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

Biological Opinion (Corrected)

Agency:	Permits, Conservation, and Education Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service
Activity Considered:	The Proposal to Issue Permit No. 14233 to Dr. Scott Kraus, New England Aquarium, and Permit No. 14603 to the Provincetown Center for Coastal Studies for Research on North Atlantic Right Whales in the U.S. Atlantic Exclusive Economic Zone
Consultation Conducted by:	Endangered Species Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service
Approved by:	[illegible] for J. H. Lecky
Date:	Jun 5, 2011

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

For the actions described in this document, the action agency is NMFS' Office of Protected Resources – Permits, Conservation, and Education Division (Permits Division). The consulting agency is NMFS' Office of Protected Resources – Endangered Species Division (Endangered Species Division). The Permits Division proposes to issue a permit to Dr. Scott Kraus of the New England Aquarium and a permit to the Provincetown Center for Coastal Studies for close approaches to large whales during aerial and vessel surveys for photo-identification, behavioral observation, passive acoustic recording, biopsy sampling, suction-cup tagging, fecal sampling, and prey mapping and sampling in the U.S. Atlantic Exclusive Economic Zone (EEZ), pursuant to section 104 of the Marine Mammal Protection Act of 1972, as amended (MMPA) (16 U.S.C. 1361 *et seq.*) and section 10(a)(1)(A) of the ESA. These actions will result in direct "takes" of North Atlantic right whales (*Eubalaena glacialis*), humpback whales

(*Megaptera novaeangliae*), and fin whales (*Balaenoptera physalus*), all of which are listed as endangered under the ESA. These actions also occur in part within certain areas in the northeast and southeast U.S. designated as critical habitat for the North Atlantic right whale. This ESA Section 7 consultation as corrected (Opinion) considers the effects of the proposed research studies on endangered and threatened species and designated critical habitat.

CONSULTATION HISTORY

On February 19, 2010, the Permits Division requested consultation with the Endangered Species Division on a proposed action to issue scientific research permit No. 14233 to Scott Kraus of the New England Aquarium and No. 14603 to the Provincetown Center for Coastal Studies for research on North Atlantic right whales (*Eubalaena glacialis*) in the U.S. Atlantic EEZ. The permits would be valid for five years from the date of issuance. The initiation package included the permit applications from the respective applicants, discussion of the effects of the research on the target species, and drafts of the proposed permits.

On March 19, 2010, the Endangered Species Division met with the Permits Division to clarify the scope of the proposed research and to request additional information regarding the timing of research activities included in permit No. 14603 as well as the effects of biopsy sampling North Atlantic right whale calves in permit No. 14233. As part of this request for additional information, the Endangered Species Division requested an update on the status of the ongoing study effort conducted by NMFS Northeast Fisheries Science Center investigating the effects of biopsy sampling North Atlantic right whale mother-calf pairs in the western North Atlantic Ocean.

The Endangered Species Division deemed the additional information sufficient and initiated formal consultation on April 16, 2010. Formal consultation was completed on September 1, 2010 and a Biological Opinion was issued with a determination that the proposed action was not likely to jeopardize the continued existence of any listed species and not likely to destroy or adversely modify designated critical habitat.

Due to concerns of NOAA's Office of General Council (NOAA GC) regarding the legal status of critical habitat for North Atlantic right whales, the abovementioned Biological Opinion did not consider effects to North Atlantic right whale critical habitat. This decision was based on a legal opinion issued by NOAA GC in 2004 that advised that critical habitat for North Atlantic right whales was rendered legally invalid after NMFS published a final rule on March 6, 2008 listing North Pacific right whales *(Eubalaena japonica)* and North Atlantic right whales *(Eubalaena glacialis)* as separate species under the ESA.

On August 19, 2010, NOAA GC informed NMFS of its intentions to issue a new legal opinion concluding that the original 1994 critical habitat designation would in fact remain viable for North Atlantic right whales.

Based on the revised legal opinion regarding the validity of North Atlantic right whale critical habitat, the Endangered Species Division is correcting the previously issued Biological Opinion to include analysis of effects to North Atlantic right whale designated critical habitat, where appropriate.

BIOLOGICAL OPINION (CORRECTED)

DESCRIPTION OF THE PROPOSED ACTION

The Permits Division proposes to issue scientific research permits to Scott Kraus of the New England Aquarium and the Provincetown Center for Coastal Studies for the directed, nonlethal
"take"[1] of targeted North Atlantic right whales and non-targeted humpback and fin whales in the U.S. Atlantic EEZ by way of harassment, pursuant to section 104 of the MMPA and section 10(a)1(A) of the ESA. The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. However, the MMPA defines harassment as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal population in the wild or has the potential to disturb a marine mammal or marine mammal population in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" [16 U.S.C. 1362(18)(A)]. The latter portion of this definition (that is, "...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering") is almost identical to the U.S. Fish and Wildlife Service's regulatory definition of "harass" pursuant to the ESA. For this Opinion, "harassment" is defined similarily as an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents.

The following sections briefly describe the research activities to be authorized in each scientific research permit as part of the proposed action. Additional details on these activities can be found in the Environmental Assessment, the permit applications, and the permits themselves.

<u>Scott Kraus, Permit No. 14233</u>
The research activities proposed in permit No. 14233 for Dr. Scott Kraus include aerial and vessel surveys, including close vessel approaches for photo-identification, behavioral observation, biopsy sampling, passive acoustic recording, and fecal sampling. The permit would also authorize North Atlantic right whale tissues and parts to be received, imported from or exported to other researchers around the world. No lethal "take" of listed species would be authorized. The purpose of the research is to monitor the health and status of the North Atlantic right whale species. **Table 1** displays the annual "take"

1 The ESA defines "take" as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct

of listed North Atlantic right whale individuals proposed in Dr. Kraus' permit along with the total amount of "take" expected over the duration of the five year period.

Table 1. Research Activities and Proposed Takes of Listed Species for Permit No. 14233 (Dr. Scott Kraus)

SPECIES (LIFE STAGE)	ACTIVITY	INDIVIDUALS TAKEN OR PARTS IMPORTED/ EXPORTED ANNUALLY	INDIVIDUALS TAKEN OR PARTS IMPORTED/ EXPORTED OVER FIVE YEAR DURATION	DETAILS
North Atlantic Right Whale (Adult/Juvenile)	Close Vessel Approach; Passive Acoustic Recording; Count/Survey; Behavioral Observations, Monitoring; Photo-id; Photograph/Video; Skin and Blubber Biopsy Sampling	30	150	1 biopsy sample will be collected per individual per year. Each sample *attempt* constitutes a take regardless if darting is successful or not (no more than 3 takes allowed per individual per day).
North Atlantic Right Whale (Calves atleast 1 month old)	Close Vessel Approach; Passive Acoustic Recording; Count/Survey; Behavioral Observations, Monitoring; Photo-id; Photograph/Video; Skin and Blubber Biopsy Sampling	20	100	1 biopsy sample will be collected per individual per year. Each sample *attempt* constitutes a take regardless if darting is successful or not (no more than 3 takes allowed per individual per day). If less than 20 calves are sampled per year, than remaining takes can be used for older individuals (adults/juveniles)
North Atlantic Right Whale (All)	Close Vessel Approach; Passive Acoustic Recording; Count/survey; Behavioral Observation, Monitoring; Photo-id; Photograph/Video; Fecal Sampling; Incidental Harrassment	2,000	10,000	Individuals may be approached up to 10 times per year.
North Atlantic Right Whale (All)	Import/Export/Receive Parts	50	250	

Aerial and Vessel Surveys
Aerial surveys would occur for locating North Atlantic right whales for photo-identification, information on calf production, and opportunistic spot checks for unusual whale sightings. Dr. Kraus would operate aerial surveys in waters off the southeastern U.S. coast. Concentrated surveys would occur from December to March during the time at which North Atlantic right whale mother-calf pairs appear in the U.S. southeast calving grounds. Other aerial surveys may occur at any time of year along the U.S. eastern Atlantic coast for spot checks and aerial reconnaissance for unusual whale sightings. Aerial surveys would be conducted using Cessna Skymasters, a high-wing twin-engine aircraft flown at 1,000 feet (ft) at approximately 100 knots. Transect lines would be spaced 3 nautical miles (nm) apart. At each right whale sighting, the aircraft would break track and descend to no lower than 900 ft to circle the animal, record the location, and to take photographs for individual identification. When photographs and locations have been obtained, the aircraft would return to the trackline at the point of departure and resume the survey.

Vessel surveys would collect information on the distribution, abundance, age, sex, health, reproduction, survival, and genetics of right whales through photo-identification, biopsy sampling, passive acoustic recordings, and fecal sampling. Vessel surveys would be conducted within the U.S. Atlantic EEZ from Florida to Maine year-round including areas designated as critical habitat for North Atlantic right whales (i.e. Great South Channel, Cape Cod Bay, and the southeastern U.S. calving grounds off the coasts of Georgia and Florida). Identification of individual right whales would be collected on all surveys, and would be frequently supplemented by biopsy sampling or other activities that address multiple studies. Several types of vessels would be used including a 17 ft zodiac with an outboard Honda engine, a 21 ft center console Mako with an outboard Honda engine, a 30 ft Dyer Bass boat with an inboard diesel engine, and a 46 ft Jarvis Newman with an inboard diesel engine. Both the Zodiac and the Mako would be trailered to specific locations for rapid response. Shipboard surveys would usually take place along pre-determined tracklines with at least two observers keeping watch during all daylight hours. At each right whale sighting, the vessel would leave the track to approach the animal. Details on approaches and associated sampling activities are described in more detail below.

Photography, Videography
Photographs will be collected from both ships and aircraft. North Atlantic right whales are individually identifiable using the unique patterns of raised epithelium or patches of hardened skin (called “callosities”) on their heads, lips, and chins along with unique body scars (Payne et al., 1983; Kraus et al., 1986), making it possible to track individuals over time. Primary photographs will be taken of the head and callosity pattern while supplementary photographs would be taken of the tails and bodies, as well as any unusual scars or markings. Photographic and catalog data would be used to track whale individuals, monitor reproduction and mortality, identify migrations, follow age and sex dependent behavior and habitat use patterns, and to monitor health.

For aerial surveys, the aircraft would circle over the whale at altitudes around 1,000 ft (no lower than 900 ft) until legible photographs of the callosity patterns on the heads are obtained or until the whale has undergone three breathing sequences. As a result, encounters are expected to last no longer than 30 minutes (min).

To obtain photographs from vessel surveys, a slow, converging course technique will be used to get between 20 and 100 meters (m) alongside an animal to obtain photographs. As with aerial surveys, researchers would limit total attempts to photograph the whale to three breathing sequences. If the whale demonstrated avoidance during all three breathing sequences, the survey team would break off any further attempts at photographing the whale. This would generally limit encounters of vessels with any right whale for photographic purposes to less than 30 min in a day.

Biopsy Sampling

Skin and blubber samples of right whales would be collected for studies on genetics, contaminants, disease, and energetics. Genetics studies include identifying carcass identity after mortalities, developing a full family tree for the population, determining the genetic constraints on reproduction and survival, and clarifying the evolutionary features of the right whale's reproductive system. Non-genetic biopsy samples would be used for health studies if whales have skin lesions or a history of disease. In addition, skin samples from younger whales (preferably juveniles) would be used to develop immortal cell lines for testing the effects of contaminants on cellular reproduction, mutation, and survival. Additionally, blubber samples collected would be archived for contaminant content studies.

The proposed permit for Dr. Kraus would authorize 50 annual takes to biopsy sample right whales: 20 takes for new whales (calves approximately one month old or older), 10 takes for whales in the population who have not been previously sampled (juveniles and adults of both sexes), and 20 takes for other studies (juveniles and adults of both sexes). The latter 20 takes for "other studies" includes 10 samples for studies on contaminants and 10 samples for lesion and skin disease assessments. Researchers intend to collect only one sample from a given whale per year. When appropriate, biopsy samples would be subsampled to accommodate multiple study requirements while minimizing harassment to the species. If researchers are unable to sample 20 calves (assuming each attempt is successful) each year, the remaining number of unused "takes" would be authorized to be used for sampling older individuals in that given year for assisting the other sampling objectives.

