia (N=357, N_{min}=236), Hawaii (N=178, N_{min}=93), and Eastern North Pacific (N=126, N_{min}=83).

Population Growth Rate

Population growth rates for sei whales are not available at this time.

Genetic Diversity

While some genetic data exist sei whales, current samples sizes are small limiting our confidence in their estimates of genetic diversity (NMFS 2011c). However, genetic diversity information for similar cetacean population sizes can be applied. Stocks that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Stocks that have a total population 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Stock populations at low densities (<100) are more likely to suffer from the 'Allee' effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density.

Distribution

There are approximately 80,000 sei whales worldwide, occurring in the North Atlantic, North Pacific, and Southern Hemisphere (Figure 13).

Status

The sei whale is endangered as a result of past commercial whaling. Now, only a few individuals are taken each year by Japan; however, Iceland has expressed an interest in targeting sei whales. Current threats include ship strikes, fisheries interactions (including entanglement), climate change (habitat loss and reduced prey availability), and noise. The species' large population size may provide some resilience to current threats, but trends are largely unknown.

Status of Species within the Action Area

The IWC recognizes seven stocks of sei whales within the North Atlantic. Of these, the Nova Scotia stock is the only found in U.S. waters and the primary stock that would be found within the action areas. Consistent with many other baleen whales, sei whales of this stock spend spring and summer foraging in higher latitudes, including the Gulf of Maine, although sei whales are typically found in deeper waters compared to many other baleen whales. While the stock is suspected to migrate south for breeding, little is known about sei whale movement patterns and migration compared to other, better studied baleen whales. Thus, as with the other baleen whales with in the action area, adults, juveniles, and non-neonate calves are likely to be found within the action area for Permit No. 19315, and all age classes may be found in the action area of Permit No. 19674. This stock is estimated to be small at only 357 individuals (N_{min}=236) and data are currently insufficient to estimate population trends, including mortality and reproductive rates (Waring et al. 2016).

Critical Habitat

No critical habitat has been designated for the sei whale.

Recovery Goals

See the 2011 Final Recovery Plan for the sei whale for complete down listing/delisting criteria for both of the following recovery goals:

1. Achieve sufficient and viable populations in all ocean basins.
2. Ensure significant threats are addressed.

4.2.5 Bowhead Whale

Table 9: Information bar provides species Latin name, common name, current and proposed Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Balaena mysticetus	**Bowhead whale**	**None**	**Endangered:** range-wide	1995	35 FR 18319	None	None Designated

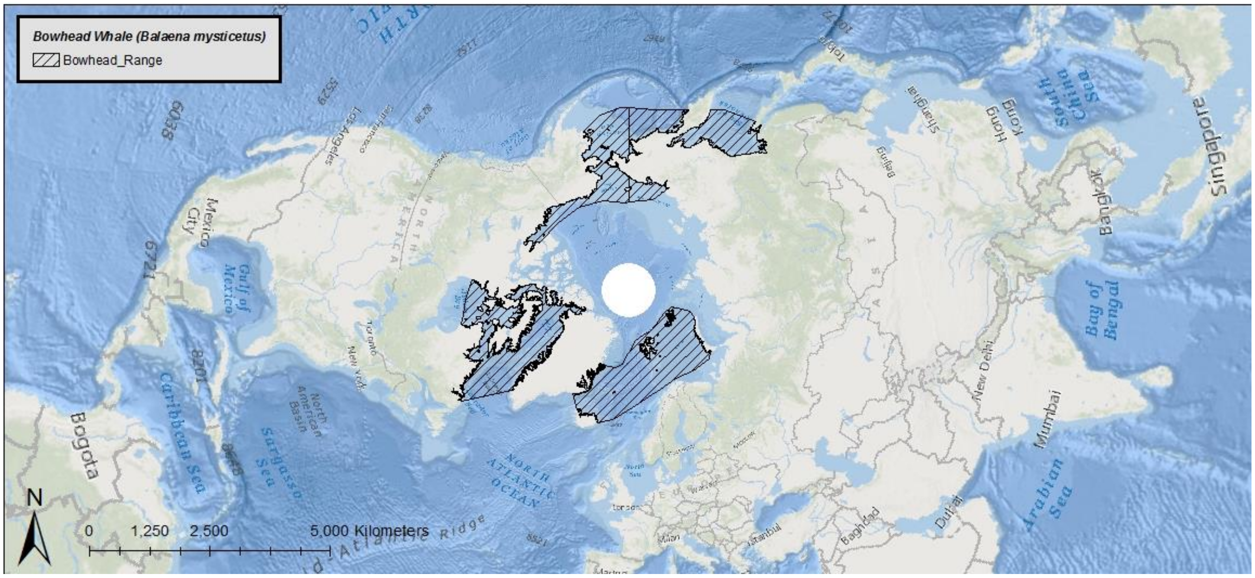

Figure 15: Map showing the range of the bowhead whale.

Species Description

Bowheads are baleen whales distinguishable from other baleen whales by a dark body with distinctive white chin, no dorsal fin, and a bow-shaped skull that takes up about 35 percent of their total body length (Figure 15). The bowhead whale was originally listed as endangered on December 2, 1970 (35 FR 18319). Information available from the recent stock assessment report (Muto et al. 2016) and the scientific literature was used to summarize the status of the species as follows.

Figure 16: Bowhead whale (*Balaena mysticetus*). Photo: NOAA.

Life History

The average lifespan of bowheads is unknown, but some evidence suggests that they can live for over 100 years. They have a gestation period of 13 to 14 months and it is currently unknown how long calves nurse. Sexual maturity is reached around 20 years of age with an average calving interval of three to four years. They spend the winter associated with the southern limit of the pack ice and move north as the sea ice breaks up and recedes during spring. Bowheads use their large skull to break through thick ice and feed on zooplankton (crustaceans like copepods, euphausiids, and mysids), other invertebrates, and fish.

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the bowhead whale.

Abundance

The global, pre-exploitation estimate for bowhead whales is 30,000 to 50,000. There are currently four or five recognized stocks of bowheads, the Western Arctic (or Bering-Chukchi-Beaufort) stock, the Okhotsk Sea stock, the Davis Strait and Hudson Bay stock (sometimes considered separate stocks), and the Spitsbergen stock (Rugh and Shelden 2009). The only stock thought to be found within U.S. waters is the Western Arctic stock. The 2011 ice-based abundance estimate puts this stick, the largest remnant stock, at over 16,892 (N_{min}= 16,091) individuals. Prior to commercial whaling, there may have been 10,000 to 23,000 whales in this stock (Rugh and Shelden 2009). Historically the Davis Strait-Hudson Bay stock may have contained over 11,000 individuals, but now it is thought to number around 7,000 bowheads (Cosens et al. 2006). In the Okhotsk Sea, there were originally more than 3,000 bowheads, but now there are only about 300 to 400. The Spitsbergen stock originally had about 24,000 bowheads and supported a huge European fishery, but today is thought to only contain tens of whales (Shelden and Rugh 1995).

Population Growth Rate

Current estimates indicate approximately 16,892 bowhead whales in the Western Arctic stock, with an annual growth rate of 3.7 percent (Givens et al. 2013). While no quantitative estimates exist, the Davis Strait and Hudson Bay stock is also thought to be increasing (COSEWIC 2009). We could find no information on population trends for the Okhotsk Sea stock. Likewise, no information is available on the population trend for the Spitsbergen stock, but it is thought to be nearly extinct.

Genetic Diversity

Genetic studies conducted on the Western Arctic stock of bowhead whales revealed 68 different mtDNA haplotypes defined by 44 variable sites (Leduc et al. 2008), making it the most diverse stock of bowheads. These results are consistent with a large, single stock with genetic heterogeneity related to age cohorts and indicate no historic genetic bottlenecks (Rugh et al. 2003). In the Okhotsk Sea stock, only four to seven mtDNA haplotypes have been identified, three of which are shared with the Western Arctic Stock, indicating lower genetic diversity, as might be expected given its much small population size (Alter et al. 2012; LeDuc et al. 2005; MacLean 2002). The Davis Strait-Hudson Bay stock has 23 mtDNA haplotypes, making it more diverse than the Okhotsk but less diverse than the large Western Arctic stock (Alter et al. 2012).

Based on historic mtDNA, the Spitsbergen stock previously had at least 58 mtDNA haplotypes, but its current genetic diversity remains unknown (Borge et al. 2007). However, given its near extirpation, it likely has low genetic diversity.

Distribution

Bowhead whales have a circumpolar distribution and can be found throughout high latitudes in the Northern Hemisphere (Figure 15). The Western Arctic stock is found in waters around Alaska, the Okhotsk Sea stock in eastern Russia waters, the Davis Strait and Hudson Bay stock in northeastern waters near Canada, and the Spitsbergen stock in the northeastern Atlantic (Rugh and Shelden 2009).

Status

The bowhead whale is endangered as a result of past commercial whaling. Prior to commercial whaling, thousands of bowhead whales existed. Global abundance declined to 3,000 by the 1920s. Bowhead whales may be killed under “aboriginal subsistence whaling” provisions of the International Whaling Commission (IWC). Additional threats include ship strikes, fisheries interactions (including entanglement), contaminants, and noise. The species’ large population size and increasing trends indicate that it is resilient to current threats.

Status of Species within the Action Area

Bowheads that may be present in the action area would be from the Davis Strait-Hudson Bay stock. This stock occurs in northeastern Canadian waters, across the Arctic Ocean to Greenland. Like other bowheads, they spend summer months in relatively ice free waters near the arctic, and migrate south with sea ice in the winter. All life stages except neonates may be found in the action area, since calving occurs during summer in the north Arctic. This is the second largest stock of bowheads and preliminary data show signs of recovery with an increasing population trend, although quantitative estimates of its population growth rate are not available (COSEWIC 2009; Higdon and Ferguson 2010).

Critical Habitat

No critical habitat has been designated for the bowhead whale.

Recovery Goals

Currently, there is no recovery plan available for the bowhead whale.

4.2.6 Blue Whale

Table 10: Information bar provides species Latin name, common name, current and proposed Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Balaenoptera musculus	**Blue whale**	**None**	**Endangered:** range-wide	None	35 FR 18316	1998 Intent to update (77 FR 22760)	None Designated

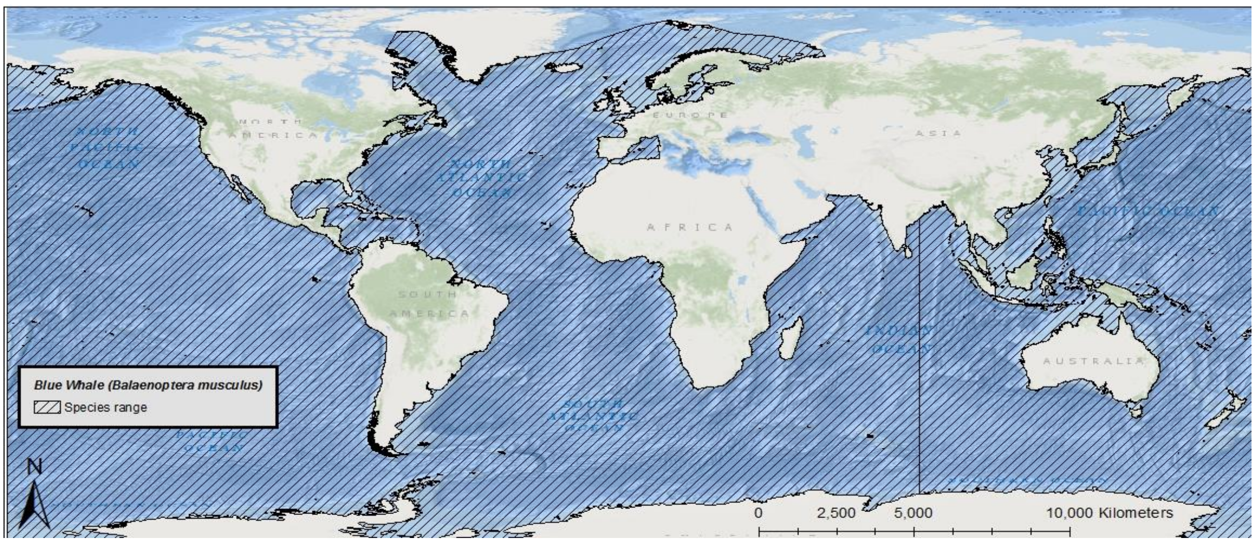

Figure 17: Map showing the range of the blue whale.

Species Description

The blue whale is a widely distributed baleen whale found in all major oceans. Blue whales are the largest animal on earth and distinguishable from other whales by a long-body and comparatively slender shape, a broad, flat "rostrum" when viewed from above, proportionally smaller dorsal fin, and are a mottled gray color that appears light blue when seen through the water (Figure 18). Most experts recognize at least three subspecies of blue whale, *B. m. musculus*, which occurs in the Northern Hemisphere, *B. m. intermedia*, which occurs in the Southern Ocean, and *B. m. brevicauda*, a pygmy species found in the Indian Ocean and South Pacific. The blue whale was originally listed as endangered on December 2, 1970 (35 FR 18319). Information available from the recovery plan (NMFS 1998), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016), and status review (COSEWIC 2002) were used to summarize the status of the species as follows.

Figure 18: Blue whale (*Balaenoptera musculus*) Photo: NOAA

Life History

The average life span of blue whales is 80 to 90 years. They have a gestation period of 10 to 12 months, and calves nurse for six to seven months. Sexual maturity is reached between five and 15 years of age with an average calving interval of two to three years. Blues are often found in coastal waters but generally occur in offshore waters, from subpolar to subtropical latitudes (Figure 17). They winter at low latitudes, where they mate, calve and nurse, and summer at high latitudes, where they feed almost exclusively on krill and can eat approximately 3,600 kilograms a day. Feeding aggregations are often found at the continental shelf edge, where upwelling produces concentrations of krill at depths of 90 to 120 meters.

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the blue whale.

Abundance

The global, pre-exploitation estimate for blue whales is approximately 181,200 (IWC 2007). Current estimates indicate approximately 5,000 to 12,000 blue whales globally (IWC 2007). Blue whales are separated into populations by ocean basin in the North Atlantic, North Pacific, and Southern Hemisphere. There are three stocks of blue whales designated in U.S. waters: the eastern North Pacific (current best estimate N=1,647, N_{min}=1,551; (Kraus et al. 1986)) central North Pacific (N=81, N_{min}=38), and western North Atlantic (N_{min}=440). The Southern Hemisphere ocean basins have approximately 2,000 individual blue whales.

Population Growth Rate

Current estimates indicate a growth rate of just under three percent per year for the eastern North Pacific stock (Calambokidis et al. 2009). An overall population growth rate for the species or growth rates for the two other individual U.S. stocks are not available at this time.

Genetic Diversity

Little genetic data exist on blue whales globally. Data from Australia indicates that at least populations in this region experienced a recent genetic bottleneck, likely the result of commercial whaling, although genetic diversity levels appear to be similar to other, non-threatened mammal species (Attard et al. 2010). Consistent with this, data from Antarctica also demonstrate this bottleneck but high haplotype diversity, which may be a consequence of the recent timing of the bottleneck and blue whales long lifespan (Sremba et al. 2012). Data on genetic diversity of blue whales in the Northern Hemisphere are currently unavailable. However, genetic diversity information for similar cetacean population sizes can be applied. Stocks that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Stocks that have a total population 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Stock populations at low densities (<100) are more likely to suffer from the ‘Allee’ effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density.