To collect biopsy samples, vessel approaches would be made at an idling speed on a converging course with the whale (never directly toward or from behind the whale). If a biopsy attempt is missed, researchers would attempt to sample that whale again. Biopsy attempts would be made from distances of 5 to 15 meters using crossbows and small diameter darts fitted with biopsy tips. Surgical stainless steel biopsy tips would be 0.7 millimeters (mm) in diameter and 2.5 centimeters (cm) deep, and fitted with a stop-collar backing to prevent deeper penetration. Whales would be darted in conjunction with approaches for photo-identification. Photo-identification would always occur before

darting to ensure the animal is identified in any future analysis as well as to reduce unnecessary darting of individuals already sampled that year by other researchers.

Skin biopsies would be preserved immediately in a saturated brine solution and DMSO. For certain pathological or contaminant sampling, samples would be frozen or stored on ice in sterile containers for shipment and storage. Sample labeling would be integrated with the photo-identification labeling system, and samples would be shipped to the relevant collaborating laboratories as soon as the field schedule and procedures under the Convention on International Trade of Endangered Species (CITES) allow.

Passive Acoustic Recording
Passive acoustic recordings allow researchers to associate whale calls with particular observed behaviors. Occasionally, during vessel surveys to be authorized in Dr. Kraus' permit, researchers would drop a hydrophone into the water to listen for right whale calls associated with particular behaviors. These recordings would be done while the vessel is shut down and would generally last no more than an hour (hr).

Fecal Sampling
Fecal samples would be collected to assess reproductive hormones, stress, parasites, red tide effects, diet composition, energetics, and nutrition. Fecal sampling would not require approaching animals directly, as usually the sample is left floating at the surface after the whale is gone. Researchers would not attempt to contact whales to collect samples. Sampling could occasionally occur within 300 ft (or 100 yards) of an animal, particularly if a known individual has defecated nearby. Samples could be collected from any right whale during vessel surveys in association with other activities that do not involve physical contact, such as photo-identification and passive acoustic recordings. Samples would be collected from a stationary boat with a handheld 333-micron mesh dip net.

Receipt, Import or Export of Parts
The import or export of right whale parts would allow samples to be archived for future genetic studies, comparative studies on genetics and disease, or to determine historic stock divisions, matrilineal history, historical habitat use, and historical feeding habits from genetic or radio-isotope analysis. Right whale biopsy samples collected in the United States would be exported to Trent University in Canada for genetic analysis. Shipments would be handled by courier, and all applicable hazmat standards for dry-ice shipments would be met. After use, right whale samples would be archived indefinitely at -80° C for future genetic studies or destroyed. Biopsy samples from other North Atlantic groups of right whales could be imported from other researchers for comparative studies on genetics and disease. Historic samples of right whale bones or baleen (or bones/baleen that may potentially be from right whales) could be imported or exported to determine historic stock divisions, matrilineal history, historical habitat use, and historical feeding habits from genetic or radio-isotope analysis.

Mitigation Measures
The following section summarizes the mitigation measures associated with Permit No. 14233 to mitigate effects to North Atlantic right whales and other non-targeted protected

species during research activities. More detailed information may be found in the associated permit and Environmental Assessment document. The following conditions are included in Dr. Kraus' permit:

1. In the event a serious injury or mortality of a protected species occurs, the Researchers must suspend permitted activities and contact the Chief, NMFS Permits, Conservation, and Education Division by phone within two business days. Researchers must also submit a written incident report.

2. If authorized take is exceeded, the Researchers must cease all permitted activities and notify the Chief, NMFS Permits, Conservation, and Education Division by phone as soon as possible but not later than two business days. Researchers must also submit a written incident report.

3. Any "approach"[2] of a cetacean constitutes a take by harassment and must be counted and reported.

4. Regardless of success, any attempt, which includes the associated close approach, to biopsy sample an animal constitutes a take and must be counted and reported.

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

6. To minimize disturbance of the subject animals, the Permit Holder must exercise caution when approaching animals and must retreat from animals if behaviors indicate the approach may be interfering with reproduction, feeding, or other vital functions.

7. 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 interefering 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 startle response;

    d. Must not approach any mother or calf while the calf is actively nursing;

    e. Must, if possible, sample the calf first to minimize the mother's reaction when sampling mother/calf pairs; and

2 An "approach" is defined as a continuous sequence of maneuvers involving a vessel or researcher's body in the water, including drifting, directed toward a cetacean or group of cetaceans closer than 100 yards for large whales, or 50 yards for smaller cetaceans.

f. Must limit the time spent pursuing and approaching (including biopsy sampling cow/calf pairs to no more than 30 minutes. If unsuccessful after 30 minutes, Researchers must discontinue efforts and allow whales to resume their normal activities.

8. Researchers must not approach a right whale calf less than 6 months old that appears unusually thin or emaciated.

9. If a marine mammal shows a response to the presence of the aircraft during aerial surveys, the aircraft must leave the vicinity and either resume searching or continue on the line-transect survey.

10. All biopsy tips must be disinfected between and prior to each use.

11. Before attempting to sample an individual, investigators must take reasonable measures (e.g., compare photo-identifications) to avoid repeated sampling of any individual.

12. A biopsy attempt must be discontinued if an animal exhibits repetitive strong adverse reactions to the activity or the vessel.

13. In no instance will the Permit Holder attempt to biopsy a cetacean anywhere forward of/anterior to the pectoral fin.

14. For right whales, data must be recorded for each biopsy attempt to include, at a minimum, the animal id, date, time, location, age class, sex, and response/behavior of the animals.

15. Should other protected species be encountered during the research activities authorized under this permit, researchers must exercise caution and remain a safe distance from the animal(s) to avoid take, including harassment.

16. The Permit holder must submit annual reports to the Chief, NMFS Permits, Conservation, and Education Division and a final report must be submitted within 180 days after expiration of the permit.

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

In addition to adhering to the permit conditions, Dr. Kraus will keep vessel approach speeds constant and as slow as possible, and vessel encounter trajectories would occur from the side and would be slowly convergent with the whale to minimize any alteration of behavior. For biopsy activities, Dr. Kraus would minimize the number of samples needed by identifying individual whales before darting and cross referencing the id to

determine if a whale has already been sampled that year. When animals are darted, researchers will usually divide a single sample several times for multiple studies, thereby minimizing the number of samples needed. Biopsy darts would be used only once per day on a single animal to minimize any chance of infection or contamination. Used biopsy tips will be returned to the field station each day and will be washed and disinfected in a 30-second bath of 5.25 percent sodium hypochlorite. Also, at the end of each field season, all biopsy tips will be steam autoclaved.

Provincetown Center for Coastal Studies, Permit No. 14603

The research activities proposed in permit No. 14603 for the Provincetown Center for Coastal Studies (CCS) would include close approaches during aerial and vessel surveys for photo-identification, behavioral observation, habitat sampling and prey mapping, and suction cup tagging and tracking. No lethal "take" of listed species would be authorized. The purpose of CCS' research is to monitor demographics, life history traits, habitat use, and behavior of North Atlantic right whales in the Gulf of Maine, including critical habitat areas in the northeast U.S. (i.e. Great South Channel and Cape Cod Bay). **Table 2** displays the annual "take" of listed whale species to be authorized in CCS' permit along with the total amount of "take" expected over the duration of the five year period.

Table 2. Research Activities and Proposed Takes of Listed Species for Permit No. 14603 (Provincetown Center for Coastal Studies)

SPECIES (LIFE STAGE)	ACTIVITY	INDIVIDUALS TAKEN ANNUALLY	INDIVIDUALS TAKEN OVER FIVE YEAR DURATION	DETAILS
North Atlantic Right Whale (All)	Aerial Survey; Behavioral Observations; Photo-id	700	3500	
North Atlantic Right Whale (All)	Close Vessel Approach; Acoustic, Sonar for Prey Mapping; Plankton Collections by Net or Pump; Photograph/Video	350	1,750	
North Atlantic Right Whale (Adult/Juvenile)	Close Vessel Approach; Behavioral Observations; Photo-Id; Acoustic, Sonar for Prey Mapping; Suction-Cup Instrumentation Attachment (e.g VHF, TDR)	20	100	Maximum 10 successful tag attachments annually; individuals may be tagged up to 3 times annually
Unidentified Baleen Whales	Close Vessel Approach; Behavioral Observation, Monitoring; Photo-Id; Incidental Harassment	20	100	Harassment incidental to right whale vessel surveys; opportunistic photo id's may be taken

Unidentified Baleen Whales	Aerial Survey; Behavioral Observation, Monitoring; Incidental Harassment	20	100	Harassment incidental to right whale aerial surveys; opportunistic photo id's may be taken

Aerial and Vessel Surveys

Aerial surveys would be conducted for photo-identification and behavioral observation. Aerial surveys would be flown in either a Cessna 336 (Skymaster) or 337 (both high-wing twin-engine aircraft) at 750 ft (or 229 m) altitude at approximately 100 knots using methodology developed by the Cetacean and Turtle Assessment Program (CETAP, 1982; Scott and Gilbert, 1982) and adapted for right whale surveys by the North Atlantic Right Whale Consortium (NARWC). Survey track lines would typically be spaced at 1.5 nm (or 2.8 kilometer) intervals. At each right whale sighting, and at rare sightings of large whales not immediately identified to species, the aircraft would break track to circle the animal, record the location, and to take photographs for individual identification. The average amount of time spent circling an individual right whale for photo-identification would be 15-20 min. The plane would generally leave an individual after 30 min, regardless of whether good identification photographs have been obtained. After photographing the animal, the aircraft would return to the track line at the point of departure. If entangled right whales are spotted during surveys, the aircraft would circle for extended periods of time. In the past, CCS has circled an entangled whale for up to 3 hours.

The proposed permit for CCS would authorize 700 annual "takes" of North Atlantic right whales by harassment during aerial surveys. This number would account for the potential for some individuals in the population to be harassed multiple times (up to 10 times per year) annually and also to account for population growth over the life of the permit. Other listed baleen whale species that would be incidentally harassed during right whale surveys include humpback (*Megaptera novaeangliae*), and fin whales (*Balaenoptera physalus*). Most sightings of these non-targeted species would not involve approach or circling because they can be identified from outside of 100 yards. CCS anticipates that less than two sightings per survey would involve an approach of a non-target balaenopterid to determine the species. CCS' permit would authorize the harassment of up to 20 unidentified baleen whales each year (expected to include a combination of fin and/or humpback whales). Annual reports would require a description of the number of animals of each species approached annually.

Planned surveys would occur from December to May, but the permit would authorize surveys year-round for response to entanglements or out-of-season sightings. CCS reports that a full aerial survey of Cape Cod Bay takes approximately 4 hours in a day if no whales are sighted, with the duration increasing as more and more whales are encountered.

Vessel surveys would be conducted for photo-identification, behavioral observation, and collection of prey samples. Shipboard surveys would be conducted using one of two CCS research vessels: the 40 ft twin diesel engine R/V Shearwater or the 40 ft twin outboard engine R/V Ibis. Although it is unlikely that any other vessel would be used for

the principal study in Cape Cod Bay, other potential platforms include twin engine outboard vessels between 17-30 ft in length and single or twin inboard diesel powered vessels up to 45 ft in length. Shore-launched inflatable vessels also could be used in the case of an aggregation of whales sighted off beaches that are difficult to access during periods of heavy weather in winter time. However, the R/V Shearwater is the only boat CCS anticipates using in the foreseeable future.

Surveys would be conducted at a speed of 12 knots or less and would follow designated track lines. When North Atlantic right whales are sighted, the vessel would approach for photo-identification purposes. Approaches would be conducted from the side at slow or idle speed (under 4 knots) with no sudden changes in vessel speed or direction. Photographs would be taken from a distance of 10-100 m from the animal. When possible, photographs would be taken of both sides of the head. Sighting data from the shipboard surveys would be submitted to the NARWC database. If North Atlantic right whales are sighted from the vessel or during aerial surveys, prey sampling may also occur as well (see below). During the regular season of North Atlantic right whale residency in Cape Cod Bay, no more than two vessel surveys and three aerial surveys each week are expected.