Distribution

In general, blue whales’ have a fairly global distribution which is driven largely by their food requirements. While they can be found in coastal waters, they are thought to prefer waters further offshore. In the North Atlantic Ocean, blue whales range from the subtropics to the Greenland Sea. In the North Pacific Ocean, they range from Kamchatka to southern Japan in the west and from the Gulf of Alaska and California to Costa Rica in the east. They primarily occur off of the Aleutian Islands and the Bering Sea. In the northern Indian Ocean, there is a “resident” population of blue whales with sightings being reported from the Gulf of Aden, Persian Gulf, Arabian Sea, and across the Bay of Bengal to Burma and the Strait of Malacca. In the Southern Hemisphere, distributions of subspecies (*B. m. intermedia* and *B. m. brevicauda*) seem to be segregated. *B. m. intermedia* occurs in relatively high latitudes south of the “Antarctic Convergence” (located between 48° South and 61° South latitude) and close to the ice edge, whereas *B. m. brevicauda* is typically distributed north of the Antarctic Convergence.

Status

The blue whale is endangered as a result of past commercial whaling. In the North Atlantic, at least 11,000 blue whales were taken from the late 19th to mid-20th centuries. In the North Pacific, at least 9,500 whales were killed between 1910 and 1965. Commercial whaling no longer occurs, but blue whales are threatened by ship strikes, entanglement in fishing gear, pollution, harassment due to whale watching, and reduced prey abundance and habitat degradation due to climate change. Because at least some populations appear to be increasing in size, the species appears to be somewhat resilient to current threats; however, the species has not recovered to pre-exploitation levels.

Status of Species within the Action Area

There are thought to be two populations of blue whales within the North Atlantic, one in the west and one in the east. The Western North Atlantic stock, which is the primary population that would be found within the action area, ranges from the subtropics to the Greenland Sea. They are most frequently sighted in waters off of eastern Canada with a majority of sightings taking place in the Gulf of St. Lawrence and western North Atlantic. However, the blue whale is considered only an occasional visitor to U.S. waters, which my represent the southern limit of its foraging range. Nonetheless, it has been sighted in waters of Cape Cod, Massachusetts. Like other large baleen whales, blue whales within the action area foraging at higher latitudes during spring and summer and migrate to lower latitudes in winter to breed. As such, adults, juveniles, and non-neonate blue whales may be present within the action area for Permit No. 19315, and all age classes may be present in the action area for Permit No. 19674. In general, little is known about the population size of blue whales within the North Atlantic, but the best available data produces a minimum estimate of 400 individuals. Currently no data are available to estimate population trends or mortality and reproduction rates for this stock (Waring et al. 2016).

Critical Habitat

No critical habitat has been designated for the blue whale.

Recovery Goals

See the 1998 Final Recovery Plan for the Blue whale for complete down listing/delisting criteria for each of the following recovery goals:

1. Determine stock structure of blue whale populations occurring in U.S. waters and elsewhere
2. Estimate the size and monitor trends in abundance of blue whale populations
3. Identify and protect habitat essential to the survival and recovery of blue whale populations
4. Reduce or eliminate human-caused injury and mortality of blue whales
5. Minimize detrimental effects of directed vessel interactions with blue whales
6. Maximize efforts to acquire scientific information from dead, stranded, and entangled blue whales
7. Coordinate state, federal, and international efforts to implement recovery actions for blue whales
8. Establish criteria for deciding whether to delist or down-list blue whales.

4.2.7 Sperm Whale

Table 11: Information bar provides species Latin name, common name, current and proposed Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common	Distinct Population	ESA Status	Recent Review	Listing	Recovery	Critical

	Name	Segment		Year		Plan	Habitat
Physeter microcephalus	**Sperm whale**	**None**	**Endangered:** range-wide	2015	35 FR 18319	2010	None Designated

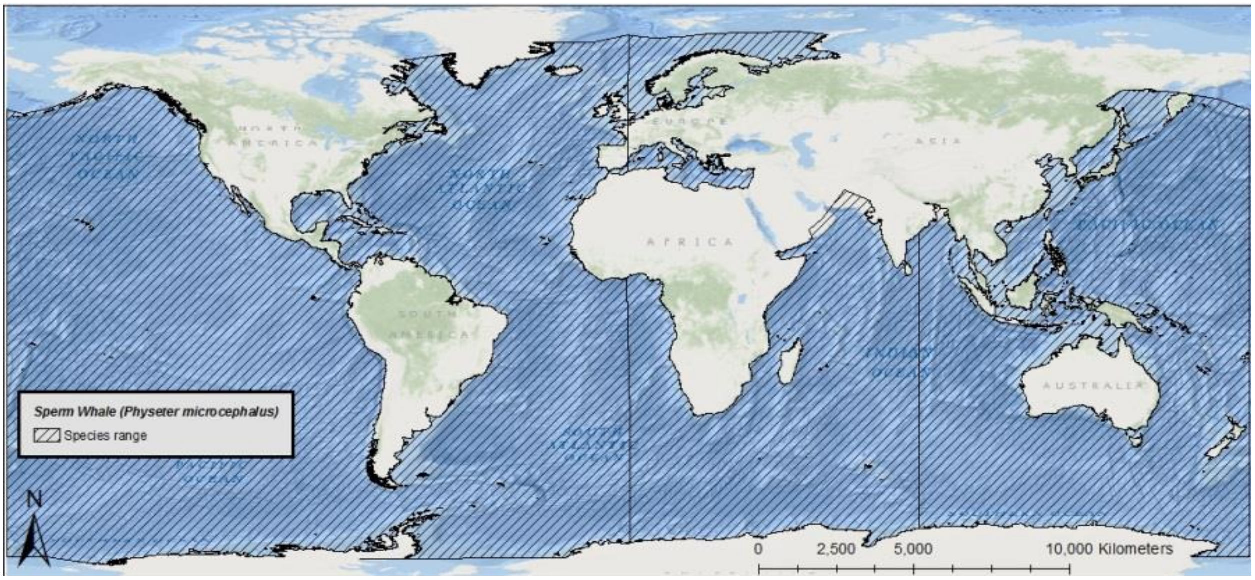

Figure 19: Map showing the range of the sperm whale.

Species Description

The sperm whale is a widely distributed toothed whale found in all major oceans. They are the largest toothed whale and distinguishable from other whales by an extremely large head, which takes up to 25 to 35 percent of their total body length, and a single blowhole asymmetrically situated on the left side of the head near the tip (Figure 20). The sperm whale was originally listed as endangered on December 2, 1970 (35 FR 18319). Information available from the recovery plan (NMFS 2010c), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016), and status review (NMFS 2015) were used to summarize the status of the species as follows.

Figure 20: Sperm whale (*Physeter microcephalus*). Photo: NOAA.

Life History

The average lifespan of sperm whales is estimated to be at least 50 years (Whitehead 2009). They have a gestation period of one to one and a half years, and calves nurse for approximately two years. Sexual maturity is reached between seven to 13 years of age for females with an average calving interval of four to six years. Male sperm whales reach full sexual maturity in their 20s. Sperm whales mostly inhabit areas with a water depth of 600 meters or more, and are uncommon in waters less than 300 meters deep. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed primarily on squid; other prey include octopus and demersal fish (including teleosts and elasmobranchs).

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the sperm whale.

Abundance

The sperm whale is the most abundant of the large whale species, with total abundance estimates between 200,000 and 1,500,000. The most recent estimate indicated a global population of between 300,000 and 450,000 individuals (Whitehead 2009). The higher estimates may be approaching population sizes prior to commercial whaling, the reason for ESA listing. There are six recognized stocks of sperm whales that exist in U.S. waters: California/Oregon/Washington (N=2,106, N_{min}=1,332), Hawaii (N=3,354; N_{min}=2,539), Northern Gulf of Mexico (N=763, N_{min}=560), North Pacific (no reliable estimate at this time), North Atlantic (N=2,288 [underestimate]; N_{min}=1,815), and Puerto Rico and the U.S. Virgin Islands (insufficient data).

Population Growth Rate

There is insufficient data to evaluate trends in abundance and growth rates of sperm whales at this time.

Genetic Diversity

Ocean-wide genetic studies indicate sperm whales have low genetic diversity, suggesting a recent bottleneck, but strong differentiation between matrilineally related groups (Lyrholm and Gyllensten 1998). Consistent with this, two studies of sperm whales in the Pacific indicate low genetic diversity (Mesnick et al. 2011; Rendell et al. 2012). Furthermore, sperm whales from the Gulf of Mexico, the western North Atlantic, the North Sea, and the Mediterranean Sea all have been shown to have low levels of genetic diversity (Engelhaupt et al. 2009). As none of the stocks for which data are available have high levels of genetic diversity, the species may be at some risk to inbreeding and 'Allee' effects, although the extent to which is currently unknown.

Distribution

Sperm whales have a global distribution and can be found in relatively deep waters in all ocean basins (Figure 19). While both males and females can be found in latitudes less than 40º, only adult males venture into the higher latitudes near the poles.

Status

The sperm whale is endangered as a result of past commercial whaling. Although the aggregate abundance worldwide is probably at least several hundred thousand individuals, the extent of depletion and degree of recovery of populations are uncertain. Commercial whaling is no longer allowed, but illegal hunting may occur at biologically unsustainable levels. Continued threats to sperm whale populations include ship strikes, entanglement in fishing gear, competition for resources due to overfishing, pollution, loss of prey and habitat due to climate change, and noise. The species' large population size indicates it is somewhat resilient to current threats.

Status of Species within the Action Area

Currently only one stock of sperm whales is recognized in the North Atlantic. Generally speaking, sperm whales within the area can be found on the continental shelf edge, over the continental slope, and into mid-ocean regions. More specifically, in winter, sperm whales are concentrated east and northeast of Cape Hatteras. In spring, the center of distribution shifts northward to east of Delaware and Virginia, and is widespread throughout the central portion of the mid-Atlantic bight and the southern portion of Georges Bank. In summer, the distribution is similar but now also includes the area east and north of Georges Bank and into the Northeast Channel region, as well as the continental shelf south of New England. In the fall, sperm whale occurrence south of New England on the continental shelf is at its highest level, and there remains a continental shelf edge occurrence in the mid-Atlantic bight (Waring et al. 2016).

Since sperm whales winter and breed at lower latitudes, the age classes likely to be found within the action area for Permit No. 19315 are adults, juveniles, and non-neonate calves. Given its greater southern extension, neonate calves may also be found in the action area for Permit No. 19674. However, as adult males migrate to polar latitudes to feed and move among populations to breed, they are less likely to be found within the action areas of either permit.

The current population estimate for the North Atlantic stock of sperm whales is estimated to be 2,288 individuals (N_{min}=1,815), but this is likely to be an underestimate. No data are available to estimate population trends or mortality and reproduction rates for this stock (Waring et al. 2016).

Critical Habitat

No critical habitat has been designated for the sperm whale.

Recovery Goals

See the 2010 Final Recovery Plan for the sperm whale for complete down listing/delisting criteria for both of the following recovery goals:

1. Achieve sufficient and viable populations in all ocean basins.
2. Ensure significant threats are addressed.

5 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

A number of human activities have contributed to the current status of populations of large whales in the action areas. Some of those activities, most notably commercial whaling, occurred extensively in the past, continue at low levels, and no longer appears to significantly affect these whale populations, although the effects of these reductions persist today. Other human activities are ongoing and appear to continue to affect whale populations in the action areas for this consultation. The following discussion summarizes these impacts, which include climate change, whaling, ship strikes, whale watching, sound, military activities, fisheries, pollution, and scientific research.

5.1 Climate Change

There is no question that our climate is changing. The globally-averaged combined land and ocean surface temperature data, as calculated by a linear trend, show a warming of approximately 0.85° Celsius over the period 1880 to 2012 (IPCC 2014). Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850 (IPCC 2014). Burning fossil fuels has increased atmospheric carbon dioxide concentrations by 35 percent with respect to pre-industrial levels, with consequent climatic disruptions that include a higher rate of global warming than occurred at the last global-scale state shift (the last glacial-interglacial transition, approximately 12,000 years ago) (Barnosky et al. 2012). Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90 percent of the energy accumulated between 1971 and 2010 (IPCC 2014). It is virtually certain that the upper ocean (zero to 700 meters) warmed from 1971 to 2010 and it likely warmed between the 1870s and 1971 (IPCC 2014). On a global scale, ocean warming is largest near the surface, and the upper 75 meters warmed by 0.11° Celsius per decade over the period 1971 to 2010 (IPCC 2014). There is high confidence, based on substantial evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Higher carbon dioxide concentrations have also caused the ocean rapidly to become more acidic, evident as a decrease in pH by 0.05 in the past two decades (Doney 2010).

This climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine ecosystems in the near future. It is most likely to have the most pronounced effects on species whose populations are already in tenuous positions (Isaac 2008). As such, we expect the extinction risk of ESA-listed species to rise with global warming. Primary effects of climate change on individual species include habitat loss or alteration, distribution changes, altered and/or reduced distribution and abundance of prey, changes in the abundance of competitors and/or predators, shifts in the timing of seasonal activities of species, and geographic isolation or extirpation of populations that are unable to adapt. Secondary effects include increased stress, disease susceptibility, and predation. Cetaceans with restricted distributions linked to water temperature may be particularly exposed to range restriction (Issac 2009; Learmonth et al. 2006). MacLeod (2009) estimated that, based on expected shifts in water temperature, the ranges of 88 percent of cetaceans would be affected, 47 percent would be negatively affected, and 21 percent would be put at risk of extinction. Bowhead whales were predicted to decrease their range as a result of warming temperatures, whereas North Atlantic right whales were predicted to shift their range northward. All other ESA-listed baleen whales in the action area except sei whales (humpback, fin, and blue whales) have fairly global, cosmopolitan distributions, and so were not predicted to significantly alter their ranges. However, even if ranges are not expected to shift, changes in the timing of migratory events such as the arrival at and departure from feeding grounds may still occur (e.g., humpback and fin whales) (Ramp et al. 2015). Since sperm whales are fairly widely distributed, their range was also predicted to be minimally affected, but it is possible females and juveniles may expand their ranges poleward. Finally, sei whales are expected to expand their ranges into higher latitudes.

In the western North Atlantic, surface temperatures have been unusually warm in recent years (Blunden and Arndt 2016). A study by (Polyakov et al. 2009), suggests that the North Atlantic overall has been experiencing a general warming trend over the last 80 years of 0.031 ± 0.006 ºCelsius per decade in the upper 2,000 meters of the ocean. These sea surface temperatures are closely related to the North Atlantic Oscillation, which results from variability in pressure differences between a low pressure system that lies over Iceland and a high pressure system that lies over the Azores Islands. The North Atlantic Oscillation Index, which is positive when both systems are strong and negative when both systems are weak, varies from year to year. In years when the North Atlantic Oscillation Index is positive, sea surface temperature generally increases, which is thought to produced favorable conditions for *C. finmarchicus*, the principal prey of North Atlantic right whales (Conversi et al. 2001). As a result, during these years North Atlantic right whale calving rates generally increase, although there may be some lag in timing

(Greene et al. 2003). In years when the index is negative, sea surface temperatures are generally lower, and as a result, so is the abundance of *C. finmarchicus* and consequently, North Atlantic right whale calving rates in subsequent years (Drinkwater et al. 2003; Greene et al. 2003; Pershing et al. 2010). In recent years, the oscillation has been mostly positive, leading to increases in copepod abundance and North Atlantic right whale calving rates (Meyer-Gutbrod and Greene 2014). However, climate change models suggest that increases in ocean temperature may produce more severe fluctuations in the North Atlantic Oscillation, which may cause dramatic shifts in the reproductive rate of North Atlantic right whales (Drinkwater et al. 2003; Greene et al. 2003). While the relationship between changes in sea surface temperature, prey, and the reproduction of other ESA-listed whales in the action area is unknown, it is likely that these species will be similarly affected by future climatic changes.