Prey Mapping and Sampling

Habitat sampling during vessel surveys would support habitat quality assessment, forecasting of whale distribution, and determination of foraging behavior and depth selection that exposes whales to risk of ship strike or entanglement. Surveys would focus on sampling zooplankton in the Cape Cod Bay area (including within the Cape Cod Bay and Great South Channel designated critical habitat) to assess the quality of the food resource that dictates the locations where North Atlantic right whales congregate. Samples would be collected from the wider Cape Cod Bay area at stations that have been sampled since 1984 or using vessel-based food resource sampling equipment. Some sampling efforts would be directed at locations where right whales are aggregated and/or actively feeding.

Right whales would be approached opportunistically, using the methods described earlier for vessel surveys, for photo-identification purposes and to check for entanglements during sampling and on transits to and from sampling sites. Data collection would include the recording of survey tracks, behavior and location of whales observed during cruises, and opportunistic photographic identification.

The R/V Shearwater is equipped with oceanographic and prey resource sampling equipment including a CTD (conductivity, temperature, and depth) recorder, plankton nets, and a vertical plankton pump. A Remote Sampling Sensor Package (RSSP) composed of a tow-body (Acrobat II) and a seabird SBE 19 CTD/flourometer/incident light PAR meter package multiplexed with an Optical Plankton Counter would be used to document oceanographic conditions and to enumerate zooplankton food resources. Conditions in the upper 50 m of the water column throughout the habitats under study (with a focus on Cape Cod Bay) would be documented. The data collected using the RSSP would be compared with data from up to 18 fixed stations, established for sampling in 1984, to develop a profile of the food resources that support right whales and

control the distribution and occurrence of the whale population in the Cape Cod Bay region. The RSSP would be towed at 2-6 knots behind the R/V Shearwater. The depth of the sampling in the upper 50 m of the water column would be controlled by computer commands from the vessel. The RSSP would generally be towed 1 kilometer (km) or more from North Atlantic right whale individuals. The equipment used would allow an accurate assessment of food resources in the vertical and horizontal planes.

Nets used for zooplankton sampling would be 30 and 50 cm in diameter with a 333 micrometer mesh and a ratio of 3:1 or 5:1 towed and tended by ½-inch nylon line behind the research vessel. Sampling at fixed stations would usually be 2 km or more from right whales. However, in some cases (likely less than 10 times per year) data would also be collected in the vicinity of actively feeding whales. In these cases, tows would be taken behind the whale as it feeds or travels to sample at the edge of the feeding cylinder (the imaginary cylinder of water passed through by the open mouth). In these cases right whales would usually be 50 – 100 m or more from the nets. Regular zooplankton collections would generally last less than 5 min.

A hose and pump system would be used to sample the vertical characteristics of the zooplankton resource. A 1.5 inch hose would be hung from the vessel with a CTD cage attached and water would be pumped at 15 gallons/min into collection nets on deck. Pump sampling would be conducted in the regions where whales are aggregated, but would generally occur over a kilometer from the whales themselves. CCS has reported that in previous surveys, whales have occasionally approached the vessel while the vessel was drifting with the engine running. If a curious approach by a right whale occurs, the pump hose would be lifted aboard to minimize harassment of the individual.

Standard fish finders operating at 38 and 200 kilohertz (kHz) would be used to assess and map the distribution of zooplankton, but regular sampling would occur 1 km or more from right whale individuals. On occasion, 120 and 710 kHz frequencies would also be used.

A maximum of 350 North Atlantic right whales would be harassed annually during vessel surveys and/or habitat sampling. Individual whales would not be taken more than 5 times annually. Other listed baleen whale species that would be incidentally harassed during right whale surveys include humpback and fin whales. CCS' permit would authorize incidental harassment of up to 20 unidentified baleen whales annually during vessel surveys and habitat sampling to account for this. Annual reports would require a description of the number of animals of each species approached annually.

Suction Cup Tagging

Suction-cup tags would be attached to adults or juveniles to study diving patterns and compare them to vertical distribution and migration of food layers to define shifting patterns of ship strike and entanglement risk associated with feeding behavior. Suction cup tagging would be conducted separately from the habitat documentation effort, using a small (< 8m) rigid-hulled inflatable boat (RIB), outboard powered and modified for tagging. Tagging efforts may occur in conjunction within regular vessel surveys.

Suction cup tag attachment would be conducted in three stages: 1) identification and assessment of an individual North Atlantic right whale as a suitable tagging candidate; 2) careful small vessel maneuvering for a close approach to less than 5 m from the individual whale by trained personnel for tag attachment; and 3) small vessel tracking of the tagged whale to monitor behavior and assess prey field dynamics near the tagged whale. While some suction-cup tagging may occur in the Cape Cod Bay critical habitat, no suction cup tagging would occur in the Great South Channel.

An observation vessel would be used to locate a suitable right whale for tagging (i.e., juvenile or adult, not currently injured or entangled, and not a mother of a calf less than 6 months old). The RIB would be maneuvered to less than 5 m from the targeted right whale individual for application of the tag. A 10-20 m (30-60 ft) pole cantilevered from the bow of the RIB or a long 7-10 m (21-30 ft) hand-held pole would be used to attach the tag to the whale. Tags would be attached on the dorsal surface of the animal posterior of the blowhole and pectoral flippers. After successful tag attachment, the survey team will follow the whale until the tag falls off (generally 2 mins to 6 hrs with a maximum duration of 24 hrs). The observation vessel would be used to track the tagged whale using a VHF beacon on the tag and observe the behavior and document the position of the whale when it is at the surface. When following, the observation vessel will stay 300 m or more from the tagged whales.

Two types of tags would be used based on availability at the time of the surveys:

1. Dtags, developed by the Woods Hole Oceanographic Institution, and

2. Acousonde or BProbe tags, developed by Greenridge Sciences.

The dimensions of the current version of the Dtag are approximately 4.25 in x 1.6 in x 0.9 in (11 cm x 4 cm x 2 cm) for the actual tag, and 7.7 in x 3.8 in x 1.8 in (20 cm x 10 cm x 4 cm), for the tag in its deployment housing. The weight of the tag, including attachment, is 330 grams (g) [or 12 ounces (oz)] in air, and it is slightly buoyant in water. The Dtag includes sensors for acoustic recordings, pressure, pitch, roll, heading, surfacing events, and temperature. The Dtag housing is designed to provide a low-drag hydrodynamic attachment.

The Acousonde (the second generation of the Bprobe) is approximately 8.7 in long x 1.25 in diameter (or 22 cm x 3 cm), and weighs 86 g in water. The Acousonde is an electronic data-logging tag that records calibrated acoustic pressure data with a flat frequency response between 10 and 7400 hertz (Hz), digitized with 16-bit resolution. The Acousonde also records temperature, depth, and 3-axis acceleration, enabling the derivation of instantaneous body orientation (i.e., tilt and roll), as described by Goldbogen et al. (2006; 2008), resulting in a 3-D track of the whale relative to the external cues in the environment.

CCS' permit would authorize 20 North Atlantic right whale individuals to be harassed annually during suction cup tagging. Up to three attempts would be made per day to attach a tag to a whale. Tags would not be attached to calves less than 6 months old or their mothers. Whales could be tagged up to 3 times in any 12-month period. The type of tag to be used would depend on availability at the time of the project. Only one tag would be attached to a whale at a time.

The average encounter time for all activities would vary depending on whale behavior. For whales on long-diving patterns, with dives exceeding 20 min, the vessel would remain in the area for more than 40 min (or through three surfacings). Average encounters would be approximately 3 min to 40 min, with photo ID and D-tagging efforts lasting less than 20 min, depending on behavior.

Mitigation Measures

The following section summarizes the mitigation measures associated with Permit No. 14603 to mitigate effects to North Atlantic right whales and other non-targeted protected species during CCS' research activities. More detailed information may be found in the associated permit and Environmental Assessment document. The following conditions are included in CCS' permit:

1. In the event a serious injury or mortality of a protected species occurs, the Researchers must suspend permitted activities and contact the Chief, NMFS Permits, Conservation, and Education Division by phone within two business days. Researchers must also submit a written incident report.

2. If authorized take is exceeded, the Researchers must cease all permitted activities and notify the Chief, NMFS Permits, Conservation, and Education Division by phone as soon as possible but not later than two business days. Researchers must also submit a written incident report.

3. Any "approach" of a cetacean constitutes a take by harassment and must be counted and reported.

4. Regardless of success, any attempt to tag an animal, which includes the associated close approach to tag an animal, constitutes a take and must be counted and reported.

5. During aerial surveys, any cetacean observed below 1,000 ft should be be counted and reported as a take.

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

7. To minimize disturbance of the subject animals, the Permit Holder must exercise caution when approaching animals and must retreat from animals if behaviors indicate the approach may be interfering with reproduction, feeding, or other vital functions.

8. 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 interefering 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 startle response;

    d. Must not approach any mother or calf while the calf is actively nursing.

9. If an animal shows a response to the presence of the aircraft during aerial surveys, the aircraft must leave the vicinity and either resume searching or continue on the line-transect survey.

10. Aerial flights must not be conducted over marine mammal haul out areas.

11. Only adults and juveniles may be tagged. Females attending calves younger than 6 months of age may not be tagged.

12. No more than 3 attempts may be made to attach a tag to an individual.

13. A tag attachment attempt must be discontinued if an animal exhibits repetitive strong adverse reactions to the activity or the vessel.

14. In no instance will the Permit Holder attempt to tag a cetacean anywhere forward of the pectoral fin.

15. Tagging activities are not authorized in the Great South Channel or in the northern and eastern sections of the Gulf of Maine.

16. The Permit holder must submit annual reports to the Chief, NMFS Permits, Conservation, and Education Division and a final report must be submitted within 180 days after expiration of the permit.

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

CCS will terminate an approach if a whale exhibits evidence of significant disturbance, such as evasive behavior, cessation of feeding, significant increase in dive times, or high energy behavior (e.g., breaching or lob tailing). When plankton sampling occurs in the vicinity of right whales, vessels would not approach closer than 50 m from the whales. If a whale approaches the vessel during plankton sampling, CCS will lift pump hoses out of

the water to minimize disturbance. Finally, approaches to right whales would be limited to 3 surface sequences (i.e., the time between rising to the surface after a long-duration dive and the next long-duration dive) per cruise.

APPROACH TO THE ASSESSMENT

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

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

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

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

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

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

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

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

physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) are likely to respond given exposure to the direct or indirect consequences of the proposed action on the natural environment, we ask if those responses are likely to be sufficient to reduce the quantity, quality, or availability of those constituent elements or physical, chemical, or biotic phenomena.

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

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

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

During each consultation, we conduct electronic searches of the general scientific literature using *American Fisheries Society*, *Google Scholar*, *ScienceDirect*, *BioOne*, *Conference Papers Index*, *JSTOR*, and *Aquatic Sciences and Fisheries Abstracts* search engines. We supplement these searches with electronic searches of doctoral dissertations

and master's theses. These searches specifically try to identify data or other information that supports a particular conclusion (for example, a study that suggests whales will exhibit a particular response to biopsy sampling or tagging) as well as data that does not support that conclusion.

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

ACTION AREA

Dr. Kraus' permit would authorize research in the U.S. Atlantic EEZ from Florida to Maine, bounded by the Hague Line to the north, the Gulf of Mexico to the south, the U.S. coastline to the west, and the boundary of the U.S. EEZ to the east (up to 200 nm from the shoreline).

CCS' permit would authorize research in the Gulf of Maine throughout the year. Research activities would primarily occur within Cape Cod Bay and within 100 km of Cape Cod during typical right whale residency (December to May).

The effects of the proposed action extend throughout the U.S. Atlantic EEZ; therefore, the action area considered in this Opinion includes the entire U.S. Atlantic EEZ.

STATUS OF THE SPECIES

The Endangered Species Division has determined that the following listed resources provided protection under the ESA occur within the action area and may be affected by proposed action:

Common Name	Scientific Name	Listing Status
Atlantic salmon (Gulf of Maine DPS)	*Salmo salar*	Endangered
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
North Atlantic right whale	*Eubalaena glacialis*	Endangered

Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Green sea turtle	*Chelonia mydas*	Endangered[3]
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
North Atlantic Right Whale Critical Habitat		

Listed Resources Not Likely to be Adversely Affected

During the proposed research activities, the applicants may encounter five species of listed sea turtles (green, hawksbill, Kemp's ridley, leatherback, and loggerhead), three species of listed whales (blue, sei, and sperm) and one listed anadromous fish species (Atlantic salmon) that are not the specific focus of the proposed research activities. These non-targeted species would not be exposed to biopsy sampling or tagging nor would they be approached for photo-identification or videography but still have the possibility of being incidentally harassed during research activities conducted on targeted species and during plankton sampling conducted in the Gulf of Maine.

Listed sea turtles occur in the action area and could therefore be disturbed by the proposed activities. However, because the proposed research activities are targeted specifically to whales, any interactions with and threats to the sea turtles are extremely unlikely and therefore discountable. NMFS' expects that the slow transit speeds during vessel surveys allow non-targeted sea turtles ample time to move away from the oncoming vessels. Moreover, observers looking for targeted species would identify sea turtles so that evasive maneuvers, if necessary, could be employed to avoid harassing any sea turtles encountered. Consequently, the increases in vessel traffic caused by the proposed research may affect, but would be unlikely to have any measurable adverse effect on green, hawksbill, Kemp's ridley, leatherback, and/or loggerhead sea turtles. There is the potential for sea turtles to become entangled in a plankton tow net during CCS' plankton surveys. However, the relatively small size of the tow net and the fact that the survey team will not target areas with high aggregrations of sea turtles make any potential threats of entanglement extremely unlikely and therefore discountable. Therefore, the proposed action is not likely to adversely affect any listed sea turtle species and these species will not be considered further in this opinion.

Endangered sperm, blue, and sei whales occur in the range of the proposed action and could be subject to disturbance and boat strikes from the proposed activities. However, because of the highly targeted nature of these activities and because the research vessels would transit at such slow speeds, the possibility of sperm, blue, and sei whales being exposed to the effects of the proposed research is very remote and therefore discountable. These species are very unlikely to be exposed and no adverse effects to these listed whale

3 Green sea turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. Due to difficulties in distinguishing between individuals from the Florida breeding population from other populations, green sea turtles are considered endangered wherever they occur in U.S. waters.

species are expected. Therefore, the proposed action is not likely to adversely affect sperm, blue, and sei whales and these species will not be considered further in this Opinion.

Atlantic salmon (*Salmo salar*) may occur in the action area and could potentially be affected by disturbance and boat strikes from the proposed activities. However, because of the highly targeted nature of these activities, the possibility of Atlantic salmon being exposed to the effects of the proposed research is very remote and therefore discountable. Atlantic salmon are very unlikely to be exposed and no adverse effects to salmon are expected. Therefore, the proposed action is not likely to adversely affect Atlantic salmon or any other listed anadromous fish species and these species will not be considered further in this Opinion.

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

Listed Resources Likely to be Adversely Affected

North Atlantic Right Whale

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

New England waters represent an important feeding habitat for North Atlantic right whale, especially during the spring, summer, and fall months (Kenney et al., 1995a). During the late winter and spring months, peak abundances occur in Cape Cod Bay and from Jordan and Wilkinson basins to the Great South Channel (Kenney et al., 1995b; Nichols et al., 2008; Pace III and Merrick, 2008). In the summer and fall months, right whale distribution then shifts from the northern edge of Georges Bank to the Bay of Fundy, the western Gulf of Maine, and around Roseway Basin (Winn et al., 1986; Kenney et al., 1995b; Kenney et al., 2001; Pace III and Merrick, 2008). Nichols et al. (2008) notes that right whale distribution in the western North Atlantic has shown some year-to-year variation in space and time, likely resulting from patchy prey distribution.

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

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

Life History Information

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

The calving interval for North Atlantic right whales is between 2 and 7 years (Knowlton et al., 1994; Best et al., 2001b; Burnell, 2001; Cooke et al., 2001). From 1980 to 1992, the average calving interval for females was 3.67 years (Knowlton et al., 1994); however, from 1990-1998 that interval increased to 5.8 years (Kraus et al., 2001), effectively lowering the reproductive rate of the western North Atlantic right whale population. Possible causes for the depressed reproductive rate include low genetic diversity, loss of habitat, food limitation and contaminants, biotoxins, and disease. Interestingly, calving data from 2001-2005 showed a dramatic increase in North Atlantic right whale calving (23 calves per year) indicating that the calving interval may have since decreased in this population (Kraus et al., 2005).

Right whales fast during the winter and feed during the summer, although some may opportunistically feed during periods of migration. They rely on dense patches of copepods (largely of the genus *Calanus* and *Pseudocalanus*) found in highly variable and spatially unpredictable locations in the Bay of Fundy, Roseway Basin, Cape Cod Bay, the Great South Channel, and other areas off the northern U.S. and Canadian coastlines

(Wishner et al., 1988; Murison and Gaskin, 1989; Mayo and Marx, 1990; Baumgartner et al., 2003; Baumgartner and Mate, 2003). Although right whales feed on copepod aggregations at the surface (Mayo and Marx, 1990), they more commonly dive below the surface to exploit areas of high prey density (Kenney et al., 1995a; Baumgartner et al., 2003; Baumgartner and Mate, 2003). Mothers and calves have been known to spend prolonged periods of time at the surface compared to other foraging individuals (Baumgartner and Mate, 2003).

Evidence indicates that the North Atlantic right whales, like other baleen whales, are able to hear at least low frequencies based on the morphology of its auditory apparatus (Ketten, 1997) and vocalize in the low frequency range (Richardson et al., 1995).

Listing Status

The North Atlantic right whale was originally listed as endangered under the precursor to the ESA and under the ESA since its inception in 1973 (35 FR 8495). The original listing included both the North Atlantic and the North Pacific populations. Following a comprehensive status review, NMFS concluded that these two populations consisted of two distinct species. On December 27, 2006 (71 FR 77704 and 71 FR 77694), NMFS published two proposed rules to list these species separately. The final rule published on March 6, 2008 (73 FR 12024). The North Atlantic right whale is also protected by CITES and the MMPA.

Status and Trends

Historically, North Atlantic right whales were greatly affected by commercial whaling activities. An estimate of pre-exploitation population size of North Atlantic right whales is not available; however, Reeves and Mitchell (1987) and Reeves et al. (1992) concluded that there were atleast hundreds to over a 1,000 right whale individuals, respectively, in the western North Atlantic in the 1600's with the greatest rate of population decline occurring in the 1700's. These studies were based on incomplete whaling data and should be viewed with caution. Back calculations using the present population size and growth rate suggest that the population may have numbered fewer than 100 individuals by 1935 when the IWC extended protection to right whales (Hain, 1975; Reeves et al., 1992) but this estimate should also be viewed with caution since little is known about the population dynamics of right whales in the years since whaling began.

In 1992, the western North Atlantic right whale population was estimated to be 295 individuals and an updated analysis gives a minimum population size of 345 individuals for 2005 based on the most recent reviews of the photo-id recapture database (Waring et al., 2009). The population growth rate reported for the period 1986-1992 by Knowlton et al. (1994) was 2.5 percent (CV=0.12) suggesting that the stock was showing signs of recovery. However, work by Caswell et al. (1999) suggested that the crude survival probability declined from about 0.99 in the early 1980's to about 0.94 in the late 1990's. The authors also determined that if the mortality rate is not slowed and reproduction not improved, extinction could occur within 100 years. Additional work conducted in 1999 showed that survival had indeed declined in the 1990's particularly for adult females (Best et al., 2001b; Clapham, 2002). The most recent stock assessment for the species

reported a mean growth rate of 1.8 percent for the period 1990-2005, giving evidence that annual growth in the population remains extremely low (Waring et al. 2009). The number of right whales in the eastern North Atlantic Ocean is probably much smaller, although there is insufficient data available to make an estimation of the size of this population.

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

Levels of chromium reported in right whale blubber samples are sufficient to be mutagenic and may be affecting recovery of the species along with exposure to other contaminants in the marine environment (Chen et al., 2009; Wise et al., 2009). Annual mortality rate, and calculations based on demographic data through 1999 indicate that this mortality rate increase could reduce population growth by approximately 10 percent per year (Fujiwara and Caswell, 2001, Kraus et al., 2005).
Concerns also exist for changes in climate and its effect on the ability of North Atlantic right whales to recover in future years (Greene et al., 2003). Specifically, the variations in oceanography resulting from current shifts and water temperatures may significantly affect the occurrence of the North Atlantic right whale's primary prey resource (i.e. copepod crustaceans). To adapt, North Atlantic right whales may have to shift their distribution to reflect changes in prey distribution, pursue other prey types, or face prey shortage. Changes in calving intervals with sea surface temperature have already been documented for southern right whales (Leaper et al., 2006); however there is insufficient data to know the effects that current climate-related trends are having on the North Atlantic right whale population.

In summary, North Atlantic right whales were heavily reduced by whaling up to the late 19th century. While the population was beginning to show signs of recovery in the late 1980's and early 1990's, this trend was reversed by the late 1990's and current estimates show that mean growth rates for the species remain extremely low. Recent increases in calving may indicate that the calving interval for the species is decreasing, although other anthropogenic sources of mortality such as ship strikes and entanglement in fishing gear continue to threaten the species and slow its ability to recover. Factors that may account for the increasing extinction risk of this population include loss of genetic diversity prior to the 20th century and the continued loss of individuals, particularly reproductive females. In addition, the small population size increases the species' sensitivity to

deleterious phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, effectively raising the species' risk of extinction. More details on natural and anthrogenic factors affecting North Atlantic right whale survival and recovery in the action area are addressed in the *Environmental Baseline* section of this Opinion.

North Atlantic Right Whale Critical Habitat

Habitat Description, Listing Status, and Essential Features

Critical habitat has been designated for the endangered North Atlantic right whale in the Great South Channel[4], Cape Cod Bay[5], and off the states of Georgia and Florida[6] (59 FR 28793; June 3, 1994). The critical habitat designation encompasses three primary feeding and nursery habitats in the United States used by right whales during their annual migration. The physical, chemical, and biotic features that form right whale critical habitat include the composition of zooplankton in feeding areas, the topographic and seasonal oceanographic characteristics conducive to zooplankton growth; and water depth, water temperatures, and distance from shore for calving and nursery areas (59 FR 28793; June 3, 1994).

The Great South Channel is a large funnel-shaped bathymetric feature at the southern extreme of the Gulf of Maine between Georges Bank and Cape Cod, Massachusetts. The channel is bordered on the west by Cape Cod and Nantucket Shoals, and on the east by Georges Bank. The Great South Channel has an average depth of 175m and a maximum depth of 200m to the north. The late winter/early spring mixing of warmer shelf waters with the cold Gulf of Maine water funneled through the channel causes a dramatic increase in faunal productivity in the area, including zooplankton species important to North Atlantic right whales (Wishner et al., 1988).

Cape Cod Bay is a large embayment on the U.S. Atlantic Ocean off the state of Massachusetts that is bounded on three sides by Cape Cod and the Massachusetts coastline. Cape Cod Bay has an average depth of about 25 m and a maximum depth of about 65 m. Just as with the Great South Channel, late winter/early spring mixing causes an increase of zooplankton fauna important to North Atlantic right whales and other cetaceans. Samples taken in the daytime indicated greater densities of copepods at greater depths with densities of 100 individuals per cubic meter or more occurring from April through June (Mayo and Marx, 1990).

The southeastern U.S. migratory corridor and calving grounds average about 30 m in depth with a maximum depth of about 60 m. The deepest waters occur along the coast of Florida, just south of Cape Canaveral. The continental shelf slopes gently from the coast

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

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

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

to approximately the 50 m (164 ft) isobath; where it drops off to the 200 m (656 ft) isobath. While these areas are not considered important feeding grounds for North Atlantic right whales, they do represent the primary calving and nursery ground for the species.