5.2 Whaling

It is not known how many whales were taken by aboriginal hunting and early commercial whaling, though some stocks were already reduced by 1864 (the beginning of the era of modern commercial whaling using harpoon guns as opposed to harpoons simply thrown by men). From 1864 to 1985, at least 2.4 million baleen whales (excluding minke whales) and sperm whales were killed (Gambell 1999). In 1982, the IWC issued a moratorium on commercial whaling beginning in 1985. There is currently no legal commercial whaling by IWC Member Nations party to the moratorium; however, whales are still killed commercially by countries that filed objections to the moratorium (Iceland and Norway). Since the moratorium on commercial whaling in 1985, 939 ESA-listed whales (388 sperm and 551 fin whales) have been documented as killed for commercial purposes (IWC 2016b). Additionally, the Japanese whaling fleet carries out whale hunts under the guise of "scientific research," though very few peer-reviewed papers have been published as a result of the program, and meat from the whales killed under the program is processed and sold at fish markets. Since 1985, 1,525 ESA-listed whales have been documented as killed for "scientific research" under these IWC special permits (310 fin, 56 sperm, and 1,249 sei whales) (IWC 2016c). Whales are also killed for subsistence purposes; since 1985, an estimated 1,948 ESA-listed whales (1,481 bowhead, 356 fin, 108 humpback, and three sei whales) have been killed for subsistence purposes (IWC 2016a).

While most current whaling activities occur outside of action areas, it is possible that the whales that are killed as part of these activities may be part of the population that inhabit the action areas for this consultation. Whaling for commercial purposes still occurs off the coast of Norway and Iceland in the Eastern North Atlantic, and while unlikely, it is possible some of these whales may be exposed to the research activities that would be authorized under Permit Nos. 19674 and 19315. Regardless, prior exploitation is likely to have altered population structure and social cohesion of all whale species within the action areas, such that effects on abundance and recruitment continued for years after harvesting has ceased.

5.3 Ship Strikes

Ship strikes are considered a serious and widespread threat to ESA-listed whales. This threat is increasing as commercial shipping lanes cross important breeding and feeding habitats and as whale populations recover and populate new areas or areas where they were previously extirpated (Swingle et al. 1993; Wiley et al. 1995). As ships continue to become faster and more widespread, an increase in ship interactions with cetaceans is to be expected. The vast majority of ship strike mortalities of cetaceans are likely undocumented, as most are likely never reported and most whales killed by ships strike likely end up sinking rather than washing up on shore. Kraus et al. (2005) estimated that 17 percent of ship strikes are actually detected. Of 11 cetacean species known to be threatened by ship strikes, fin whales are the mostly commonly struck species, but right, humpback, sperm, and gray whales are also hit (Laist et al. 2001; Vanderlaan and Taggart 2007). While any vessel has the potential to hit whales, in most cases, lethal or severe injuries are caused by ships 80 meters or greater, travelling 14 knots or faster (Laist et al. 2001). Based on this, in 2008 the NMFS has established regulations requiring all vessels 65 feet or longer to travel at 10 knots or less in several areas along the U.S. East Coast at certain times of the year to reduce the threat of ship collisions (78 FR 73726).

Vessel traffic within the North Atlantic can come from both private and federal ships (including military), but most traffic is the result of commercial shipping. The North Atlantic is one of the most traveled areas in the world for marine shipping. Between 2002 and 2015, over 163,098 port calls between Delaware and Port Canaveral were made (Table 12) (U.S. Maritime Administration 2016). As a result of the recent Panama Canal Expansion (June 2016), maritime traffic and the size of ships is expected to increase in the U.S. Atlantic. (U.S. Maritime Administration 2013).

Table 12: 2002-2015 Vessel calls at ports located between Delaware and Cape Canaveral, Florida.

Year	Calls of All Types	Tanker Calls	Container Calls	Dry Bulk Calls	Roll-On/Roll-Off Calls	Gas Carrier Calls	General Cargo Calls
2002	9,989	1,085	4,815	1,351	1,920	24	794
2003	9,576	1,104	4,529	1,279	1,901	46	717
2004	10,840	1,217	5,251	1,582	1,922	74	794
2005	11,230	1,366	5,402	1,601	2,083	71	707
2006	12166	1,433	5,891	1,796	2,268	72	706
2007	12062	1,428	6,236	1,453	2,240	37	668
2008	11,809	1,405	5,791	1,569	2,391	77	576
2009	10,776	1,156	5,745	1189	2,098	60	528
2010	13,240	1,257	6,917	1,592	2,777	41	656
2011	13,553	1,242	6,757	2,118	2,681	36	719
2012	12,492	921	6,360	1,743	2,769	27	672
2013	11,416	787	5,687	1,495	2,391	10	1,046
2014	12,090	912	5,921	1,616	2,559	10	1,072
2015	11,859	915	5,737	1,420	2,683	26	1,078
2002 to 2015 Totals							
	163,098	16,228	81,039	21,804	32,683	611	10,733

The effects of ship strikes are particularly profound on species with low abundance, such as North Atlantic right whales. However, all ESA-listed species within the action area have the potential to be affected by ship strikes. The latest mortalities and serious injuries related to ship strikes for the stock of each species most likely to be found in the action area are given in Table 13 below. At this time, we could not find recent data on ship strikes specific to the Cape Verde/Northwest Africa DPS of humpback whales nor bowhead whales in within the action areas.

Table 13: Mortalities and serious injuries related to ship strikes for Endangered Species Act listed whale species within the action area (Henry et al. 2016; Waring et al. 2016)

Species	Date Range	Ship Strikes	Annual Average
North Atlantic right whale	2010 to 2014	6	1.2
Fin whales	2010 to 2014	16	3.2
Sei whales	2010 to 2014	4	0.8
Blue whale	2010 to 2014	0	0
Sperm whales	2008 to 2012	1	0.2

5.4 Whale Watching

Whale watching is a rapidly-growing business with more than 3,300 operators worldwide, serving 13 million participants in 119 countries and territories (O'Connor et al. 2009). Although considered by many to be a non-consumptive use of cetaceans with economic, recreational, educational and scientific benefits, whale watching has the potential impact whales in a variety of whales (Reviewed in Parsons 2012). In some cases, whale watching vessels have a high frequency of collision with whales (Parsons 2012). Whale watching vessels can also contribute to underwater noise that may affect whales (Parsons 2012). Harassment from whale watching vessels has been known to cause whales to alter surfacing, acoustic, and swimming behavior and can lead to changes in direction, group size, and coordination (Parsons 2012). In addition, preferred habitats may be abandoned if disturbance levels are too high (Parsons 2012). The particular response observed appears to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity. While numerous short-term behavioral responses to whale watching vessels are well documented, much less is known about long-term negative effects. However, in a recent study of humpback whales off the coast of New England, Weinrich and Corbelli (2009) found no detectable impacts on calf production or survival. Nonetheless, as longitudinal research on these species continues, including that conducted by the applicants for Permit Nos. 19674 and 19315, we will soon have a better understanding of the population-level, long-term impacts of whale watching.

With the high density of whales found in the action areas, specifically the smaller action area of Permit 19315, there are numerous whale watching operations that may impact the ESA-listed species within the action area (Wiley et al. 2008). While a voluntary conservation program aimed at protecting ESA-listed whales from the impacts of whale watching was implemented in the northeastern U.S. in 1998, there is little compliance with the program, indicating that whales in this region are almost certainly subject to many of the threats that can result from whale watching (Wiley et al. 2008).

5.5 Sound

Cetaceans generate and rely on sound to navigate, hunt, and communicate with other individuals and anthropogenic sound can interfere with these important activities (Nowacek et al. 2007). Anthropogenic sound in the action area is generated by commercial and recreational vessels, sonar, aircraft, military activity (discussed in Section 5.6), seismic exploration, in-water construction activities, wind farms, and other human activities. These activities occur to varying degrees throughout the year and may lead to behavioral disturbance or even physical damage, both of which have the potential to negatively impact fitness. Behavioral disturbances may include changes in surfacing, diving, orientation, and vocalizations (Nowacek et al. 2007). Physiological responses can include stress related changes such as increases in heart rate, respiratory rates, stress hormones, and temporary or permanent hearing threshold shifts (Kunc et al. 2016; Nowacek et al. 2007).

Commercial shipping traffic is a major source of low frequency anthropogenic sound in the action areas (NRC 2003) (Section 5.3). Large vessels emit predominantly low frequency sound which overlaps with many mysticetes predicted hearing ranges [7 Hertz (Hz) to 35 kHz, (NOAA 2016)] and may mask their vocalizations and cause stress (Rolland et al. 2012). Studies also report broadband sound from large cargo ships above two kHz that may interfere with important biological functions of odontocetes (Holt 2008). Other commercial vessels (e.g., whale watching, fisheries, etc.) and recreational vessels also operate within the action area and may produce similar sounds, although to a lesser extent given their much smaller size. Nonetheless, even sound from small whale watching vessels can cause auditory masking, behavioral responses, and temporary threshold shifts in cetaceans (Nowacek et al. 2007). Anthropogenic sound from vessel traffic may be particularly prevalent in shallower waters (13 to 19 meters, Figure 21), which are preferred by North Atlantic right whales during calving in the southeast portion of the action area of Permit No. 19674 (Keller et al. 2006). At greater foraging depths less but still substantial vessel traffic sound can be heard (Figure 22).

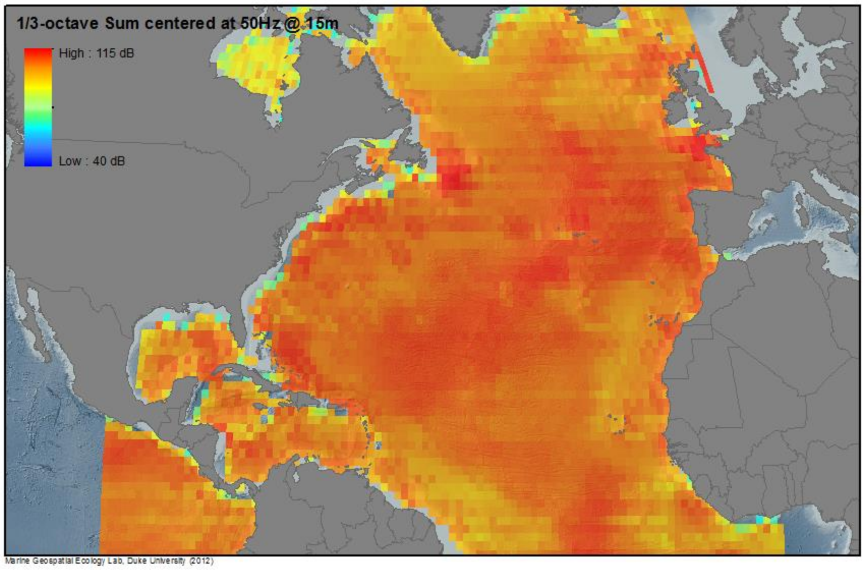

Figure 21: Vessel traffic sound at 50 Hertz at 15 meters depth within the action area. Data from http://cetsound.noaa.gov/

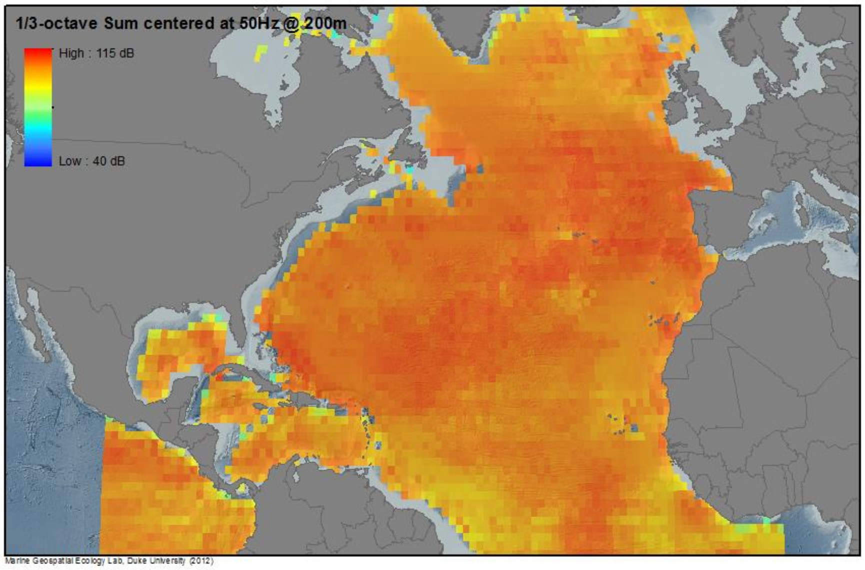

Figure 22: Vessel traffic sound at 50 Hertz at 200 meters depth within the action area. Data from http://cetsound.noaa.gov/

Sonar systems are used on recreational, commercial, and military vessels and may also affect marine mammals (NRC 2003). Although little information is available on potential effects of multiple commercial and recreational sonars to marine mammals, the distribution of these sounds would be small because of their short durations and the fact that the high frequencies of the signals attenuate quickly in seawater (Nowacek et al. 2007). However, military sonar, particularly low frequency active sonar, often produces intense sounds at high source levels, and these are known to impact whale vocalizations (Nowacek et al. 2007).

Aircraft within the action area may consist of small commercial or recreation airplanes or helicopters, to large commercial airliners. These aircraft produce a variety of sounds that could potentially enter the water and impact cetaceans. While it is difficult to assess these impacts, several studies have documented what appear to be minor behavioral disturbances in response to aircraft presence (Nowacek et al. 2007).

While there is currently a ban on drilling for oil in gas in federal waters off the Atlantic coast through 2022 (80 FR 4941), exploration for oil and gas reserves in the area are not prohibited. The primary method that would be used to locate oil and gas deposits is seismic surveys using towed airguns. Airguns generate intense low-frequency sound pressure waves capable of penetrating the seafloor and are fired repetitively at intervals of 10 to 20 seconds for extended periods (NRC 2003). Most of the energy from the guns is directed vertically downward, but significant sound emission also extends horizontally. Peak sound pressure levels from airguns usually reach 235 to 240 decibels (dB) at dominant frequencies of five to 300 Hz (NRC 2003). Most of the sound energy is at frequencies below 500 Hz, which is within the hearing range of the ESA-listed cetaceans within the action area, particularly baleen whales (Nowacek et al. 2007). Although there is no ongoing seismic exploration for oil and gas in the North Atlantic, seismic surveys for scientific research purposes and/or to locate fault structure and other geological hazards have and do occur here. In the United States, all seismic surveys for oil and gas exploration and most research activities involving the use of airguns with the potential to take marine mammals are covered by incidental harassment authorizations under the MMPA.

Marine construction in the action area that produces sound includes drilling, dredging, pile driving, cable laying, and explosions. These activities are known to cause behavioral disturbance and physical damage. While most of these activities are coastal, offshore construction does occur and is often associated with wind farms. Currently there are no offshore windfarms operations off the east coast of the U.S. but that will likely change in the near future (DOE and DOI 2016). Two offshore wind energy projects are already under construction and several more have already been approved. In fact, the Block Island wind farm located in Rhode Island is expected to be operational before the end of 2016. While the full extent of impacts from wind farms is unknown, there are likely much greater impacts during construction than during operation (Madsen et al. 2006).