Status and Trends

Threats affecting the status and conservation value of North Atlantic right whale critical habitat are similar to threats affecting North Atlantic right whale individuals and populations occurring within these areas (e.g. vessel interactions, ocean noise, other forms of habitat contamination, etc.). Please refer to the *Status and Trends* section for North Atlantic right whales above and the *Environmental Baseline* Section of this Opinion for more information on these threats affecting the status of both the North Atlantic right whale species and its designated critical habitat. The discussion below expands on the threats shaping the global status of North Atlantic right whales to include additional factors shaping the status of critical habitat areas for the species.

Sea surface temperatures in the North Atlantic Ocean are closely related to the North Atlantic Oscillation (NAO) Index and influence the abundance of zooplankton in foraging areas important to the North Atlantic right whale. In the 1970s and 1980s, the NAO Index was positive and sea surface temperatures increased. These increases are believed to have produced conditions that were favorable for the copepod *Calanus finmarchicus* (the principal prey of North Atlantic right whales) and may have increased calving rates (Greene et al., 2003). In the late 1980s and 1990s, the NAO Index was mainly positive but exhibited two substantial, multi-year reversals to negative values. This was followed by two major, multi-year declines in copepod prey abundance (Drinkwater et al., 2003). Calving rates for North Atlantic right whales followed the declining trend in copepod abundance, although there was a time lag between the two (Greene et al., 2003). Although the NAO Index has been positive for the past 25 years, atmospheric models suggest that increases in ocean temperature associated with climate change forecasts may produce more severe fluctuations in the North Atlantic Oscillation. Such fluctuations would be expected to cause dramatic shifts in the reproductive rate of critically endangered North Atlantic right whales (Drinkwater et al., 2003; Greene et al., 2003) and possibly a northward shift in the location of right whale calving areas (Kenney, 2007).

The availability of dense concentrations of zooplankton blooms in Cape Cod Bay in late winter and the Great South Channel in spring is described as the key factor for right whale utilization of these areas. However, the combination of highly oxygenated water and dense zooplankton concentrations are optimal conditions for the small schooling fishes (sand lance, herring and mackerel) that prey upon some of the same zooplankton as North Atlantic right whales. Efforts being made to recover commercially targeted finfish stocks from their current overfished condition may lead to a reduction in the biomass of these types of small schooling fish throughout the region thereby reducing interspecific competition for prey and increasing the conservation value of this critical habitat for North Atlantic right whales. While it is not known whether zooplankton densities that occur seasonally in Cape Cod Bay or the Great South Channel are expected to increase

significantly, increased predation by groundfish on small schooling fish in certain areas and at specific critical periods may allow the necessary high zooplankton densities to be maintained in these areas for longer periods, or accumulate in other areas at levels acceptable to North Atlantic right whales.

The presence of commercial and recreational vessels and the threat of entanglement in fishing gear pose significant threats to the conservation value of these habitat areas by potentially interrupting feeding or nursing behavior or even causing temporary habitat displacement in areas essential to the survival of the species. Habitat contamination and pollution from land based sources may contaminate prey resources important to North Atlantic right whales, thereby lowering the conservation value of foraging grounds in the northeast. These threats are expected to continue to affect the conservation value of foraging grounds and/or calving areas for North Atlantic right whales and remain a significant threat to the recovery of the species as whole.

Humpback Whale

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

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

Humpback whales also occur in the North Pacific and Southern Hemisphere. In the North Pacific, the species is found off the Hawaiian Islands, from Mexico north to the Gulf of Alaska and Bering Sea, and west along the Aleutian Islands to the Kamchatka

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

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

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

Life History Information

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

males sing long, complex songs directed toward females and other males. Males compete for mates and are polygamous (Clapham, 1996).

Although largely solitary, humpback whales often cooperate during feeding activities (Elena et al., 2002). They exhibit a wide range of foraging behaviors, and feed on a range of prey types including small schooling fishes, euphausiids, and other large zooplankton (Nemoto, 1957; Nemoto, 1959; Nemoto, 1970; Krieger and Wing, 1984; 1986). Since a majority of humpback whale prey is found above 300 m (or 984 ft), most dives are relatively shallow (approximately 60-170 m) (Hamilton et al., 1997). Dives usually range between 2-5 min, but can last as long as 20 min (Dolphin, 1987). Feeding groups can be stable for long periods of times, and there is good evidence of some territoriality on both feeding (Clapham, 1996) and wintering grounds (Tyack, 1981).

Humpback whale vocalization is much better understood than hearing sensitivity, although like other baleen whales, evidence indicates the species is able to hear at least low frequencies (less than 1 kHz) based on the morphology of its auditory apparatus (Ketten, 1997). Different whale calls have been associated with different functions including feeding, breeding, and other social calls. Humpback whales are reported to be less vocal when found on their high-latitude feeding grounds in summer compared with their lower-latitude winter ranges (Richardson et al, 1995). Au (2000) compiled information on humpback whale vocalizations and reported sounds to include grunts in the frequency range of 25-1,900 Hz, pulses in the frequency range of 25-89 Hz, and songs with components ranging from 30-8,000 Hz.

Listing Status

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

Status and Trends

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

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

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

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

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

Organochlorines, including PCB and DDT, have been identified from humpback whale blubber samples (Gauthier et al., 1997). As with blue whales, these contaminants are

transferred to young through the placenta, leaving newborns with contaminant loads equal to that of mothers before bioaccumulating additional contaminants during life and passing the additional burden to the next generation (Metcalfe et al., 2004).

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

In summary, the regional estimates suggest that the global population of humpback whales numbers in the tens of thousands, meaning that current abundances appear to be significantly lower than pre-exploitation levels in all ocean basins although numbers appear to be increasing in the North Atlantic and Southern Hemisphere stocks. At present, several factors may be affecting humpback whales globally, although the significance of any effects remains largely unknown. These factors include entrapment and entanglement in commercial fishing gear, ship strikes, habitat issues such as pollutants and increased ocean noise, subsistence harvest, scientific whaling and research, and commercial and private whale watching. Humpback whale populations are of sizes that are likely large enough to withstand natural environmental and genetic stresses to fitness. However, their resilience to anthropogenic stressors is less clear. Factors specific to the action area that are affecting the ability of the species to survive and recover in the wild are addressed in the *Environmental Baseline* section of this Opinion.

Fin Whale

Species Description, Distribution, and Population Structure

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

Fin whales are widely distributed throughout the world's oceans; however, they tend to avoid tropical and pack ice waters with the high-latitude limit of their range set by ice and the lower-latitude limit by warmer tropical waters approximately 15° C (Sergeant, 1977). They also are less concentrated in nearshore environments while appearing to favor deeper waters (Clark et al., 1995). Fin whales can be found singly or in pairs, but can also form larger groupings of more than 3 individuals, particularly while feeding. Balcomb (1987) noted that fin whales commonly travel in herds, often widely dispersed, ranging from 6 to more than 100 individuals. They have also been reported grouped with other balaenopterid whale species at times (Corkeron et al., 1999; Shirihai, 2002). Most fin whales in the northern hemisphere migrate seasonally from the Arctic in summer to lower latitudes in the winter to breed. However , the locations of these breeding grounds

are not known and their migration patterns are less predictable than for similar species such as humpback whales (Perry et al., 1999).

In the North Atlantic, fin whales are ubiquitous during the summer; however, they winter in the western Atlantic from from the edge of the sea ice south to the Gulf of Mexico and in the eastern Atlantic from southern Norway to the Bay of Biscay with some whales also migrating into the Mediterranean Sea (Gambell, 1985). A general migration in the fall from the Labrador and Newfoundland region, south past Bermuda, and into the West Indies has also been theorized (Clark, 1995). Fin whales are also endemic to the Mediterranean Sea, where (at least in the western Mediterranean), individuals tend to aggregate during summer and disperse in winter over large spatial scales (Cotte et al., 2009). It has been suggested that waters off New England and in the Gulf of Maine within the action area for this consultation represent a major feeding ground for fin whales as there is some evidence of site fidelity by females (Clapham and Seipt, 1991; Agler et al., 1993).

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

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

Life History Information

The life expectancy of fin whales is thought to be between 70 and 80 years (Kjeld et al., 2006). Fin whales become sexually mature between 5 and 15 years of age (Gambell, 1985; COSEWIC, 2005) and have a calving interval of 2-3 years (Agler et al., 1993). Gestation lasts about 12 months and nursing occurs for 6-11 months (Perry et al., 1999). Calving and mating activities occur in late fall and winter (Mackintosh and Wheeler,

1929; Nishiwaki, 1952; Tomilin, 1957) although specific breeding areas remain unknown. Little is known of the group behavior or composition during the reproductive season; however, a staged seasonal migration has been suggested, with pregnant females migrating in advance of other sex or age classes and immature whales migrating last (COSEWIC, 2005; NMFS, 2006). Agler (1993) reported that the gross annual reproductive rate of fin whales in the Gulf of Maine was about 8 percent during the 1980s.

Fin whales feed on euphausiids and large copepods in addition to schooling fish (Nemoto, 1970; Kawamura, 1982; Watkins et al., 1984) although their diet varies seasonally and geographically (Watkins et al., 1984; Shirihai, 2002). Competition may occur with other baleen whales or other consumers of these prey types (Nemoto, 1970; Kawamura, 1980), although Payne et al.(1990) concluded that fin whales are less stressed by fluctuations in prey availability than humpback whales due to their greater ability to exploit patchy prey aggregations.

Evidence indicates that the species, like other baleen whales, is able to hear at least low frequencies based on the morphology of its auditory apparatus (Ketten, 1997) and vocalizes in the low frequency range. Richardson et al. (1995) reported the most common sound produced by fin whales is a one-sound vocalization at around 20-Hz, occurring in short series of pulses in spring, summer, and fall, and in repeated stereotyped patterns in winter. The source depth of calling fin whales has been reported to be about 50 m (Watkins et al., 1987). The amount of time fin whales spend diving varies from a tens of seconds to over an hour (Watkins et al., 1981; Gambell, 1985; Hain et al., 1992; Croll et al., 2001a).

Listing Status

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

Status and Trends

Historically, fin whale populations worldwide were severly affected by commercial whaling in the 20th century in the North Atlantic, North Pacific, and Southern oceans (Cherfas, 1989 *as cited in* Perry et al., 1999). Braham (1991) compiled available regional estimates and estimated the global population of fin whales in 1991 to be about 119,000 individuals, which represented about a quarter of his estimated pre-exploitation abundance of 464,000 individuals.

Sergeant (1977) estimated that prior to commercial exploitation, there may have been as many as 30,000 to 50,000 fin whale individuals in the North Atlantic. While there are currently no reliable estimates of the entire population of the North Atlantic, estimates do exist for portions of the North Atlantic. For the year's 1996-2001, the IWC's best estimate for the population of fin whales in the central and northeastern Atlantic was

30,000 individuals. Braham (1991) estimated the western North Atlantic to contain between 3,590 and 6,300 individuals while Hain et al. (1992) estimated that there were approximately 5,000 fin whales in the western North Atlantic Ocean based on a 1978-1982 survey. The most recent abundance estimate for the western North Atlantic stock was 2,269 individuals (Waring et al., 2009).

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

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

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

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

Fin whales are still hunted in subsistence fisheries off West Greenland and are hunted by Japanese whalers in the Southern Ocean as part of Japan's JARPA II research program with anticipated harvests of 50 fin whales each year expected for the period 2007-2019

(Nishiwaki et al., 2006). Other current threats affecting fin whale recovery include effects of ocean noise as well as disturbance from whale watching and other scientific research activities.

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

In summary, current estimates of fin whale abundance appear to be significantly lower than historic levels in all ocean basins; however, there is insufficient data to determine overall population trends for this species (Carretta et al., 2007). At present, several factors may be affecting fin whales globally, although the significance of any effects remains largely unknown. These factors include entrapment and entanglement in commercial fishing gear, ship strikes, habitat issues such as pollutants and increased ocean noise, subsistence harvest, scientific whaling and research, and commercial and private whale watching. Factors specific to the action area that are affecting the ability of the species to survive and recover in the wild are addressed in the *Environmental Baseline* section of this Opinion.