5.6 Military Activities

The U.S. Navy conducts military readiness activities within the action area (Atlantic Fleet Training and Testing [AFTT], Figure 23), which can be categorized as either training or testing exercises. During training, existing and established weapon systems and tactics are used in realistic situations to simulate and prepare for combat. Activities include: routine gunnery, missile, surface fire support, amphibious assault and landing, bombing, sinking, torpedo, tracking, and mine exercises. Testing activities are conducted for different purposes and include at-sea research, development, evaluation, and experimentation. The U.S. Navy performs testing activities to ensure that its military forces have the latest technologies and techniques available to them.

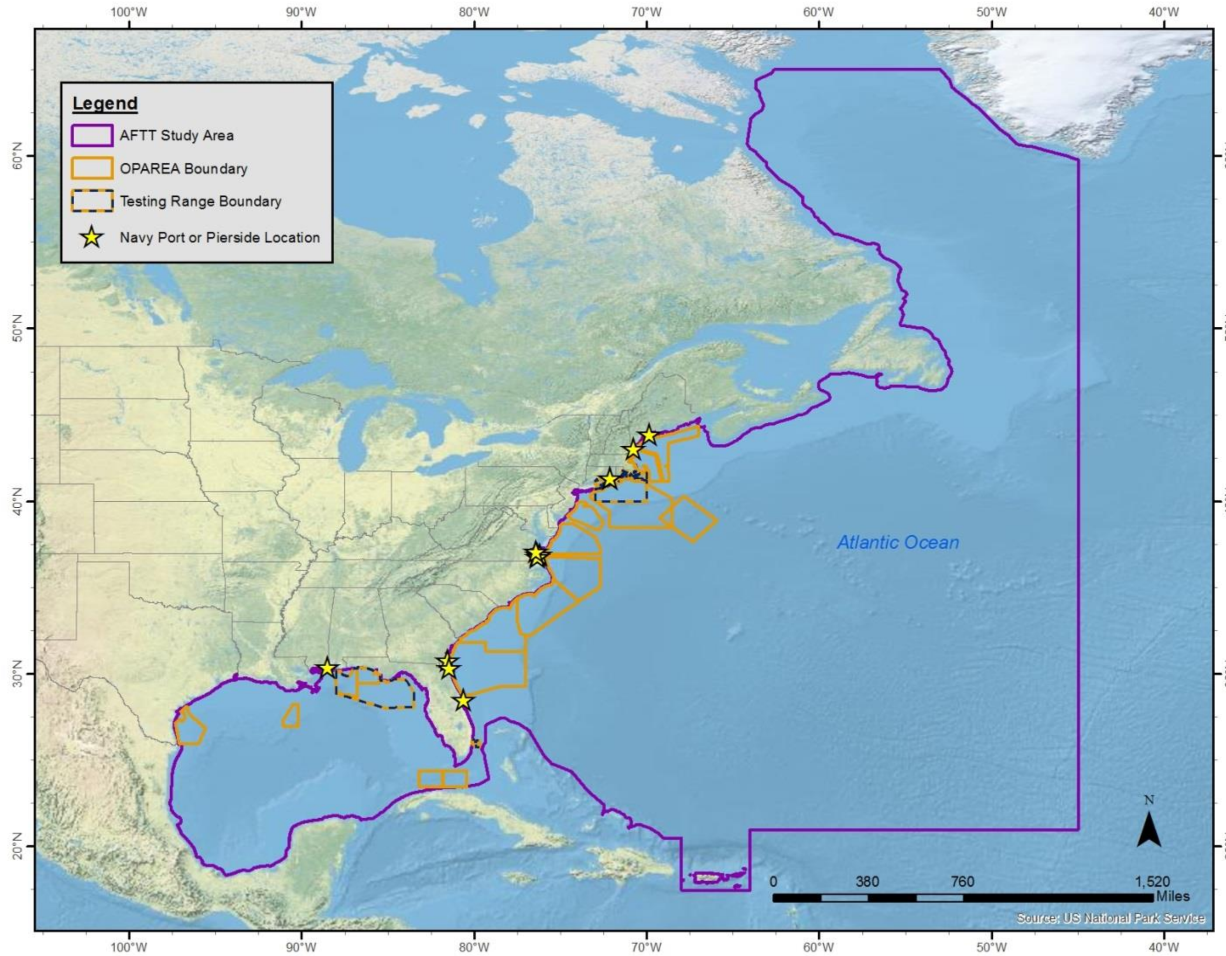

Figure 23: Navy Atlantic fleet training and testing area. OPAREA stands for at-sea Operating Area and is where training exercise and system qualification tests are routinely conducted.

U.S. Navy activities are likely to produce sound and visual disturbance to cetaceans and may result in ship strikes (NMFS 2013). Take of ESA-listed species for these Navy activities that has been authorized and previously consulted on within the action area can be seen in Table 14 (NMFS 2013). Takes are listed according to the level of harassment as defined by the MMPA. Level A harassment has the potential to injure a marine mammal or marine mammal stock in the wild, whereas level B harassment has the potential to disturbed a marine mammal by causing disruption of behavioral patterns including but not limited to migration, breathing, nursing, feeding, or sheltering but does not have the potential to injure a marine mammal or marine mammal stock in the wild. Even though our previous biological opinion considering the effects of Navy activities within the action area resulted in an incidental take statement, we concluded that the Navy's actions were not likely to jeopardize the continued existence of ESA-listed species, nor adversely modify designated critical habitat.

Table 14: Authorized annual take for Navy Atlantic fleet training and testing area.

Species	Level A Harassment	Level B Harassment
Blue whales	0	165
Fin whales	1	5,089
Humpback whales	1	1,843
North Atlantic right whales	0	199
Sei whales	1	10,984

5.7 Fisheries

Entrapment and entanglement in fishing gear is a frequently documented source of human-caused mortality in marine mammals (see Dietrich et al. 2007). Materials entangled tightly around a body part may cut into tissues, enable infection, and severely compromise an individual’s health (Derraik 2002). Entanglements also make animals more vulnerable to additional threats (e.g., predation and ship strikes) by restricting agility and swimming speed. The majority of cetaceans that die from entanglement in fishing gear likely sink at sea rather than strand ashore, making it difficult to accurately determine the extent of such mortalities. Cetaceans are also known to ingest fishing gear, likely mistaking it for prey, which can lead to fitness consequences and mortality. Necropsies of stranded whales have found that ingestion of net pieces, ropes, and other fishing debris has resulted in gastric impaction and ultimately death (Jacobsen et al. 2010).

As with ship strikes, entanglement or entrapment in fishing gear likely has the greatest impact on populations of ESA-listed cetaceans with the lowest abundance. In fact, given the current regulations limiting vessel speeds, interactions with fisheries may be one of the most significant threats still facing North Atlantic right whales (Kraus et al. 2016). Nevertheless, all species of cetacean may face threats from derelict fishing gear. The latest mortalities and serious injuries related to fishing gear entanglement for the stock of each species most likely to be found in the action area are given in Table 15 below.

Table 15: Mortalities and serious injuries related to fishing gear entanglements for Endangered Species Act listed whale species within the action area (Henry et al. 2016; Waring et al. 2016)

Species	Date Range	Entanglements	Annual Average
North Atlantic right whale	2010 to 2014	24	4.8
Fin whales	2010 to 2014	10	2
Sei whales	2010 to 2014	0	0
Blue whale	2010 to 2014	0	0
Sperm whales	2008 to 2012	3	0.6

In addition to these direct impacts, cetaceans may also subject to indirect impacts from fisheries. Many cetacean species (particularly fin and humpback whales) are known to feed on species of fish that are harvested by humans (Waring et al. 2016). Thus, competition with humans for prey is a potential concern. Reductions in fish populations, whether natural or human-caused, may affect the survival and recovery of ESA-listed populations. North Atlantic right whales feed almost exclusively on copepods and therefore are not in direct competition with human fishing operations, although their food supply may still be indirectly affected by fishing activities.

5.8 Pollution

Contaminants cause adverse health effects in cetaceans. Contaminants may be introduced by rivers, coastal runoff, wind, ocean dumping, dumping of raw sewage by boats and various industrial activities, including offshore oil and gas or mineral exploitation (Garrett 2004; Grant and Ross 2002; Hartwell 2004). The accumulation of persistent organic pollutants, including polychlorinated-biphenyls, dibenzo-p-dioxins, dibenzofurans and related compounds, through trophic transfer may cause mortality and sub-lethal effects in long-lived higher trophic level animals such as marine mammals (Waring et al. 2016), including immune system abnormalities, endocrine disruption, and reproductive effects (Krahn et al. 2007). Persistent organic pollutants may also facilitate disease emergence and lead to the creation of susceptible “reservoirs” for new pathogens in contaminated marine mammal populations (Ross 2002). Recent efforts have led to improvements in regional water quality and monitored pesticide levels have declined, although the more persistent chemicals are still detected and are expected to endure for years (Law 2014)

Exposure to hydrocarbons released into the environment via oil spills and other discharges pose risks to marine species. Cetaceans are generally able to metabolize and excrete limited amounts of hydrocarbons, but exposure to large amounts of hydrocarbons and chronic exposure over time pose greater risks (Grant and Ross 2002). Cetaceans have a thickened epidermis that greatly reduces the likelihood of petroleum toxicity from skin contact with oils (Geraci 1990), but they may inhale these compounds at the water’s surface and ingest them while feeding (Matkin and Saulitis 1997). Hydrocarbons also have the potential to impact prey populations, and therefore may affect ESA-listed species indirectly by reducing food availability.

Cetaceans are also impacted by marine debris, which includes: plastics, glass, metal, polystyrene foam, rubber, and derelict fishing gear (Baulch and Perry 2014; Li et al. 2016). Marine debris is introduced into the marine environment through ocean dumping, littering, or hydrologic transport of these materials from land-based sources. Even natural phenomena, such as tsunamis and continental flooding, can cause large amounts of debris to enter the ocean environment. Cetaceans often become entangled in marine debris (Johnson et al. 2005). The ingestion of marine debris has been documented to result in blockage or obstruction of the digestive tract, mouth, and stomach lining of various species and can lead to serious internal injury or mortality (Derraik 2002). In addition to interference with alimentary processes, plastics lodged in the alimentary tract could facilitate the transfer of pollutants into the bodies of whales and dolphins (Derraik 2002).

Aquatic nuisance species are aquatic and terrestrial organisms, introduced into new habitats throughout the United States and other areas of the world, that produce harmful impacts on aquatic ecosystems and native species (http://www.anstaskforce.gov). They are also referred to as invasive, alien, or nonindigenous species. Introduction of these species is cited as a major threat to biodiversity, second only to habitat loss (Wilcove et al. 1998). They have been implicated in the endangerment of 48 percent of ESA-listed species (Czech and Krausman 1997).

5.9 Scientific Research

Scientific research similar to that which would be conducted under Permit Nos. 19674 and 19315 has and will continue to impact ESA-listed cetaceans within the action are. The primary objective of these studies is generally to monitor populations or gather data for behavioral and ecological studies. These activities may directly or incidentally result in harassment, stress, and injury. Annual takes of ESA-listed species resulting from research activities that are currently permitted by the NMFS within the action can be seen in Table 16 (Permit Nos. 13927, 14118, 14233, 14245, 14450, 14603, 14809, 14856, 15488, 15575, 15682, 16109, 16325, 16388, 16473, 17312, 17355, 18786, 19091). The table is broken down based on the nature of the take and when applicable, in a matter that matches the description of research activities in Section 2. No mortalities are authorized for any animal of any age and no mortalities have been reported from the permits currently active in the action area. It is important to note that the research activities that would be conducted under Permit Nos. 19674 and 19315 would be in addition to those listed in Table 16. Many individuals would be subject to more than one activity within in a given year, and in some cases could also be subject to the same activity multiple times within a single year. All of these permits have undergone ESA section 7 consultation and for each permit we concluded that the permits and research was not likely to jeopardize the continued existence of ESA-listed species, nor adversely modify designated critical habitat.

Table 16: Currently authorized scientific research takes of Endangered Species Act listed cetaceans in the action areas.

Take Activity	Blue whale	Bowhead whale	Fin whale	Humpback whale[1]	North Atlantic right whale	Sei whale	Sperm whale
Aerial surveys	1710	3290	13840	19285	7895	4255	8890
Vessel Survey	3230	4710	15700	23985	9495	4570	10805
Photography and Videography	2275	3440	14975	25285	13545	5115	10325
Biopsy Sampling	455	340	1225	2750	395	650	1760
Sloughed Skin Sampling	895	1690	6725	11825	2375	1930	2605
Exhaled Breadth Sampling	270	1540	6130	9325	1645	1335	1745
Fecal Sampling	855	1650	1665	5210	6230	1870	1455
Passive Acoustic Recording	970	3110	3200	7250	6990	3085	6815
Import and Export of Parts	575	1800	1505	4830	1730	1730	1175

[1] Humpback whale takes would mostly likely be of the West Indies DPS, which is not listed under the ESA. Very few takes, if any, would be of the Cape Verde/Northwest Africa DPS.

Take Activity	Blue whale	Bowhead whale	Fin whale	Humpback whale[1]	North Atlantic right whale	Sei whale	Sperm whale
Prey Mapping and Sampling	0	0	0	0	370	0	0
Suction-cup Tagging	400	370	625	950	675	550	635
Implantable Tagging	105	280	330	380	110	255	325
Ultrasound	40	40	40	190	45	40	40
Acoustic Playback	40	40	40	90	45	40	90
Auditory Brainstem Response Test	40	40	40	40	45	40	40
Total Takes	11860	22340	66040	111395	51590	25465	46705

Table 16 represents substantial research effort relative to species abundance in the action area with repeated disturbances of individuals likely to occur each year. However, all permits contain conditions requiring the permit holders to coordinate their activities with the NMFS regional offices and other permit holders and, to the extent possible, share data to avoid unnecessary duplication of research. In addition, some values represent permitted research activities occurring over the entire range of the species or in areas extending further than the limits of the action area considered in this Opinion. Nevertheless, these numbers represent a worst-case scenario for the targeted species in the action area.

As detailed further below in our response analysis, whales may respond to these research activities in a variety of ways including no obvious response, minor behavioral disturbances, avoidance and stress related response, temporarily abandoning important behaviors such as feeding and breeding, and in rare cases whales may become injured, infected, and possibly even die when biological samples are taken or implantable tags are used (NMFS 2016a). The fact that multiple permitted "takes" of ESA-listed cetaceans is already permitted in the action areas and is expected to continue to be permitted in the future means that research has the ability to contribute to or even exacerbate the stress response to marine mammals generated from other threats occurring in the action area.

6 Effects of the Action

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

As was stated in Section 3, this biological opinion includes both a jeopardy analysis and an adverse modification analysis.

The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

The adverse modification analysis considers the impacts on the conservation value of designated critical habitat. This opinion relies on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR §402.02: a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of an ESA-listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features.

In this section, we describe the potential stressors associated with the proposed actions, the probability of individuals of ESA-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 Section 3, for any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, or lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the ESA-listed species those populations represent. For this consultation, we are particularly concerned about behavioral and stress-based physiological disruptions and potential unintentional mortality that may result in animals that fail to feed, reproduce, or survive because these responses are likely to have population-level consequences. The purpose of this assessment and, ultimately, of this opinion is to determine if it is reasonable to expect the proposed action to have effects on ESA-listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.