ENVIRONMENTAL BASELINE

By regulation, environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR §402.02).

The purpose of the *Environmental Baseline* section is to step down from the species level discussion in the *Status of the Species* section and establish the current and projected viability or fitness of individuals and populations within the action area so that the effects of the proposed research activities can be measured and assessed. The following sections summarize the natural phenomena as well as the anthropogenic activities that have affected and continue to affect listed whale individuals and populations within the action area, including areas designated as critical habitat for North Atlantic right whales.

Natural Sources of Stress and Mortality

Predation and Interspecific Competition

Killer whale or shark attacks may result in serious injury or death in very young or sick fin whale individuals and adults have shown little resistance when overtaken in the past (Perry et al., 1999; Ford and Reeves, 2008). Humpback whales have been known to be preyed upon in the eastern Pacific (Steiger et al., 2008); however, it is not known if

humpback whales are currently affected in the North Atlantic. Large sharks and killer whales may conceivably prey on North Atlantic right whales as scars have been reported indicating evidence of attacks (Kraus, 1990; NMFS, 2005); however it is not known what impact these attacks have on right whale populations.

In addition to threats from shark and killer whale attacks, several researchers have suggested the recovery of the North Atlantic right whale has been impeded by competition with other whales (most notably Sei whales) for copepod food resources in the western North Atlantic (Rice, 1974; Mitchell, 1975; Scarff, 1986). While this may represent a natural threat to recovery, the extent to which this type of interspecific competition impacts the conservation value of critical habitat by lowering prey resources available to North Atlantic right whales is not well known.

Diseases, Parasites, and Biotoxins

Parasites and biotoxins from red-tide blooms are other potential causes of mortality of listed baleen whales in the action area (Perry et al., 1999). The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in humpback and fin whales and may be affecting recovery of these species (Lambertsen, 1992). The threat of mortality and debilitation of North Atlantic right whales from similar diseases and red tide events is currently unknown; however, the primary prey resource of North Atlantic right whales (i.e. *Calanus finmarchicus)* has been shown to carry biotoxins generated from red-tide blooms in the Bay of Fundy (Doucette et al., 2006), suggesting that foraging areas including areas designated as critical habitat could contain similar types of contaminated prey. Also, given their low numbers, right whales are expected to have a lower resilience to disease-related stressors that could affect this species' ability to recover.

Oceanographic Features and Climatic Variability

Naturally occurring climatic patterns, such as the Pacific Decadal Oscillation and the El Niño and La Niña events, are identified as major causes of changing marine productivity and may therefore influence listed species' prey abundance in the action area (Mantua et al., 1997; Francis et al., 1998; Beamish et al., 1999; Hare et al., 1999; Benson and Trites, 2002). There is also close linkage between North Atlantic right whale foraging and the physical forcing processes that concentrate prey in the oceanic environment (Kenney et al., 2001). Interannual, decadal, and longer time-scale variability in climate can alter the distribution and biomass of prey available to North Atlantic right whales. For example, decade-scale climatic regime shifts have been related to changes in zooplankton in the North Atlantic (Fromentin and Planque, 1996), including within foraging grounds designated as critical habitat for North Atlantic right whales. In addition, increases in ocean temperature may cause dramatic shifts in the reproductive rate of North Atlantic right whales (Drinkwater et al., 2003; Greene et al., 2003) and possibly a northward shift in the location of right whale calving areas (Kenney, 2007). However, gaps in information and the complexity of climatic interactions complicate the ability to predict the effects that climate variability may have to these species from year to year (Kintisch, 2006; Simmonds and Isaac, 2007).

Other possible effects of climatic variability for listed whales include the alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, and altered timing of breeding (MacLeod et al., 2005; Robinson et al., 2005; Kintisch, 2006; Learmonth et al., 2006; McMahon and Hays, 2006).

Anthropogenic Sources of Stress and Mortality

Commercial Whaling

Large whale populations in the action area were historically impacted by commercial whaling. Humpback whales were one of the predominant species targeted by commercial whaling operations in the western North Atlantic between the early 1800's and the early part of the 1900's including summer feeding grounds located in the Gulf of Maine where a majority of the proposed research activities are expected to occur (Stevick et al., 2003). American whalers alone harvested 14,164-18,212 humpbacks in the North Atlantic between 1805-1909 (Best, 1987 *as cited in* NMFS, 1991) while whaling operations off the east coast of Canada took 1,387 humpback whales between 1903 and 1970 (Mitchell, 1974). Fin whales were also heavily affected, as over 48,000 fin whales were harvested between 1860 and 1970 in the North Atlantic alone (Braham, 1991). Right whales were also historically impacted by commercial whaling with their greatest rates of population decline probably occurring in the 1700's (Reeves and Mitchell, 1987; Reeves et al., 1992). In addition, hunting in the 19th and early 20th centuries, largely by Norwegian whaling operations, are likely to have irreversibly damaged or extirpated this stock (Collett, 1909; Brown, 1976).

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

Habitat Degradation

A number of human activities may be directly or indirectly affecting listed whale species and designated critical habitat in the action area through habitat degradation. Anthropogenic activities such as discharges from wastewater systems, dredging, ocean dumping and disposal, aquaculture, and additional impacts from coastal development are known to degrade coastal waters utilized by listed whales in the action area including foraging and calving grounds designated as critical habitat for North Atlantic right whales. Multiple municipal, industrial and household sources as well as atmospheric transport introduce various pollutants such as pesticides, hydrocarbons, organochlorides (e.g. DDT and PCBs), and other pollutants that may cause adverse health effects to listed whales (Iwata, 1993; Grant and Ross, 2002; Garrett, 2004; Hartwell, 2004).

The accumulation of persistent pollutants through trophic transfer may cause mortality and sub-lethal effects to marine mammals (Waring et al, 2009), including immune system abnormalities, endocrine disruption and reproductive effects (Krahn et al., 2007). Due to their large amount of blubber, marine mammals readily accumulate lipid-soluble contaminants such as PCBs (O'Hara and Rice, 1996) and concentrations of organochlorides have been documented in blubber samples collected for the species targeted by the proposed research activities (Aguilar and Borrell, 1988; Gauthier et al., 1997; Metcalfe et al., 2004). Recent efforts have led to improvements in regional water quality in the action area, although the more persistent chemicals are still detected and are expected to endure for years (Mearns, 2001; Grant and Ross, 2002). Also, acute exposure to hydrocarbons from petroleum products released into the environment via oil spills and other discharges are known to cause behavioral changes in marine mammals (Grant and Ross, 2002) and may directly injure individuals through skin contact with oils (Geraci, 1990), inhalation at the water's surface and ingesting compounds while feeding (Matkin and Saulitis, 1997). Hydrocarbons also have the potential to impact prey populations, and therefore may affect listed species indirectly by reducing food availability in the action area and lowering the conservation value of critical habitat for right whales in the northeast foraging grounds (i.e. Great South Channel and Cape Cod Bay).

Habitat in the action area may also be degraded by various sources of marine debris such as plastics, glass, metal, polystyrene foam, rubber, and derelict fishing gear. Marine debris is introduced into the marine environment through ocean dumping, littering, or hydrologic transport of these materials from land-based sources. Listed whales may become entangled in marine debris or directly ingest it while feeding, potentially leading to digestive problems, injury, or even death.

Ocean Noise

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

Commercial shipping traffic is a major source of low frequency anthropogenic noise in the action area (NRC, 2003). Although large vessels emit predominantly low frequency sound, studies report broadband noise from large cargo ships at levels exceeding 2 kHz, which may interfere with important biological functions of cetaceans (Holt, 2008). However, the primary concern of incidental shipping noise is not related to acute exposures, but rather to the general increase in continuous background ambient noise and

the potential masking of marine animals' communication systems, their ability to hear mating calls, and their ability to pick up acoustic environmental cues that animals use to navigate and/or sense their surroundings, including sounds that are used to detect predators (OSPAR, 2009).

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

Marine construction and industrial activities include pile driving, dredging, cable laying, drilling, the operation of offshore wind farms, and the use of explosives in construction and decommissioning. In 2001, Cape Wind Associates, LLC filed a permit application with the USACE, New England District, in anticipation of constructing a wind park located on Horseshoe Shoals in Nantucket Sound, Massachusetts. The proposed park would consist of 130 offshore wind turbine generators with a maximum potential electric output of approximately 454 megawatts (MW). The Minerals Management Service (MMS) is also currently drafting an EIS regarding a proposal from the Long Island Power Authority and Florida Power and Light Energy to construct an eight square mile wind park of 40, 3.6 MW wind turbine generators in federal waters, approximately 3.6 miles south of Jones Beach Island, Long Island, New York. Also, Northeast Gateway Energy Bridge, LLC submitted a proposal for a liquefied natural gas facility approximately 13 miles southeast of the city of Gloucester in Massachusetts Bay waters. All these activities have the potential to affect listed marine mammals in the action area and/or lower the conservation value of designated critical habitat for North Atlantic right whales through habitat displacement, increased vessel traffic, and acoustic harassment.

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

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

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

In summary, listed whales occurring in the action area are regularly exposed to several sources of anthropogenic sound sources, the effects of which are not well understood. Short-term exposure to high-energy sound sources such as underwater explosions, pile driving and other marine construction have the potential to result in direct injury or even death to cetacean individuals located near the sound source while the effects of exposure

to more moderate but generally increasing background sound levels from vessel traffic, seismic surveys, and sonar pings may increase the effects of masking as well as the long term-habitat quality in the action area. The latter has the potential to lead to more population level effects such as overall distribution and rates of reproduction although more work needs to be done to confirm this.

U.S. Navy Activities

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

In August and September 2008, the U.S. Navy conducted a ship shock trial on the MESA VERDE in waters east of Jacksonville, Florida, using high blast explosives. Surveys conducted after these activities did not detect any dead or injured listed marine mammals. In addition, no marine mammal or sea turtle stranding has been attributed to the shock trial. However, the lack of direct observations of adverse responses to these activities does indicate that that no responses occurred as a result of these activities.

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

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

that marine mammals could have been exposed to these exercises and may have undergone short-term behavioral reactions to the sonar exposure.

On 28 July 2009, NMFS issued a final biological opinion on the U.S. Navy's proposal to place a network of underwater transducer devices and undersea cables in a 1,713 km^2 area of the ocean about 93 km (or 50 nm) offshore of northeastern Florida beginning in 2012 or 2013 with operations scheduled to begin sometime in 2014 or 2015. The instrumented area, which would be called the Undersea Warfare Tracking Range, would be connected by cable to a facility that would be located on shore where the data collected would be used to evaluate the performance of participants in shallow water training exercises. NMFS concluded that 106 humpback whales and 47 North Atlantic right whales might be exposed to active sonar operations at received levels that might result in behavioral responses. However, the Opinion concluded that these exposures were not likely to jeopardize the continued existence of these species.

Fishing Activities

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

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

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

NMFS has no observer records of fin whales being killed or seriously injured in commercial fisheries observed from 1997 to 2001 in the U.S. North Atlantic (Waring et al., 2004). However, NMFS stranding and entanglement records during the same time period yield an average of 0.2 fin whale mortalities per year from fishery interactions or

entanglements in U.S. Atlantic waters (Waring et al., 2004). In addition, recent records show there were 14 confirmed reports of fin whales being entangled in fishing gear between 2004 and 2008 off the Atlantic coast of the U.S. and Maritime Provinces of Canada, with 3 whales dying of their wounds and an additional 3 sustaining serious injuries (Glass et al., 2010).

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

Ship Strikes and Other Vessel Interactions

In addition to noise effects described earlier, vessels operating in the action area adversely affect listed whales through direct ship strikes and/or other physical and behavioral disturbance. From 2000-2004, there were 42 confirmed ship strikes on large whales in the North Atlantic with 21 confirmed deaths (Cole et al., 2006). Fin whales were the most frequently struck whale, although North Atlantic right and humpback whales were also commonly struck (Laist et al., 2001). Recent records show that from 2004-2008, there were 17 confirmed reports of North Atlantic right whales being struck with 8 whales dying of their wounds and 2 additional right whales whales sustaining serious injuries (Glass et al., 2010). Results for for that same period listed 14 reports of humpbacks getting struck (including 8 confirmed mortalities) and 13 reports of fin whales being struck (including 10 confirmed mortalities) (Glass et al., 2010). Deaths of females, in particular, are especially threatening the ability of the North Atlantic right whale population to recover. For instance, in 2005, mortalities included six adult females, three of which were carrying near-term fetuses and four of which were just starting to bear calves, thereby representing a lost reproductive potential of as many as 21 individuals (Kraus et al., 2005).

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

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

Scientific Research

Large whales in the action area have been the subject of numerous scientific research activities, as authorized by NMFS permits. Research activities include close vessel and aircraft approaches, biopsy sampling, suction cup and implantable satellite tagging, the opportunistic collection of sloughed skin, and active acoustic experiments. There are currently 14 active permits authorizing research on the whales targeted by the proposed action in the U.S. Atlantic EEZ. **Table 3** below displays the current take numbers permitted over the next 5 years (2010-2015), including the additional numbers proposed for the research activities included in this consultation. See **Appendix A** for a list of the permit holders, permit numbers and expiration dates for these permits and see **Appendix B** for a breakdown of the expected take broken down for each year.

Table 3. Cumulative Take Numbers for Target Species from Currently Active Scientific Research Permits Operating in the Action Area (2010-2015)

Target Species	Level B Harassment Only[7]		Biopsy*		Suction Cup Tagging*		Implantable Satellite Tagging*		Active Acoustics (Sonar)*	
	Current	Proposed	Current	Proposed	Current	Proposed	Current	Proposed	Current	Proposed
North Atlantic Right Whale	5,150	13,500	240 (120 calf)	250 (100 calf)	430 (60 calf)	100	135	0	0	1,750
Fin Whale	5,852	100	830 (90 calf)	0	684	0	235	0	0	0

7 Level B harassment activities are defined as any activity that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild.

Hump back Whale	11,698	100	1,460 (80 calf)	0	684	0	235	0	3,000	0

* The proposed takes for biopsy sampling, tagging, and active acoustics would occur simultaneously with Level B activities. This table represents a worst-case scenario for species.

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. Authorized "takes" by harassment included in **Table 3** represent substantial research effort relative to species abundance in the action area with repeated disturbances of individuals likely to occur each year. However, all permits for marine mammals contain conditions requiring the permit holders to coordinate their activities with the NMFS regional offices and other permit holders and, to the extent possible, share data to avoid unnecessary duplication of research. 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.

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

Nevertheless, the fact that multiple permitted "takes" of listed whales is already permitted and is expected to continue to be permitted in the future, means that short term behavioral harassment expected to listed whales from similar research activities has the ability to contribute to or even exacerbate the stress response to marine mammals generated from other threats occurring in the action area. The point at which this leads to a measurable cumulative impact on the survival and recovery of listed whales or significantly reduces the conservation value of critical habitat for North Atlantic right whales, however, is uncertain. Our ability to detect long-term effects from research activities will depend on several factors including our ability to better detect sub-lethal effects from research actions as well as funding and prioritizing long-term studies investigating survival and

reproductive abilities of whales targeted by similar types of research in the past. This may lead to statistically significant trends showing whether or not repeated disturbances by research activities are affecting the ability of listed whales to survive and recover in the wild to an appreciable degree. More information on anticipated effects from similar research actions is included in the *Effects of the Proposed Action* section of this Opinion.

Conservation and Management Efforts

Several conservation and management efforts have been undertaken for listed whales in the action area to aid in recovery efforts. Recovery plans under the ESA help guide the protection and conservation of listed species. A final plan is in place for the humpback whale and the North Atlantic right whale (NMFS, 1991; 2005) while the recovery plan for the fin whale is currently being finalized at the time of this consultation. NMFS implements conservation and management activities for these species through its Regional Offices and Fishery Science Centers in cooperation with states, conservation groups, the public, and other federal agencies. In addition, the status of protected whale species is monitored by surveys conducted every three years.

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

EFFECTS OF THE PROPOSED ACTION

Pursuant to Section 7(a)(2) of the ESA, federal agencies are directed to insure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed action, the probability of individuals of listed species and designated critical habitat being exposed to these stressors, and the probable responses of those individuals or, in the case of critical habitat, the responses of physical, chemical, or biotic phenomena that give the

designated area value for the conservation of listed species (given probable exposures) based on the best scientific and commercial evidence available.

As described in the *Approach to the Assessment* section, for any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, and lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the listed species those populations represent. In the case of critical habitat, for any responses that are expected to reduce the quantity, quality, or availability of the primary or secondary constituent elements of the area of designated critical habitat (or physical, chemical, or biotic phenomena), we ask if those reductions are likely to be sufficient to reduce the conservation value of the designated critical habitat for listed species in the action area. The purpose of this assessment is to determine if it is reasonable to expect the proposed research activites to have effects on listed species that could appreciably reduce their likelihood of surviving and recovering in the wild or whether effects to critical habitat would be sufficient to reduce the conservation value of the entire critical habitat designation.

For this consultation, we are particularly concerned about behavioral disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level consequences. The proposed permits would authorize non-lethal "takes" by harassment of listed species by way of aerial and vessel surveys including close vessel approaches for biopsy sampling, suction cup tagging, and prey mapping and sampling. As stated earlier, we define harassment as an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents.

Some forms of harassment, including vessel survey approaches for biopsy sampling as well as prey sampling and mapping will occur in areas designated as critical habitat for North Atlantic right whales. Therefore, these activities also have the potential to reduce the conservation value of designated critical habitat for North Atlantic right whales, including foraging grounds designated in the northeast U.S. (i.e. Great South Channel and Cape Cod Bay), and calving grounds designated in the southeast U.S. (i.e. calving grounds located off the coasts of Georgia and Florida).

Potential Stressors

The assessment for this consultation identified several possible stressors associated with the activities proposed to be authorized under proposed permit. These include noise and visual disturbance during aerial and vessel surveys, noise and visual disturbance during prey sampling activities, reduction in prey resources collected during sampling, the potential for vessel strikes during transit, biopsy sampling, suction cup tagging, and exposure to active sonar from fish finders used for mapping prey resources.

Exposure Analysis

Exposure analyses identify the co-occurrence of ESA-listed species and critical habitat with the action's effects in space and time, and identify the nature of that co-occurrence. The exposure analysis identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the action's effects and the population(s) or subpopulation(s) those individuals represent. For the exposure analysis conducted for this consultation, we estimated the number of individual whales likely to be exposed to the effects of the proposed research activities using the best information available to us including recent population estimates, expected growth rates over the life of the permits, the maximum survey effort expected from the researchers over the life of the permits, and past take numbers reported from permits issued to the same researchers or other researchers that have performed similar types of research in similar areas. We also identified areas designated as critical habitat for North Atlantic right whales that would be exposed to the effects of the research activities.

While annual reports detailing prior "takes" are useful in estimating exposure levels, it must be noted that the frequency, duration, area, and focus of research activities often vary on an annual basis due to factors such as weather, funding, opportunistic events, and evolving research goals and needs. Also, the threshold for reporting whether an actual "take" occurred has evolved over the years, thus possibly introducing some level of human error or bias into numbers reported in prior annual reports (e.g. some researchers may have reported a "take" only if the animal somehow reacted to an approach while other researchers may have assumed a "take" whether the animal exhibited a visible reaction or not). Thus, past annual reports introduce some level of uncertainty as to their accuracy for predicting future activities, levels of effort, and expected "takes" of listed species. Despite this uncertainty, annual reports remain one of the most valuable resources to the Endangered Species Division for estimating exposure levels of future permit actions and were thus utilized in this consultation. The Permits Division has made an effort to standardize reporting of "takes" resulting from research activities which should lead to more accurate and informative annual reports in future years and hopefully reduce the level of error and uncertainty associated with the number of "takes" reported.

Our analysis considered the amount of North Atlantic right whale individuals that were observed in past years from aerial and vessel surveys performed by Dr. Scott Kraus, CCS, and NMFS-NEFSC in the action area during the period 2005-2009 under their active permits or permits that have recently expired. Numbers were split between surveys done in the southeastern U.S. off the coasts of Florida and Georgia and surveys done off the northeastern U.S. in the Gulf of Maine. To account for the variability in research effort from year to year, we calculated, to the extent possible, the mean North Atlantic right whale sightings observed per survey in each region during that time span rather than the mean sightings reported each year. We equated these mean sightings per survey to an average observed level of exposure for North Atlantic right whales for aerial surveys as well as vessel surveys during that time span. Then, using the maximum possible survey effort expected from the research applicants, we estimated the maximum amount of whale individuals likely to be exposed each year over the life of the proposed permits. Using a standard distribution, we estimated likely exposures out to 4 standard

deviations to account for more than 99% of the annual levels of "take" possible as well as to account for variability in annual research effort and population growth over the life of the proposed permits. A similar analysis was done for "takes" resulting from both biopsying and suction cup tagging efforts to estimate the maximum annual exposure expected for these stressors as well. Based on this analysis, the expected exposure to stressors from the proposed research activities as well as the expected levels of "take" did not deviate from the numbers requested in the proposed permits and provided in the *Description of the Proposed Action* section of this Opinion. More detailed information regarding the exposure analysis for each permit is provided in the sections that follow.

Tables 4 and 5 below identifies the expected number and ages of listed whale species reasonably expected to be exposed annually to the stressors associated with permit No. 14233 and permit No. 14603, respectively. Individuals may be of either sex and no individual whale may be harassed more than 3 times in one day across all proposed activities. The duration of each exposure depends on the duration of the close vessel approach (usually up to 30 minutes) or tag attachment (usually less than 24 hours). NMFS expects that in any given year, not all proposed "takes" would occur. However, since the level of research effort expected is variable from year to year due to weather, funding, and other factors, these numbers represent a "worst-case scenario" for listed species by representing the highest level of exposure possible in any given year over the life of the permits based on the best available information. Also, for each type of research activity identified in the following tables, the column to the far right indicates whether any North Atlantic right whale critical habitat would be similarly exposed.

Table 4. Exposure Analysis for Listed Species for Permit No. 14233 (Dr. Scott Kraus)

SPECIES (LIFE STAGE)	ACTIVITY	INDIVIDUALS LIKELY TO BE EXPOSED ANNUALLY	INDIVIDUALS LIKELY TO BE EXPOSED OVER FIVE YEAR DURATION	DETAILS
North Atlantic Right Whale (All)	Close Vessel Approach; Passive Acoustic Recording; Behavioral Observation; Photograph/Video; Fecal Sampling; Incidental Harassment	2,000	10,000	Individuals may be approached up to 10 times per year. Activities would also occur within the Great South Channel, Cape Cod Bay, and in the southeastern U.S. critical habitat.
North Atlantic Right Whale (Adult/Juvenile)	Close Vessel Approach; Passive Acoustic Recording; Behavioral Observation; Photograph/Video; Skin and Blubber Biopsy Sampling	30	150	1 biopsy sample will be collected per individual per year. Each sample *attempt* constitutes a take regardless if darting is successful or not (no more than 3 takes allowed per individual per day). Activities would also occur within the Great South Channel, Cape

				Cod Bay, and in the southeastern U.S. critical habitat.
North Atlantic Right Whale (Calves 1 month old or older)	Close Vessel Approach; Passive Acoustic Recording; Behavioral Observation; Photograph/Video; Skin and Blubber Biopsy Sampling	20	100	1 biopsy sample will be collected per individual per year. Each sample *attempt* constitutes a take regardless if darting is successful or not (no more than 3 takes allowed per individual per day). Takes may include older individuals if less than 15 calves are biopsied in a given year. Activities would also occur within the Great South Channel, Cape Cod Bay, and in the southeastern U.S. critical habitat.