6.1 Stressors Associated with the Proposed Action

Stressors are any physical, chemical, or biological entity that may induce an adverse response either in an ESA-listed species or their designated critical habitat. The issuance of Permit Nos. 19674 and 19315 would authorize several research activities that may expose North Atlantic right, bowhead, blue, fin, humpback, sei, and sperm whales to a variety of stressors. Each research activity presents a unique set of stressors, as further detailed below.

Aerial surveys would expose whales to aircraft noise and visual disturbance depending on the aircraft altitude. Vessel surveys would present a range of stressors including vessel traffic, discharge, noise, and visual disturbance. Photography and videography would occur during both aerial and vessel surveys, but during neither would it present any additional stressors other than those associated with the surveys themselves. The remainder of the research activities would occur during vessel surveys and so include the previously mentioned stressors associated with vessel surveys, but also present other stressors unique to the particular activity. Sloughed skin sampling, exhaled breadth sampling, fecal sampling, passive acoustic sampling, and prey mapping and sampling present the additional stressor of the potential for interaction with scientific equipment. On top of this, prey mapping and sampling would present the stressors of noise from fish finders and a reduction in prey resource from prey sampling, while suction-cup tagging would present the additional stressors of the application and continued attachment of suction-cup tags, as well as noise from the tag's VHF transmissions. Biopsy sampling would present the unique stressor of tissue collection. The import and export of parts is not expected to present any additional stressors other than those associated with the original sample collection and so we do not consider it further in this opinion.

6.2 Mitigation to Minimize or Avoid Exposure

Several aspects of the proposed action are designed to minimize ESA-listed species' exposure to the potential stressors associated with the proposed research activities. These include the experience and measures taken by the researchers themselves and the terms and conditions specified in the permits, as proposed by the Permits Division.

6.2.1 Permit No. 19674

The applicant for Permit No. 19674, Dr. Scott Kraus, has over 35 years of experience conducting research on North Atlantic right whales within the action area in all areas described in the permit application and beyond. He has held numerous scientific researcher permits under the Permits Division, and as noted in Section 1.1, his research has previously undergone section 7 consultation several times, all resulting in biological opinions concluding that his research was not likely to jeopardize the continued existence of ESA-listed species, nor adversely modify designated critical habitat. He has regularly improved his research methods (and the field's more broadly) in order to minimize impacts on cetaceans. The exhaled breadth sampling as proposed hear is a prime example of this (Hunt et al. 2014). He has also been a major proponent for North Atlantic right whale conservation and recovery (e.g., Kraus et al. 2016). As a member of the Atlantic Large Whale Disentanglement Network, his efforts regularly document and respond to fishing gear entanglement to help free North Atlantic right whales, among other species (Knowlton et al. 2016). Given his experience and motivation, we anticipate Dr. Kraus will take all possible measures available to minimize or avoid exposing ESA-listed species to the stressor associated with his research. In addition, in his permit application he outlines the following mitigation measures designed to minimize exposure to ESA-listed species:

"For both shipboard photographic approaches and for biopsy approaches (these are done at the same time), boat speeds are constant and as slow as possible, and vessel encounter trajectories are from the side and are slowly convergent. These methods habituate the whale to the immediate presence of the vessel, and cause minimal (if any) alteration of behavior. For biopsy activities our approach to minimizing effects is to minimize the number of samples needed. We identify individual whales before darting, cross reference the identity to determine if a whale has been darted, and minimize or eliminate repeat dartings of each known whale. When animals are darted, we usually divide a single sample several times for multiple studies, further minimizing the need for frequent biopsy sampling. Biopsy darts are only used once per day on a single animal to minimize any chance of infection or contamination. Used biopsy tips are returned to the field station each day, washed and dis-infected in a 30 second bath of 5.25 percent sodium hypochlorite. At the end of each field season, all biopsy tips are steam autoclaved.

For blow and fecal sampling, approaches are made consistent with the photo-id approaches, minimal time to get a respiration sample is used, and attempts are limited to three respiration sequences. Further, duplicate sampling is eliminated where possible by field identifications of individuals. For both aerial and shipboard research, we make an effort to coordinate activities on a daily basis with any other research team in the study area. Because the New England Aquarium research team curates and manages the North Atlantic right whale catalog, we are the recipients of updated photographic data on biopsied animals. Real time identifications allow in-field coordination between all research teams to avoid duplicate sampling, and all researchers are collaborative in exchanging contact info whenever they will be working in proximity to one another. The right whale research community is a small one, and all scientists know each other. Coordination of efforts in other habitats is done by email and phone as right whales move through the different habitats."

In addition to these mitigation measures taken by the applicant himself, the Permits Division proposed to include the following mitigation measures as part of the terms and conditions of the permit:

1) Researchers must immediately stop permitted activities and the Permit Holder must contact the Chief of the Permits Division for written permission to resume if:
    a. Serious injury or mortality of protected species occurs.
    b. Authorized take is exceeded in any of the following ways:
        i. More animals are taken than allowed in take table.[2]
        ii. Animals are taken in a manner not authorized by this permit.
        iii. Protected species other than those authorized by this permit are taken.
2) Researchers may approach an animal up to three times in one day.
3) To minimize disturbance of the subject animals the Researchers 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.
4) Where females with calves are authorized to be taken, Researchers:
    a. Must immediately terminate efforts if there is any evidence that the activity may be interfering with pair-bonding or other vital functions;
    b. Must not position the research vessel between the mother and calf;
    c. Must approach mothers and calves gradually to minimize or avoid any startle response;

[2] Animals = the maximum number of animals, not necessarily individuals, that may be targeted for research annually for the suite of procedures in each row of the take table.

   d. Must discontinue an approach if a calf is actively nursing; and
   e. Must, if possible, sample the calf first to minimize the mother's reaction when sampling mother/calf pairs.

5) During biopsy and blow sampling:
   a. Researchers may attempt (deploy or discharge/fire) each procedure (biopsy, breath sample) on an animal three times a day.
   b. All biopsy tips must be disinfected prior to each use.
   c. Researchers may biopsy sample non-neonate calves and females accompanied by these calves.
   d. Before attempting to biopsy or blow sample an individual, Researchers must take reasonable measures (e.g., compare photo-identifications) to avoid unintentional repeated sampling of any individual.
   e. An attempt must be discontinued if an animal exhibits repetitive, strong, adverse reactions to the activity or the vessel.
   f. Researchers must not attempt to biopsy a cetacean anywhere forward of the pectoral fin.

The Permits Division would require individuals conducting the research activities to possess qualifications commensurate with their roles and responsibilities. In accordance, the only personnel authorized to conduct the research would be Dr. Kraus, listed Co-Investigators, and research assistants. We anticipate that requiring that the research be conducted by experienced personnel will further minimize impacts to the ESA-listed cetaceans that may be exposed to the stressors, as these individuals should be able to recognize adverse responses and cease or modify their research activities accordingly.

6.2.2 Permit No. 19315

The applicant for Permit No. 19315, the Center for Coastal Studies, also has extensive experience conducting research on North Atlantic right whales within the action area. In fact, the research project for which this permit is being applied began in 1984 and has continued ever since. Like the applicant for Permit No. 19674, the Center for Costal Studies has held numerous scientific researcher permits under the Permits Division, and all previous section 7 consultations resulted in biological opinions concluding that the research was not likely to jeopardize the continued existence of ESA-listed species, nor adversely modify designated critical habitat. Dr. Charles Mayo, who would be the primary researcher under Permit No. 19315, has over 30 years of experience in the research methods described in the proposed action (Section 2.2) and as a result, knows right whale behavior intimately, including how to recognize adverse responses, allowing him to minimize the impact his research has on the species. Furthermore, his research program focuses on understanding North Atlantic right whale foraging ecology in effort to mitigate two major threats to the species: ship strikes and entanglement. By providing an understanding of when and where right whales forage deep, where they may potentially interact with fishing gear, or near the surface, where they may be exposed to ship strikes, his work aims to provide managers with the knowledge and tools necessary to reduce these threats. The Center for Coastal Studies is also a central member of the Atlantic Large Whale Disentanglement Network, providing documentation and response to large whales entangled in fishing gear, and is one of few members on the water to provide coverage during winter months.Given their experience and motivation, we expect the Center for Coastal studies to take all measures possible to limit the exposure of ESA-listed species to the stressors associated with their research activities. In addition, in their permit application they outline the following mitigation measures designed to minimize exposure to ESA-listed species:

“The negative effects that will likely be associated with the activities being requested is the short-term behavioral disruption that occurs during a fraction of approaches to right whales for photo-identification or sampling purposes. While this occurs infrequently, we will take the following measures to avoid disturbance:

- Active vessel approaches at less than four knots to individual right whales for photo-ID will be limited to the minimal number possible of surface sequences possible for sufficient sampling per cruise. A surface sequence is delineated as the time between rising to the surface after a long-duration dive and the next long duration dive; long duration dives are often but not always indicated by "fluking" behavior.
- When plankton sampling in the vicinity of the whales, we will not approach whales after entering areas where they are present, but instead sample in their vicinity, by active approach not closer than 50 meters
- Should a suction-cup tagging project be developed, tagging attempts will be limited to three surfacing sequences of an individual whale. Using individual ID photographs of tagging, no whale will be tagged more than once in a day and the total number of tagging efforts directed at any individual per year will be limited to 3. Approach speeds will be at less than four knots.
- Aerial photographs will be limited to altitudes of 750 feet and circling time over right whales will be limited to the minimum time necessary to obtain photographs of sufficient quality for identification purposes.

Criteria to determine if disturbance has occurred may include but are not limited to: evasive behavior, cessation of feeding, significant increase in dive times, and high energy behavior (e.g. breaching or lob tailing). If an animal exhibits evidence of such significant disturbance, the approach will be terminated and no further attempts to approach will be made during that day.

While the co-investigators listed may undertake listed studies independent of the principal investigator, but under his guidance, they will be expected to adhere to the same measures as described here, as with all other aspects of the permit.”

In addition to these mitigation measures taken by the applicant himself, the Permits Division proposed to include the following mitigation measures as part of the terms and conditions of the permit:

1) Researchers must immediately stop permitted activities and the Permit Holder must contact the Chief of the Permits Division for written permission to resume if:
    a. Serious injury or mortality of protected species occurs.
    b. Authorized take is exceeded in any of the following ways:
        i. More animals are taken than allowed in take table.[3]
        ii. Animals are taken in a manner not authorized by this permit.
        iii. Protected species other than those authorized by this permit are taken.
2) Researchers may approach an animal by vessel up to three times in one day.
3) To minimize disturbance of the subject animals the Researchers 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.
4) Where females with calves are authorized to be taken, Researchers:
    a. Must immediately terminate efforts if there is any evidence that the activity may be interfering with pair-bonding or other vital functions;
    b. Must not position the research vessel between the mother and calf;
    c. Must approach mothers and calves gradually to minimize or avoid any startle response; and
    d. Must discontinue an approach if a calf is actively nursing.
5) Aerial surveys must be flown at an altitude of 750 feet or higher.
6) During suction-cup tagging:
    a. Researchers may attempt (by deploying gear) tagging an animal three times a day.
    b. Only adults and juvenile right whales may be tagged, excluding females with calves.
    c. Before attempting to tag an individual, Researchers must take reasonable measures (e.g., compare photo-identifications) to avoid unintentional repeated tagging of any individual.
    d. A tag attachment attempt must be discontinued if an animal exhibits repetitive, strong, adverse reactions to the activity or the vessel.
    e. Researchers must not attempt to tag a cetacean anywhere forward of the pectoral fin.

As with the previously discussed permit, the Permits Division would require individuals conducting the research activities under Permit No. 19315 to possess qualifications commensurate with their roles and responsibilities. In accordance, the only personnel authorized to conduct the research would be Dr. Charles Mayo, other researchers from the Center for Costal Studies, listed Co-Investigators, and research assistants. As before, we anticipate that requiring that the research be conducted by experienced personnel will further minimize impacts to the

[3] Animals = the maximum number of animals, not necessarily individuals, that may be targeted for research annually for the suite of procedures in each row of the table.

ESA-listed cetaceans that may be exposed to the stressors, as these individuals should be able to recognize adverse responses and cease or modify their research activities accordingly.

6.3 Exposure Analysis

In this section we quantify the likely exposure of ESA-listed species to the activities and associated stressors that may result from the proposed action (Section 6.1). Given that all of the proposed research activities take place either during aerial or vessel surveys, we first estimate exposure to close approaches by either aerial or vessel survey. For Permit No. 19674, the altitude of the aerial surveys is such that no take would occur and no historic take during aerial surveys at this altitude has been reported by Dr. Kraus. Furthermore, in his 30 plus years of research, Dr. Kraus has never observed whales respond to aerial surveys at this altitude (NMFS 2010f; NMFS 2016b). Thus, we deem effects from these aerial surveys extremely unlikely to occur and thus discountable, and so we do not estimate exposure to aerial surveys for Permit No. 19674.

Since during any given aerial or vessel survey researchers would be permitted to attempt a variety of research activities including photography and videography, sloughed skin, exhaled breadth, and fecal sampling, passive acoustic recording, and prey mapping and sampling we do not estimate the exposure to each of these activities individually. Instead, we assume a worst case scenario in which an individual whale is exposed to all the proposed activities listed above during any given aerial or vessel survey as applicable. However, in many cases (except biopsy sampling and suction-cup tagging, see Section 6.4) the close approach itself is likely the most significant stressor, with other associated activities having little further impact. For biopsy sampling and suction-cup tagging, which would not occur during all vessel surveys, we independently estimate exposure.

Tables 1, 2, and 3 specify the Permits Division’s proposed exposure to ESA-listed species associated with aerial and vessel surveys, biopsy sampling, and suction-cup tagging. These take numbers represent the maximum exposure to these activities that would be authorized under the proposed permits. However, in accordance with our implementing regulations (50 CFR 402.02), we estimate the exposure that is reasonably certain to occur, which may or may not equal the full extent of take that is proposed to be authorized. Given that multitude of factors that can affect whether or not authorized take is actualized (research funding, weather, researcher availability, animal availability, etc.), it is difficult to make these types of predictions but we detail our approach below.

For this consultation, the best available to data to estimate exposure comes from the applicants previous annual reports, which detail the actual number of takes of ESA-listed species that resulted from research activities that are similar or identical to those being proposed here. Annual reports were available for Permit Nos. 655-1652 and 14233 for Scott Kraus, covering research from 2005 to present and Permit Nos. 633-1483, 633-1763, and 14603 for the Center for Coastal Studies, covering research from 1999 to present. From these data, exposure of North Atlantic right whales to aerial and vessel surveys and biopsy sampling were estimated as described below. For suction-cup tagging, the annual reports specify that only six North Atlantic right whales have been previously tagged (once each) under all previous permits to the Center for Coastal studies (in 2004 under Permit No. 633-1483). Consequently, data were too sparse to estimate the likely exposure to suction-cup tagging and so we accept the Permits Division's proposed take as specified in Table 3 to be the maximum number of suction-cup tags that could be deployed.

For incidental harassment to non-target species during vessel surveys, historic data indicate no take of these species has occurred. While this may suggest that take of these non-target species is not reasonably certain to occur, the proposed take numbers for these species are low and designed to minimally cover the researchers in the event that they unintentionally harass these species during North Atlantic right whale research. The species that may be exposed are not identical for the two permits (e.g., no exposure of sperm whales to research under Permit 19674), which is a result of differences in the way the applicants conducts their research. For example, the Center for Coastal Studies focuses its research during the winter and on North Atlantic right whale foraging ecology and so is more likely to encounter non-target cetaceans feeding in association with North Atlantic right whales at this time of year. In fact, this is one reason the Center for Coastal studies proposes to opportunistically conduct research on bowhead whales while Dr. Kraus does not. In their permit application the Center for Coastal Studies mentions the recent appearance of bowhead whales in the action area and the proposed takes are a reasonable measure to allow investigation of bowheads in the area. Given the low level of proposed take for incidental harassment and the researchers justification for why such take numbers are reasonably certain to occur, we accept the take numbers proposed by the Permits Division in Tables 1 and 2 for all non-target species during aerial and vessel surveys (including unidentified baleen whales and cetaceans).

To estimate the number of North Atlantic right whales likely to be exposed to aerial and survey vessels and biopsy sampling, data from the annual reports were visually explored for longitudinal trends. In all cases no increase or decrease in take was apparent. On average the applicant for Permit No. 19674 has taken 88 and three North Atlantic right whales by vessel surveys and biopsy sampling respectively, and the applicant for Permit No. 19315 has taken 159 North Atlantic right whales by both vessel and aerial surveys. Since the population of North Atlantic right whales is at best exhibiting slow growth (see Section 4.2.1), no increase or decrease in take over the next five years is expected due to population growth or decline. Therefore, the number of individuals taken as a result of vessel surveys and biopsy sampling was assumed to be stable compared to previous years, and 99 percent prediction intervals assuming a Poisson distribution were calculated for each take type using the R package EnvStats (Millard 2013; R Core Team 2016). The resulting upper intervals were taken as the maximum expected number of individuals that would be taken during each activity, which were then compared to the take proposed by the Permits Division. Since our estimates were similar to those proposed by the Permits Division, and where they differed the applicants provided a justification, we accept the Permits Division's proposed takes for the number of individuals exposed to aerial and vessel surveys and biopsy sampling (Tables 1 and 2). Since historical data were unavailable to estimate repeat exposure to aerial and vessel surveys (i.e., the number of takes per animal), we accept the repeat exposure levels set by the permits' terms and conditions, as detailed in Tables 1 and 2, to be the maximum number of repeat exposures any individual could experience. For biopsy sampling, no repeat exposure would be authorized.

In summary, we accept the take numbers specified in Tables 1, 2, and 3 as the likely exposure of North Atlantic right whales and all non-target species to aerial and vessel surveys (including all associated activities), biopsy sampling, and suction-cup tagging. A combined summary of these exposures, including the cumulative exposure over the entire five-year duration of each permit, can be seen below in Table 17.

Table 17: Exposure of Endangered Species Act listed cetaceans to the activities that would be authorized under Permit Nos. 19674 and 19315.

Species	Life Stage	Take Method	Associated Procedures	Annual No. Animals	Annual Takes Per Animal	Cumulative No. Animals Over Five Years	Cumulative Takes Per Animal Over Five Years
Whale, right, North Atlantic	All	Vessel Survey	Photography and Videography, Sloughed Skin Sampling, Exhaled Breath Sampling, and Fecal Sampling, Passive Acoustic Recording	500	10	2500	50
			Photography and Videography, Prey Mapping and Sampling	700	15	3500	75
	Non-neonate		Photography and Videography, Sloughed Skin Sampling, Exhaled Breath Sampling, and Fecal Sampling, Passive Acoustic Recording, Biopsy Sampling	50	1	250	5
			Photography and Videography, Suction-cup Tagging	10	3	50	15
	All	Aerial Survey	Photography and Videography	1500	20	7500	100
Whale, bowhead	All	Vessel Survey	Incidental Harassment, Photography and Videography, Prey Mapping and Sampling	50	1	250	5
		Aerial Survey	Incidental Harassment, Photography and Videography	50	1	250	5
Whale, humpback	All	Vessel Survey	Incidental Harassment	20	1	100	5
Whale, fin	All	Vessel Survey	Incidental Harassment	20	1	100	5
			Incidental Harassment, Photography and Videography	50	1	250	5
		Aerial Survey		300	1	1500	5
Whale, sei	All	Vessel Survey	Incidental Harassment, Photography and Videography	100	1	500	5
		Aerial Survey		300	1	1500	5
Whale, blue	All	Vessel Survey	Incidental Harassment, Photography and Videography	5	1	25	5
		Aerial Survey		15	1	75	5
Whale, sperm	All	Vessel Survey	Incidental Harassment, Photography and Videography	5	1	25	5
		Aerial Survey		10	1	50	5
Whale, unidentified baleen	All	Vessel Survey	Incidental Harassment, Photography and Videography	100	1	500	5
		Aerial Survey		200	1	1000	5
Cetacean, unidentified	All	Vessel Survey	Incidental Harassment, Photography and Videography	100	1	500	5
		Aerial Survey		200	1	1000	5

This represents a significant amount of exposure to research activities over the five-year period, particularly for North Atlantic right whales. The population size of North Atlantic right whales is currently estimated to be approximately 465 individuals. Given this and the exposure in Table 17, which in many cases would permit more animals to be taken than exist in the population, not only would all North Atlantic right whales be exposed to research activities, each individual whale would likely be repeatedly exposed to multiple types of research activities. For example, within a year it is possible that an individual whale could be exposed to a total of 25 vessel and 20 aerial surveys, and be biopsied and suction-cup tagged. This is a considerable amount of research for any individual whale to be exposed to. However, as noted previously, the North Atlantic right whale research community is small and well-connected such that researchers regularly coordinate their activities so as to minimize impacts to individuals through repeat exposure. Nonetheless, the data presented in Table 17 indicate substantial exposure is possible were all research activities funded and able to be conducted to the maximum extent possible. Despite this, the response to these research activities even with multiple exposures (see Section 6.4 below) is expected to be minimal such that we are not overly concerned about multiple exposures.

Whales would be exposed to research activities year round with the duration of each exposure depending on the research activity, but in most cases being short. As described in Section 2, the duration of research all activities excepts of suction-cup tagging and passive acoustic recording would be 30 minutes or less, regardless of whether or not the objective was completed. Passive acoustic recording sessions could last up to an hour. In the case of suction-cup tagging, after the tag is attached the whale would be followed at a distance of 300 meters or greater until the tag detaches, usually after several minutes to six hours but up to a maximum 24 hours based on tag limitations. In addition, an individual would never be approached for research, and thus exposed to any related stressors, more than three times in any given day.

6.4 Response Analysis

Given the exposure estimated above, in this section we describe the range of responses among ESA-listed cetaceans that may result from the stressors associated with the research activities that would be authorized under Permit Nos. 19674 and 19315. These include stressors associated the following activities: aerial and vessel surveys, photography and videography, biopsy, sloughed skin, exhaled breadth, and fecal sampling, passive acoustic recording, prey mapping and sampling, and suction-cup tagging. For the purposes of consultation, our assessment tries to detect potential lethal, sub-lethal (or physiological), or behavioral responses that might reduce the fitness of individuals. Our response analysis considers and weighs evidence of adverse consequences, as well as evidence suggesting the absence of such consequences.

In general, all the research activities described in Section 2 have the potential to cause some sort of disturbance. Responses by animals to human disturbance are similar to their responses to potential predators (Beale and Monaghan 2004; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). These responses manifest themselves as stress responses in which an animal perceives human activity as a potential threat and undergoes physiological changes to prepare for a flight or fight response or more serious physiological changes with chronic exposure to stressors. They can also lead to 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). Further, these responses have been associated with abandonment of sites (Sutherland and Crockford 1993), reduced reproductive success (Giese 1996; Mullner et al. 2004), and the death of individual animals (Bearzi 2000; Daan 1996; Feare 1976). While stress is an adaptive response and does not normally place an animal at risk, distress involves a stress response resulting in a biological consequence to the individual. The mammalian stress response involves the hypothalamic-pituitary-adrenal axis being stimulated by a stressor, causing a cascade of physiological responses, such as the release of the stress hormones adrenaline (epinephrine), glucocorticosteroids, and others (Busch and Hayward 2009; Gulland et al. 1999; St. Aubin and Geraci 1988; St. Aubin et al. 1996; Thomson and Geraci 1986). These hormones subsequently can cause short-term weight loss, the liberation of glucose into the blood stream, impairment of the immune and nervous systems, elevated heart rate, body temperature, blood pressure, and alertness, and other responses (Busch and Hayward 2009; Cattet et al. 2003; Dickens et al. 2010; Dierauf and Gulland 2001a; Dierauf and Gulland 2001b; Elftman et al. 2007; Fonfara et al. 2007; Kaufman and Kaufman 1994; Mancia et al. 2008; Noda et al. 2007; Thomson and Geraci 1986). In some species, stress can also increase an individual's susceptibility to gastrointestinal parasitism (Greer 2008). In highly-stressful circumstances, or in species prone to strong "fight-or-flight" responses, more extreme consequences can result, including muscle damage and death (Cowan and Curry 1998; Cowan and Curry 2002; Cowan and Curry 2008; Herraez et al. 2007). The most widely-recognized indicator of vertebrate stress, cortisol, normally takes hours to days to return to baseline levels following a significantly stressful event, but other hormones of the hypothalamic-pituitary-adrenal axis may persist for weeks (Dierauf and Gulland 2001b). Mammalian stress levels can vary by age, sex, season, and health status (Hunt et al. 2006; Keay et al. 2006; Peters 1983). In addition, smaller mammals tend to react more strongly to stress than larger mammals (Hunt et al. 2006; Keay et al. 2006; Peters 1983). In sum, the common underling stressor of a human disturbance as could be caused by the research activities that would be authorized under Permit Nos. 19674 and 19315 may lead to a variety of different stress related responses. However, given the short duration of the activities, we do not anticipate these responses to result in negative fitness consequences. In addition to possibly causing a stress related response, each research activity is likely to produce unique responses as detailed further below.

6.4.1 Aerial Surveys

Aerial surveys that would be authorized under Permit No. 19315 may cause visual disturbance or noise that may impact ESA-listed cetaceans within the action area. As noted previously, aerial surveys that would be authorized under Permit No. 19674 would be conducted at higher altitudes, and thus are not expected in affect ESA-listed cetaceans. Cetacean responses to aircraft depend on the animals' behavioral state at the time of exposure (e.g., resting, socializing, foraging or traveling) as well as the altitude and lateral distance of the aircraft to the animals (Luksenburg and Parsons 2009). The underwater sound intensity from aircraft is less than produced by boats; and visually, aircraft are more difficult for whales to locate since they aren't in the water and move rapidly (Richter et al. 2006). However, when aircraft fly below certain altitudes (about 500 meters), they have caused marine mammals to exhibit behavioral responses that might constitute a significant disruption of their normal behavioral patterns (Patenaude et al. 2002). Thus, aircraft flying at low altitude, at close lateral distances and above shallow water elicit stronger responses than aircraft flying higher, at greater lateral distances and over deep water (Patenaude et al. 2002; Smultea et al. 2008). The sensitivity to disturbance by aircraft may also differ among species (Wursig et al. 1998a). Sperm whales have been observed to respond to a fixed-wing aircraft circling at altitudes of 245 to 335 meters by ceasing forward movement and moving closer together in a parallel flank-to-flank formation, a behavioral response interpreted as an agitation, distress, and/or defense reaction to the circling aircraft (Smultea et al. 2008). About 14 percent of bowhead whales approached during aerial surveys exhibited short-term behavioral reactions (Patenaude et al. 2002). While all ESA-listed whale species exposed to aerial surveys may exhibit short-term behavioral reactions, annual reports from the applicants under all past permits indicated no evasive behaviors have ever been observed in response to aerial surveys (NMFS 2005b; NMFS 2010e; NMFS 2010f; NMFS 2014; NMFS 2016b). Also, conditions in the permits would require aircraft to retreat to higher altitudes if a whale exhibits an adverse reaction to the aircraft. Therefore, it is expected the aerial surveys conducted during the proposed research activities would result in no reaction or only mild short-term behavioral reactions and not any long term behavioral changes or reduction in fitness.

6.4.2 Vessel Surveys

Vessel surveys would be conducted under both Permit Nos. 19674 and 19315 and expose ESA-listed whales within the action area to vessel traffic, discharge, noise, and visual disturbance. The purpose of vessel surveys is to closely approach animals in order to conduct other research activities, responses to which are described below in individual sections.

Vessel surveys necessarily involve transit within the marine environment, and as noted in the *Environmental Baseline* (Section 5.3), the transit of any vessel within waters inhabited by ESA-listed whales carries the risk of vessel strike. In fact, during prey mapping and sampling in 2014, the Center for Coastal Studies struck a North Atlantic right whale (Wiley et al. 2016). The event occurred on April 9 in Cape Cod, Massachusetts while researchers aboard the R/V Shearwater were performing prey mapping and sampling along pre-determined track lines between fixed sampling stations. The vessel was traveling at nine knots, below regulatory limits within the area even though these limits don't apply to the R/V Shearwater given it size. While aerial observers in the area had spotted sub-surface feeding groups of whales, the two dedicated vessel observers saw no indication of whales in the immediate vicinity of the vessel until the whale was struck. All observations of the event indicate the whale was struck on the left mid or lower flank, and while the blubber was cut, causing bleeding, the injury appeared to be non-lethal (Wiley et al. 2016). Despite significant aerial and vessel effort to photograph, relocate, and follow animal immediately after the strike, researchers were unable to confirm the individual's identity (Wiley et al. 2016). However, given the nature of the wound and that no carcass with wounds consistent with the strike has been found, the individual is assumed to have survived (Wiley et al. 2016).

As with this event, response to ship strike can involve minor, non-lethal injuries, particularly if vessel speeds are below 10 knots (Conn and Silber 2013). The probability of a vessel collision depends, in part, on the size and speed of the vessel (Jensen and Silber 2004). According to Jensen and Silber (2004) the majority (79 percent) of ship strikes of large whales occur when vessel are traveling at speeds of 13 knots or greater with 18.6 knots representing the average speed that results in serious injury or death.

The Center for Coastal Studies ship strike incident is an important reminder that even with well-trained marine mammal observers and vessel operators, all vessels, even those transiting at slow speeds, have the potential to strike whales. In this particular instance, sighting conditions were excellent (Beaufort less than one) and there were no indications of whales being present in the immediate area. While we consider this event rare as we are aware of only two instances of any research vessel permitted under the NMFS ever striking a whale in thousands of hours at sea (Wiley et al. 2016), it nonetheless illustrates the possibility of ship strikes from research activities.

Considering this, during the course of this consultation we worked with the Center for Coastal Studies and the Permits Division to further reduce the speeds at which prey mapping and sampling would occur. The applicant and the Permits Division agreed that all future prey mapping and sampling activities would occur at speeds of five knots or less if whales, particularly sub-subsurface feeding whales, are observed in the area. In addition, through early sharing of our conservation recommendations, we confirmed with the Permits Division and applicant that at least three dedicated observers would be on the lookout for whales in all future prey mapping and sampling. Having three dedicated observers on watch is the practice during non-prey mapping and sampling activities, which to date have not resulted in any whale strikes. Other research activities, unlike prey mapping and sampling at fixed stations, would be directed at whales and as a result are expected to have even lower probability of ship strike given that boat operators would be moving in deliberate ways to approach closely, but not physically contact, whales. Approaches directed at whales are even slower (less than four knots) and performed on a converging course as not to impact the whale's behavior. Thus, although strikes from research vessels are possible and background information contained in the *Status of the Species* and *Environmental Baseline* sections suggest that vessel strikes are a major threat to ESA-listed whales in the action area, given the procedures to be followed in the proposed research activities, we expect that the probability of whales being struck by research vessels is very low. Furthermore, with the slow speeds proposed, even if a whale is struck it is likely to only result in minor injury and not reduce an individual's fitness.

Discharge from research vessels in the form of leakages of fuel or oil is possible, though effects of any spills are expected to have minimal, if any, effects on ESA-listed whales. Given the experience of the researchers and boat operators in conducting these research activities in the action area, we expect it is unlikely that spills or discharges will occur. If discharge does occur, the amounts of leakage would be small, would disperse into the water, and would not affect ESA-listed whales directly, or pose hazards to their food sources. Therefore, we conclude this stressor is not likely to impact the fitness of individual whales.

Close approaches by research vessels may cause a visual or auditory disturbance to whales and may also more generally disrupt their behavior. Cetaceans have been observed to react in a variety of ways to close vessel approaches. 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 (Au and Green. 2000; Baker et al. 1983; Hall 1982; Jahoda et al. 2003; Koehler 2006; Scheidat et al. 2006). Individual factors related to a whale's physical or behavioral state can result in differences in the individual's response to vessel approaches. These factors include the age or sex of the whale; the presence of offspring; whether or not habituation to vessels has occurred; individual differences in reactions to stressors; vessel speed, size, and distance from the whale; and the number of vessels operating in the proximity (Baker et al. 1988; Gauthier and Sears 1999; Hooker et al. 2001; Koehler 2006; Lusseau 2004; Richter et al. 2006; Weilgart 2007; Wursig et al. 1998b). Observations of large whales indicate that cow-calf pairs, smaller groups and groups with calves appear to be particularly responsive to vessel approaches (Bauer 1986; Bauer and Herman 1986; Clapham and Mattila 1993; Hall 1982). Cetaceans may become sensitized or habituated to vessels as the result of multiple approaches (Constantine 2001), which could increase or decrease stress levels associated with additional approaches and or research activities following an approach. Reactions to vessel noise have been observed when engines are started at distances of 3,000 feet (Malme et al. 1983; Richardson et al. 1985), suggesting that some level of disturbance may result even if the vessel does not undergo a close approach. However, the sound that would be generated by research vessels that would be used under Permit Nos. 19674 and 19315 is expected to be at higher frequencies, and thus is not expected to not adversely affect listed whales' ability to hear mates and other conspecifics. It should be noted that human observations of a whale's behavioral response may not reflect a whale's actual experience; thus our use of behavioral observations as indicators of a whale's response to research may or may not be correct (Clapham and Mattila 1993).

Watkins et al. (1981) found that both fin whales and humpback whales appeared to react to vessel approach by increasing swim speed, exhibiting a startled reaction, and moving away from the vessel with strong fluke motions. In a study on North Atlantic right whales, 71 percent of 42 whales that were closely approached (within 10 meters) showed no observable reaction; when reactions occurred, they included lifting of the head or flukes, arching the back, rolling to one side, rolling to one side and beating the flukes, or performing a head lunge (Baumgartner and Mate 2003). These results are similar to those described by the applicants in their annual reports from past research where they note occasional evasive behaviors have resulted from close vessel approaches, but in all cases whales resumed normal behavioral patterns soon after, usually on the next surfacing cycle (approximately 20 minutes)(NMFS 2005b; NMFS 2010e; NMFS 2010f; NMFS 2014; NMFS 2016b). Studies of other baleen whales, specifically bowhead and gray whales, have documented similar patterns of short-term behavioral disturbance in response to a variety of actual and simulated vessel activity and sound (Malme et al. 1983; Richardson et al. 1985). This behavioral disturbance may negatively impact essential functions such as breeding, feeding and sheltering. Close approaches by inflatable vessels for biopsy sampling caused fin whales (n = 25) to stop feeding and swim away from the approaching vessel (Jahoda et al. 2003). A study on the effects of tag boat presence on sperm whale behavior found that sperm whales (n = 12) spent 34 percent less time at the surface and 60 percent more time in a non-foraging silent active state when in the presence of the boat than in the post-tagging baseline period, indicating costs in terms of lost feeding opportunities and recovery time at the surface (Isojunno and Miller 2015). Changes in cetacean behavior can correspond to vessel speed, size and distance from the whale, as well as the number of vessels operating in the proximity (Baker et al. 1988). Beal and Monaghan (2004) concluded that the level of disturbance was a function of the distance of humans to the animals, the number of humans making the close approach, and the frequency of the approaches.

Both Dr. Kraus and the Center for Coastal Studies would approach whales at a slow and converging course that would minimize the disturbance caused to ESA-listed whales. While annual reports from previous permits and the applications for Permit Nos. 19674 and 19315 indicate occasional evasive behaviors have been observed during previous close vessel approaches for research, in all cases whales resumed normal behavioral patterns soon after (NMFS 2005b; NMFS 2010e; NMFS 2010f; NMFS 2014; NMFS 2016b). Furthermore, no long-term effects on behavior or fitness have been documented to result from disturbances caused by close vessel approaches, both by the applicants and more generally in the literature. Based on the accounts from the applicants during previous research, and the responses documented in the literature, the proposed vessel approaches are likely to produce short- to mid-term stress responses, but no long-term behavioral changes that would result in fitness consequences for individual whales (Clapham and Mattila 1993).

6.4.3 Photography and Videography

As noted previously, photography and videography would necessarily occur during all aerial and vessel surveys and may affect all ESA-listed whales within the action area. As such, photography and videography is expected to produce the same responses as previously described in Section 6.4.2. However, simply taking and animals photograph and or a video of the animal is not expected to present any unique stressors that would cause additional responses. Therefore, no response is expected to result from photography and videography that has not already been described above for aerial and vessel surveys. Photography and videography itself would not affect the fitness of individual whales.

6.4.4 Biopsy Sampling

Biopsy sampling would only occur under Permit No. 19674 on non-neonate North Atlantic right whales. Since biopsy sampling would take place during vessel surveys, response to biopsy sampling would include all responses previously described in Section 6.4.2. In addition, biopsy sampling presents the unique stressor of tissue collection, which may result in a variety of different response from North Atlantic right whales.

Most cetaceans exhibit mild behavioral responses to biopsy darting without any long term adverse effects (Barrett-Lennard et al. 1996; Best et al. 2005; Brown et al. 1991; Clapham and Mattila 1993; Gauthier and Sears 1999; Hooker et al. 2001; Jahoda et al. 2003). Gauthier and Sears (1999) reported that minke, fin, blue, and humpback whales showed no behavioral reaction to 45.2 percent of successful biopsy samples taken using punch-type tips fired from crossbows; whales that responded, exhibited tail flicks and submergence, but typically resumed their normal behavior immediately or within a few minutes (Gauthier and Sears 1999). Weinrich et al. (1991) found that out of 71 biopsy attempts on humpback whales in the Gulf of Maine, seven percent resulted in no behavioral response, 26.8 percent resulted in low-level behavioral response (immediate dives but no other overtly forceful behavior), 60.6 percent involved a moderate reaction (trumpet blows, hard tail flicks, but no prolonged evidence of behavioral disturbance), and 5.6 percent involved a strong reaction (surges, tail slashes, numerous trumpet blows). Importantly, they also indicated that mother/calf pairs were no more sensitive to biopsy procedures than other groups (Weinrich et al. 1991). Similarly, Clapham and Mattila (1993) found that humpback whales exhibited low to moderate reactions to biopsying, with 66.6 percent of biopsied humpback whales showing no behavioral reaction or low-level reaction to the procedure. North Atlantic right whales appear to respond to biopsy samples much the same as other baleen whales. Brown et al. (1991) found that less than 20 percent of targeted North Atlantic right whales displayed disturbance responses, and most of those were short term (less than five minutes). Additional work by Best et al. (2005) has demonstrated that biopsying Southern right whales (all age classes, including neonates) off South Africa had no effect on female reproduction or calf survivorship. The study also assessed short-term behavioral reactions to biopsying and found that calves had reactions indistinguishable from those of adults, although mothers had the strongest reaction of all animals (Best et al. 2005).

We were only able to find one example of reduced fitness in a cetacean as a result of biopsy sampling. A common dolphin in the Mediterranean Sea died following penetration of a biopsy dart and subsequent handling (Bearzi 2000). The dolphin was hit in the dorsal muscle mass below the dorsal fin by a lightweight pneumatic dart fired from a distance of six meters by a variable-power carbon dioxide dart projector. The methods and equipment had been previously successfully used with minimal effect on common dolphins and other species under similar conditions; however, in the reported event, a dart stuck in the dorsal muscle mass instead of recoiling as expected. Less than two minutes after the hit, the dolphin began catatonic head-up sinking; it was recovered by a team member at depth. Basic medical care was given to ensure hemostasis, but the animal died 16 minutes later. Possible causes of death may have included either indirect vertebral trauma or stress (Bearzi 2000).

Biopsy darts used by Dr. Kraus would not be expected to penetrate the muscle layer of any sampled North Atlantic right whales and as a result, would not result in serious injury. Ultrasound measurements of juvenile and adult right whale blubber thickness taken by Moore et al. (2001) from whales in the Cape Cod Bay region varied between 12 to 23 centimeters. The blubber depths of necropsied North Atlantic right whale calves that died off the coasts of Georgia and Florida ranged from 2.75 to five centimeters (Moore et al. 2004). This thinner blubber to dart size ratio of a young calf as opposed to an adult may increase the calf's risk of injury from the proposed procedure. Nevertheless, the applicant has never killed or injured a whale during biopsy sampling and annual reports from other research permits (e.g., Permit No. 775-1875) do not report any deaths or serious injury from biopsying similar age groups of North Atlantic right whales proposed for this permit, including calves less than six months old.

Infection is also a concern with invasive procedures such as biopsy sampling; however, the applicant would minimize the risk of infection by sterilizing dart tips before sampling occurs. Infection from biopsy sampling has not been the subject of focused study, although anecdotal observations of the point of penetration or elsewhere among the many whales re-sighted in days following biopsy sampling has produced no evidence of infection (NMFS 1992). Consistent with this, Dr. Kraus has never observed any surface trauma from biopsy sampling in his previous research.

In summary, of the large number of cetaceans that have been biopsy sampled in recent decades (probably in the tens of thousands), there has been only one documented case of fitness reductions as a result of biopsy sampling. As such, we expect biopsy sampling to result in low level stress responses and temporary behavior changes, but we do not expect any individuals to experience reductions in fitness.

6.4.5 Sloughed Skin Sampling

Sloughed skin sampling would occur during vessel surveys and may affect North Atlantic right whales within the action area. The hoop net used to collect the skin may present a stressor to an individual whale if it were to interact with (i.e., contact) it. However, during sloughed skin sampling the vessel would approach areas where whales were previously, not where whales are expected to currently be. As a result, no approach to whales would be made and the likelihood that an individual whale surfaces in the exact moment in time and place where the sample is being collected is extremely low. Furthermore, even if a whale were to come near the hoop net, the small net is unlikely to injury the whale. Thus, we do not anticipate any response from whales to sloughed skin sampling, and as a result, it is not expected to in any way affect the fitness of individual North Atlantic right whales.

6.4.6 Exhaled Breath Sampling

Exhaled breath sampling would be conducted only under Permit No. 19764 and would target North Atlantic right whales during vessel surveys. As such, exhaled breath sampling carries all the stressors associated with vessel surveys and would be expected to produce the same responses. In addition, since sampling equipment (a carbon fiber pole with a sampling device) would extend from the vessel, out over and above the whale, it is possible that this activity may present the additional stressor of interaction with (i.e., contact) scientific equipment. Given that this is a relatively new technique, few data exist on the impacts of exhaled breath sampling on cetaceans, including possible interaction with sampling equipment. However, the technique was deliberately developed to provide an entirely non-invasive way to biologically sample North Atlantic right whales and other cetaceans with minimal impact (Hunt et al. 2013). In a pilot study conducted in Canada using the methods described here, Dr. Kraus collected 55 blow samples from North Atlantic right whales and observed no obvious signs of disturbance or avoidance (NMFS 2016c). We anticipate that researchers will make every effort to not contact whales as doing so would result in contamination, and or possible loss, of their sample. Furthermore, even if a whale were to contact the sampling equipment, it is not expected to cause injury. Thus, we do not anticipate any response from whales to exhaled breath sampling, and as a result, it is not expected to in any way affect the fitness of individual North Atlantic right whales.

6.4.7 Fecal Sampling

Like sloughed skin sampling, fecal sampling would occur during vessel surveys and may affect North Atlantic right whales within the action area. The dipnet used to collect the feces may present a stressor to an individual whale if it were to interact with (i.e., contact) it. However, fecal sampling is not expected to occur where whales currently are, but rather, as with sloughed skin sampling, in the path previously traveled by whales. No approach to whales would be made and the possibility that a whale surfaces at the same time and place as the fecal sample collection is remote. Moreover, if a whale were to come near the dipnet, it is very unlikely to injury the whale. Thus, we do not anticipate any response from whales to fecal sampling, and as a result, it is not expected to in any way affect the fitness of individual North Atlantic right whales.

6.4.8 Passive Acoustic Recording

Passive acoustic recording of North Atlantic right whales would be permitted during vessels surveys conducted under Permit No. 19674. As with most other activities conducted during vessel surveys, the majority of the stressors and responses to those stressors would involve the close vessel approach as described previously, rather than the passive acoustic recording itself. However, since a hydrophone would be placed in the water, there is a possibility, although very unlikely, that a whale could interact with the passive acoustic recording equipment. However, during passive acoustic recording the vessel engine would be shut down such that if a North Atlantic right whale were to surface near the equipment, the researchers would immediately know and measures could be taken to avoid contact with the whale. Furthermore, even if a whale were to contact the recording gear, it would not injure the whale in anyway. As such, we do not anticipate any response from whales to passive acoustic recording, and thus, it is not expected to in any way affect the fitness of individual North Atlantic right whales.

6.4.9 Prey Mapping and Sampling

Prey mapping and sampling in the vicinity of North Atlantic right whales would only be permitted under Permit No. 19315. While most of the stressors and related responses that would result from prey mapping and sampling would be due to the close vessel approach, this particular research activity also has the potential to cause a reduction or redistribution in the prey available to North Atlantic right whales, produce sound, and involve interaction between whales and sampling gear.

Close approaches to actively feeding whales may cause some level of turbulence at the surface that could break up dense zooplankton patches. In addition, if sampling were to occur, there may be a small reduction in the prey available within the area. Therefore, prey mapping and sampling in the vicinity of actively feeding whales has the potential to reduce the availability of prey to whales in the immediate area. However, the amount of zooplankton that would be disturbed and/or sampled would be insignificant compared to that which the whale consumes in any given mouthful. While sampling in the vicinity of feeding whales has to potential to cause whales to abandon feeding (Jahoda et al. 2003), we expect that if this were to occur, the Center for Coastal studies would cease prey mapping and sampling given that the focus of this research is on the whales foraging behavior. Thus, we do not anticipate the temporary, minor reduction and/or redistribution of prey or the disturbance to whale foraging behavior during prey mapping and sampling will significantly impact North Atlantic right whales.

Prey mapping that would be conducted under Permit No. 19315 would involve the use of fish finders that produce sound at frequencies of 38 and 200 kHz, and on occasion 120 and 710 kHz. Like most baleen whales, North Atlantic right whales are most sensitive to low-frequency sounds below one kHz. Based on morphological modeling, the hearing range of North Atlantic right whales is estimated to be 10 Hz to 22 kHz with functional ranges between 15 Hz to 18 kHz (Parks et al. 2007). Thus, the frequencies emitted by these fish finders are not likely to be audible to North Atlantic right whales, nor other baleen whales within the action areas, and so no response to the emission is expected.

Finally, while it is possible that whales could come into contact with prey mapping and sampling gear, we find the likelihood of this to be low. The Center for Coastal studies has been conducting such surveys for years in Cape Cod Bay and adjacent waters and to date, no interaction between sampling gear and whales has been reported. Prey sampling would only occasionally be conducted in the vicinity of feeding right whales and when it does, all sampling would typically be greater than 100 meters from any whale (often greater than one kilometer) and vessel speeds would be held to under six knots (usually zero to three knots). Also, if a close approach by a whale did occur, the pump hose would be lifted aboard to avoid any unintended disturbance to the whale. Given that historical data indicate the possibility of whales interacting with prey mapping and sampling gear is remote (NMFS 2005b; NMFS 2010e; NMFS 2014; NMFS

2016c), and the measures that would be taken to minimize such encounters, we do not anticipate any measurable impact to whales from interactions with prey mapping and sampling gear.

In conclusion, the stressors of a reduction or redistribution in prey, sound, and interaction with scientific equipment are not anticipated to result in any measureable response by North Atlantic right whales, and thus we do not anticipate it will affect the fitness of individual North Atlantic right whales.

6.4.10 Suction-cup Tagging

Suction-cup tagging of North Atlantic right whales would be permitted during vessels surveys conducted under Permit No. 19315. In addition to the stressors and responses that are expected as the result of close vessel approaches, the application and continued attachment of suction-cup tags, as well as noise from the tag's VHF transmissions all have the potential to adversely affect North Atlantic right whales.

Previous studies have found that despite being relatively non-invasive, whales respond to the initial suction-cup tag attachment in a variety of ways but the continued tag attachment does not appear to have a measurable impact on whale behavior. In humpback whales, Goodyear (1989a; 1989b) observed quickened dives, high back arches, tail swishes (31 percent) or no reaction (69 percent) to suction-cup attachment. Although one breach was observed in roughly 100 taggings, no damage to skin was found (Goodyear 1989a; 1989b). They also noted that humpbacks monitored several days after being suction-cup tagged did not appear to exhibit altered behavior. Baird et al. (2000) observed only low (e.g., tail arch or rapid dive) to medium (e.g., tail flick) level reactions by humpbacks in response to suction-cup tagging, and regardless of response, pre-tagging behavior was observed in all cases within minutes and no long term or strong reactions were recorded. Baumgartner and Mate (2003) reported that strong reactions of North Atlantic right whales to suction-cup tagging were uncommon, and that 71 percent of the 42 whales closely approached for suction-cup tagging showed no observable reaction. Of the remaining whales, reactions included lifting of the head or flukes, rolling, back-arching, or performing head lunges. Whales resumed normal foraging dives within two dives post tag attachment, indicating that the continued attachment of the tag had little effect on their behavior (Baumgartner and Mate 2003). This is not surprising given that tags like the D-TAGs described in Section 2.2.5 weigh less than 0.001 percent of an adult North Atlantic right whale body weight and have a hydrodynamic design to minimize drag (Johnson and Tyack 2003; Moore et al. 2004). In a review on the effects of marking and tagging on marine mammals, Walker et al. (2012) found that cetaceans exhibited only short-term behavioral responses to suction-cup tagging including changes in frequency of leaps and group speed, flinching, tail slapping, rapid swimming, and rapid surfacing attempts. To date, no long term fitness consequences have been documented from suction-cup tagging (Walker et al. 2012).

While attached to whales, the DTAG's VHF antenna would transmit sound 220 MHz to help the researchers locate the whale, and ultimately the tag upon detachment. As noted previously, the hearing range of North Atlantic right whales is thought to be at a maximum 10 Hz to 22 kHz

(Parks et al. 2007). Thus, the sound produced by the tag would be inaudible to North Atlantic right whales.

Based on the available information presented above, we expect responses to suction-cup tagging to consist of brief, low-level to moderate behavioral responses. However, we expect that individuals would return to baseline behavior within a few minutes. As a result, we do not anticipate suction-cup tagging will affect the fitness of individual North Atlantic right whales.

6.5 Risk Analysis

In this section we assess the consequences of the responses to the individuals that have been exposed, the populations those individuals represent, and the species those populations comprise. Whereas the *Response Analysis* (Section 6.4) identified the potential responses of ESA-listed species to the proposed action, this section summarizes our analysis of the expected risk to individuals, populations, and species given the expected exposure to those stressors (as described in Section 6.3) and the expected responses to those stressors (as described in Section 6.4).

We measure risks to individuals of endangered or threatened species using changes in the individuals' "fitness," which may be indicated by changes the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When we do not expect ESA-listed animals exposed to an action's effects 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. As a result, if we conclude that ESA-listed animals are *not* likely to experience reductions in their fitness, we would conclude our assessment. If, however, we conclude that individual animals are likely to experience reductions in fitness, we would assess the consequences of those fitness reductions on the population(s) those individuals belong to.

As noted in the *Response Analysis*, none of the research activities as proposed with the mitigation measures to minimize exposure and associated responses, are expected reduce the fitness of any ESA-listed species. As such, the issuance of Permit Nos. 19674 and 19315 is not expected to present any risk to individuals, populations, or species listed under the ESA.

6.6 Cumulative Effects

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

This section attempts to identify the likely changes present in the future and their impact on ESA-listed or proposed species and their critical habitats in the action area. This section is not meant to be a comprehensive socio-economic evaluation, but a brief outlook on future changes on the environment. Projections are based upon recognized organizations producing best-available information and reasonable rough-trend estimates of change stemming from these data. However, all changes are based upon projections that are subject to error and alteration by complex economic and social interactions. During this consultation, we searched for information on future state, tribal, local, or private (non-Federal) actions reasonably certain to occur in the action area. We did not find any information about non-Federal actions other than what has already been described in the *Environmental Baseline* (Section 5), which we expect will continue in the future. Anthropogenic effects include climate change, whaling, ship strikes, whale watching, sound, military activities, fisheries, pollution, and scientific research, although some of these activities would involve a federal nexus and thus, but subject to future ESA section 7 consultation. An increase in these activities could result in an increased effect on ESA-listed species; however, the magnitude and significance of any anticipated effects remain unknown at this time. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on whale and seal populations.

6.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 6) to the environmental baseline (Section 5) and the cumulative effects (Section 6.6) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 4).

The following discussions separately summarize the probable risks the proposed action poses to threatened and endangered species and critical habitat that are likely to be exposed. These summaries integrate the exposure profiles presented previously with the results of our response analyses for each of the actions considered in this opinion.

As discussed in Section 4.1, several ESA-listed species occur within the action areas of Permit Nos. 19674 and 19315 but are not likely to be adversely affected because the effects of the proposed actions are insignificant, or discountable. These include green turtles (North Atlantic DPS), hawksbill turtles, Kemp's ridley turtles, leatherback turtles, loggerhead turtles (Northwest Atlantic Ocean DPS), olive ridley turtles (all non-Mexico's Pacific breeding colonies), Atlantic sturgeon (all DPSs), and Atlantic salmon (Gulf of Maine DPS).

In addition, several designated or proposed critical habitats occur within the action areas, but none are expected to be adversely modify or destroyed. These include Atlantic sturgeon (all DPSs) proposed critical habitat, and Atlantic salmon (Gulf of Maine DPS) and North Atlantic right whale designated critical habitat.

The remainder of the ESA-listed species within the action areas (North Atlantic right, Humpback [Cape Verde/Northwest Africa DPS], fin, sei, bowhead, blue, and sperm whales) are likely to be adversely affected by the proposed actions. On an annual basis over the five-year life of the permits, 500 North Atlantic right whales of all ages would be exposed to photography and videography, sloughed skin, exhaled breath, and fecal sampling, and passive acoustic recording during vessel surveys as the result of the issuance of Permit No. 19674. In addition to these activities, 50 non-neonate North Atlantic right whales would also be exposed to biopsy sampling during vessel surveys under Permit No. 19674. Under Permit No. 19315, 700 North Atlantic right whales of all ages would be exposed to photography and videography and prey mapping and sampling during vessel surveys and ten non-neonates would also be exposed to suction-cup tagging. In addition, 1,500 North Atlantic right whales of any age would be exposed to aerial surveys, including photography and videography, under Permit No. 19315. Fifty bowhead whales of any age would be subject to incidental harassment, photography and videography, and prey mapping and sampling during vessel surveys, and an additional 50 bowheads of any age would be exposed to incidental harassment and photography and videography during aerial surveys as the result of Permit No. 19315. Twenty humpback and fin whales of any age would be exposed to incidental harassment during vessels surveys under Permit No. 19674. Fifty fin, 100 sei, and five blue and sperm whales of any age would be exposed to incidental harassment and photography and videography during vessel surveys under Permit 19315. An additional 100 unidentified baleen whales and cetaceans of any age would also be exposed to incidental harassment and photography and videography during Permit No. 19315 vessel surveys. Finally, 300 fin and sei whales, 15 blue whales, 10 sperm whales, and 200 unidentified baleen whales and cetaceans of any age would be exposed to incidental harassment and photography and videography during aerial surveys under Permit No. 19315. Based on the best available data, responses to these research activities from ESA-listed whales within the action areas range from no response, to mild behavioral and stress responses. In no case are any effects on individual fitness expected.

The status of each species, as described in Section 4.2, varies greatly. In recent years North Atlantic right whales have experienced some population growth, although their population size is still very small and they may currently be in decline. Several humpback whale populations appear to have recovered from commercial whaling and were recently delisted. However, little is known about the Cape Verde/Northwest Africa DPS, and it is conservatively assumed to not yet have recovered from historic whaling efforts. Fin whales' status varies by population; in some areas, populations may be substantial and increasing, while data are lacking for other areas leaving the overall status of the species uncertain. Little is known about the population trends of sei whales, but all populations within U.S. waters are relatively small. Most populations of bowhead whale are of reasonable size and at least some are thought to be increasing. While some populations of blue whales are still relatively small, others number over 1,000 and are currently experiencing population growth. Finally, while population trend data are not available for sperm whales, they are currently thought to be the most abundant species of large whale indicating they may be recovering from previous exploitation.

A variety of anthropogenic threats impacts these ESA-listed cetaceans within the action area including climate change, whaling (although at very low levels), ship strikes, whale watching, sound, military activities, fisheries, pollution, and scientific research. Perhaps the most significant direct anthropogenic threat these whales currently face is entanglement in fishing gear, especially for North Atlantic right whales. In fact, it is this threat that the applicants of Permit No. 19674 and 19315 are trying to reduce through their research and response to entangled whales. All of these activities are expected to continue into the future, but the magnitude at which, and their future impacts on the survival and recovery of ESA-listed species is not reliably predictable.

Considering proposed actions to which the ESA-listed species within the action area are likely to be exposed, their potential responses to these activities, the status of each species, and the baseline anthropogenic threats they face, we determined that the issuance of research Permit Nos. 19674 and 19315 will not reduce appreciably the likelihood of both the survival and recovery of any ESA-species within the action areas, nor do we anticipate their issuance would alter the trajectory of recovery of the species as listed pursuant to the ESA that would be sufficient to be readily perceived or estimated.

7 Conclusion

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects, it is the NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of North Atlantic right whales, bowhead whales, blue whales, fin whales, humpback whales (Cape Verde/Northwest Africa DPS), sei whales, and sperm whales, nor destroy or adversely modify proposed or designated critical habitat.

If the proposed critical habitat for Atlantic Sturgeon (all DPSs) is designated as proposed and assessed in this conference opinion, the Permits Division would need to request that we confirm the conference opinion as a biological opinion.

8 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

All activities associated with the issuance of Permit Nos. 19674 and 19315 involve directed take for the purposes of scientific research. Therefore, the NMFS does not expect the proposed action would incidentally take threatened or endangered species.

9 CONSERVATION RECOMMENDATIONS

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

We make the following conservation recommendations, which would provide information for future consultations involving the issuance of permits that may affect ESA-listed whales as well as reduce harassment related to the authorized activities:

1. **Programmatic Approach**

   We recommend that the Permits Division continue to develop a programmatic approach to research permit consultations on a species-specific or geographic basis, or other programmatic approach. A programmatic approach to research permit consultations would allow for a better understanding of all proposed research efforts and their effects to populations and would expedite issuance of individual research permits. As part of this programmatic, we recommend the Permits Division add a more detailed spatial requirement to all permit applications regarding the delineation of their action area. This will better help the Permits Division and us assess the impact of overlapping research efforts on populations of ESA-listed species.

2. **Reporting**

   We recommend the permits division expand their reporting requirements from researchers to provide much needed preliminary data on the effects of climate change. One predicted response to climate change is a change in distribution of marine mammals, which given that our current estimates of most species ranges are poor, is difficult to measure. The application for Permit No. 19315 notes several out of habitat species that have been observed within the action area for this permit. In fact, bowhead whales are not expected to be in this area. Requiring researchers to report information like this would be helpful to the NMFS not only for future ESA section 7 consultations, but also for in generally better understanding the effects of climate change on trusted resources. We also recommend that the Permits Division require at least basic behavioral response reports from all relatively new procedures that would be permitted. For the purposes of this consultation, this would include Exhaled Breath Sampling since little information is available about how whales respond to this procedure. However, this recommendation applies to all relatively new methodologies including the use of unmanned aerial systems.

3. **Permit Terms and Conditions**

We recommend that the permits division require an additional dedicated observer (to make for a total of three) during prey mapping and sampling for Permit No. 19315 in order to avoid future ship strikes with North Atlantic right whales. In the application for Permit No. 19315 the Center for Coastal Studies notes it typically has three observers present when performing research targeted at whales, but only two when performing prey mapping and sampling. Given that during the ship strike in 2014, only two observers where on guard, an additional observer may be beneficial for spotting whales in the vicinity of prey mapping and sampling.

Through early sharing of this conservation recommendation with the Permits Division, the applicant for Permit No. 19315 informed us that while there were only two dedicated "observers" during the 2014 ship strike, there were several other individuals who were spotting for whales. Nonetheless, they confirmed that during all future prey mapping and sampling there will be at least three observers on the lookout for whales.

4. **Data Sharing**

We recommend the Permits Division work to establish protocols for data sharing among all researchers it permits. While the applicants for Permit Nos. 19674 and 19315 collaborate and are both part of a well-connected research community, having a national standard for data sharing among all researchers permitted by the NMFS will reduce impacts to trusted resources by minimizing duplicated research efforts. We recommend basic information be required from each researcher including the species, location, number of individuals, and age, sex, and identity if known be reported at the expiration of each permit. Such information should be made available at least to all other permit holders and/or applicants, but preferably the public. In addition, any genetic samples collected under a NMFS permit should be publicly available (both the results and tissue sample itself) to prevent unnecessary biopsy sampling.

5. **Coordination Meetings**

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

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

10 Reinitiation of Consultation

This concludes formal consultation for the Permits Division's proposal to issuance Permit Nos. 19674 and 19315. As 50 CFR 402.16 states, reinitiating of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect ESA-listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the ESA-listed species or critical habitat that was not considered in this opinion, or (4) a new species is ESA-listed or critical habitat designated that may be affected by the action.

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