Table 5. Exposure Analysis for Listed Species for Permit No. 14603 (Provincetown Center for Coastal Studies)

SPECIES (LIFE STAGE)	ACTIVITY	INDIVIDUALS LIKELY TO BE EXPOSED ANNUALLY	INDIVIDUALS LIKELY TO BE EXPOSED OVER FIVE YEAR DURATION	DETAILS
North Atlantic Right Whale (All)	Aerial Survey; Behavioral Observations; Photo-id	700	3,500	Activities would also occur within the Great South Channel and Cape Cod Bay critical habitat.
North Atlantic Right Whale (All)	Close Vessel Approach; Acoustic, Sonar for Prey Mapping; Plankton Collections by Net or Pump; Photograph/Video	350	1,750	Activities would also occur within the Great South Channel and Cape Cod Bay critical habitat.
North Atlantic Right Whale (Adult/Juvenile)	Close Vessel Approach; Behavioral Observations; Photo-Id; Suction-Cup Instrumentation Attachment (e.g VHF, TDR)	20	100	Maximum 10 successful tag attachments annually; individuals may be tagged up to 3 times annually. Suction cup tagging would occur in Cape Cod Bay critical habitat.
Fin Whale (All)	Close Vessel Approach; Behavioral Observation; Photo-Id; Incidental Harassment	20	100	Harassment incidental to right whale surveys; opportunistic photo id's may be taken.

				Activities would also occur within the Great South Channel and Cape Cod Bay critical habitat.
Fin Whale (All)	Aerial Survey; Photo-id; Behavioral Observation; Incidental Harassment	20	100	Harassment incidental to right whale surveys; opportunistic photo id's may be taken. Activities would also occur within the Great South Channel and Cape Cod Bay critical habitat.
Humpback Whale (All)	Close Vessel Approach; Behavioral Observation; Photo-Id; Incidental Harassment	20	100	Harassment incidental to right whale surveys; opportunistic photo id's may be taken. Activities would also occur within the Great South Channel and Cape Cod Bay critical habitat.
Humpback Whale (All)	Aerial Survey; Photo-id; Behavioral Observation; Incidental Harassment	20	100	Harassment incidental to right whale surveys; opportunistic photo id's may be taken. Activities would also occur within the Great South Channel and Cape Cod Bay critical habitat.

Scott Kraus, Permit No. 14233

For Dr. Kraus' proposed permit, a maximum of 2,000 "takes" are expected to North Atlantic right whales annually as result of harassment from close vessel approaches, photo-id and videography, passive acoustic recording, fecal sampling, and other incidental harassment during vessel surveys. Kraus' research activities would occur year-round throughout the action area and would include all areas designated as critical habitat for North Atlantic right whales (i.e. Great South Channel, Cape Cod Bay, and the southeastern U.S. calving grounds off the coasts of Georgia and Florida). Since this exposure represents more numbers of "take" than there are individuals in the population, NMFS expects some individuals to be taken multiple times per year (e.g. whales that are approached in the southeastern calving grounds in the summer months may also be approached and identified in mid-atlantic waters along their migration route and then again later in the northeastern feeding grounds during the winter months). Also, some individuals may be opportunistically sighted in other areas as well throughout the year as not every whale makes the migration south for the winter. A maximum of 10 exposures would occur to an individual per year as a result of vessel surveys; however, the proposed permit limits the amount of times a whale can be harassed to 3 times in one day across all proposed activities. After analyzing the sightings data in Dr. Kraus' prior annual reports, the assessed exposure of North Atlantic right whales to vessel survey activities did not change from the proposed levels.

A maximum of 50 annual "takes" resulting from biopsy surveys would also occur from Dr. Kraus' research activities. Of these 50 annual takes, 10 would be for adult or juvenile whales that have not been sampled in the past and have not been genetically profiled, 10 would be for adult or juvenile whales for studies on lesions and other skin diseases, 10 would be for contaminant studies (primarily juveniles), and 20 would be for new calves (approximiately 1 month old or older). Dr. Kraus intends to collect only one biopsy sample from a given whale per year. Besides new calves which are expected to be exposed every year, adult and juvenile whale exposures to biopsy sampling for other studies would occur primarily on an opportunistic basis, making it difficult to estimate the amount of annual exposure expected simply due to the highly focused nature of these studies. For instance, it is very difficult to estimate how many whale individuals with skin lesions would be expected to be encountered in a given year or how many individuals that had not been biopsied at all in the past would be encountered in a given year, etc. Therefore, due to the uncertainty involved in estimating exposure from these types of biopsy events, we assessed the exposure at the proposed levels and included all three designated habitat areas as being exposed as well. Due to the highly targeted nature of these activities, fin whales and humpback whales are not expected to be exposed to this stressor.

For new calves, we calculated the average annual calf production seen in the U.S. southeastern calving area from 2001-2010 based on quarterly reports published for the North Atlantic Right Whale Consortium (NARWC). According to these reports, the average annual calf production for the period was 23 calves, with the lowest production occurring in 2004 (16 calves) and the highest production occurring in 2009 (39 calves). The most recent publication reported that 19 calves were observed in 2010, which represents the most recent data at the time of this consultation (NARWC, 2010). Using this dataset, we estimated the maximum expected calf production that may occur in any given year in the U.S. southeastern calving grounds during the life of the proposed permits by taking the mean calf production out to 4 standard deviations. We also estimated the amount of calves (any age) expected to be exposed to biopsying by analyzing prior takes from similar vessel effort for Kraus' previously expired permit and NMFS-NEFSC's current permit. The latter permit already includes 30 "takes" annually for biopsying calves at least 1 month old until the year 2013 and this amount was taken into account when estimating the exposures possible under Kraus' proposed permit. We also considered the possibility that some calves may not be exposed to biopsying from the NMFS-NEFSC under their current permit since some calves may be born outside of the traditional calving area each year. Since Dr. Kraus intends to biopsy whales throughout the action area, there is the possibly of additional calves being exposed that are never seen in the traditional U.S. southeastern calving grounds. Without having reliable information to estimate the exposure levels of calves born outside of the U.S. southeastern calving area, NMFS assessed the total exposure of North Atlantic right whale calves to biopsy sampling from Kraus' research activities at the proposed levels.

Provincetown Center for Coastal Studies, Permit No. 14603
CCS's research activities primarily occur within Cape Cod Bay and within 100 km of Cape Cod during typical right whale residency (December to May) including the Cape

Cod Bay and Great South Channel designated critical habitat areas. For aerial surveys, a maximum of 700 annual "takes" of North Atlantic right whales are expected due to harassment during approaches by aircraft for observation and photo-identification. This number would account for the potential for some individuals in the population to be harassed multiple times (up to 10 times per year) annually and also to account for population growth over the life of the permit. We estimated the maximum level of exposure by analyzing sightings of North Atlantic right whale individuals reported from aerial surveys performed by CCS under their previous permit from 2006-2009. Based on the analysis of sightings reported in the previous annual reports, the assessed exposure of North Atlantic right whales to CCS' aerial surveys did not change from the proposed levels. Other listed baleen whale species that would be incidentally harassed during right whale surveys include humpback and fin whales. CCS did not report sightings of humpback and fin whales in their previous annual reports; however, they expect to encounter 20 unidentified baleen whales (including fin and/or humpback whales) during their aerial surveys under this proposed permit. CCS expects to approach and photograph these listed whales in addition to North Atlantic right whales if spotted. Since the proposed permit did not specify how many of each species CCS expects to encounter and since CCS did not report sightings of these species on previous annual reports, we have assessed the exposure of humpback and fin whales to aerial surveys at 20 "takes" each, thereby representing a "worst-case scenario" for these species. Future annual reports would require a description of the number of animals of each species approached annually by aerial surveys according to the proposed permit.

A maximum of 350 North Atlantic right whales are expected to be harassed annually by CCS during vessel surveys and habitat sampling. These activities would also occur within the Cape Cod Bay and Great South Channel designated critical habitat areas. Individual whales would not be taken more than 5 times annually. We estimated the maximum level of exposure of North Atlantic right whales from vessel surveys and prey sampling efforts based on prior surveys done under CCS' previous permit. Based on the analysis of sightings reported in the annual reports, the assessed exposure of North Atlantic right whales to vessel surveys and prey sampling did not change from the proposed levels. Other listed baleen whale species that would be incidentally harassed during vessel surveys include humpback and fin whales. CCS did not report sightings of humpback and fin whales in their previous annual reports; however, they expect to encounter 20 unidentified baleen whales (including fin and/or humpback whales) during vessel surveys. CCS expects to approach and photograph these listed whales in addition to North Atlantic right whales if spotted. Since the proposed permit did not specify how many of each species CCS expects to encounter and since CCS did not report sightings of these species on previous annual reports, we have assessed the exposure of humpback and fin whales to vessel surveys at 20 "takes" each, thereby representing a "worst-case scenario" for these respective species. Future annual reports would require a description of the number of animals of each species approached annually by vessel surveys according to the proposed permit.

A maximum of 20 North Atlantic right whales (adults and/or juveniles) are expected to be harassed annually during suction cup tagging efforts. Up to three attempts would be

made per day to attach a tag to a whale. Tags would not be attached to calves less than six months old or their mothers. Whales would be tagged up to three times in any 12-month period. Only one tag would be attached to a whale at a time. Suction cup tagging would not occur within the Great South Channel designated critical habitat area but may occur in the Cape Cod Bay designated critical habitat area. We assessed the maximum exposure expected based on prior tagging efforts performed in similar areas conducted by NMFS-NEFSC in their permit that expired in 2007 and their current permit that runs through 2013. Based on the analysis of the NMFS-NEFSC's reported "takes" from suction-cup tagging efforts previously performed in the Gulf of Maine, the assessed exposure of North Atlantic right whale adults/juveniles to CCS' suction-cup tagging efforts did not change from the proposed levels. Due to the highly targeted nature of these activities, fin whales and humpback whales are not expected to be exposed to this stressor.

Response Analysis

As discussed in the *Approach to the Assessment* section of this Opinion, response analyses determine how listed resources are likely to respond after being exposed to an action's effects on the environment or directly on listed animals themselves. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal, physiological or behavioral responses that might reduce the fitness of individuals. For analyses of critical habitat, our assessments determine if primary or secondary constituent elements of designated critical habitat (or physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) are likely to respond given exposure to the direct or indirect consequences of the proposed action on the natural environment. We then ask if those responses are likely to be sufficient to reduce the quantity, quality, or availability of those constituent elements or physical, chemical, or biotic phenomena. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

Responses to Aerial Surveys

The aerial surveys authorized by the proposed permits would be flown at altitudes between 750ft and 1000 ft. 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 survey aircraft fly below certain altitudes (about 500m or 1600ft), they have caused marine mammals to exhibit behavioral responses that might constitute a significant disruption of their normal behavioral patterns (Perry, 1998; Patenaude et al., 2002). For instance, about 14 percent of bowhead whales approached during aerial surveys exhibited short-term behavioral reactions (Patenaude et al., 2002), and gray whale cow-calf pairs have shown to react sensitively to aircraft with calves swimming beneath their mothers (Moore and Clark, 2002).

While North Atlantic right, fin, and humpback whales exposed to aerial surveys and approaches may exhibit similar short-term behavioral reactions to approaching aircraft, annual reports from surveys performed by the applicants under their current permits indicated that no evasive behaviors were observed. Also, conditions in the permits

require that the aircraft 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 activites would result in only mild short-term behavioral reactions and would not result in any long term behavioral changes or reduce the fitness of individuals within the action area.

Aerial surveys conducted within areas designated as critical habitat would not affect zooplankton composition, topographic or oceanographic characteristics, water depth, water temperature, or distance of the critical habitat areas from shore. Furthermore, the proposed activities would not adversely affect the population ecology or population dynamics of prey species, predators, or competitors of right whales. Therefore, aerial surveys are not expected to reduce the quantity, quality, or availability of essential features of the critical habitat that give the critical habitat conservation value to the species.

Responses to Vessel Surveys including Close Vessel Approaches
Vessel surveys would be performed by both applicants including close vessel approaches to North Atlantic right, fin, and humpback whales for obtaining photo-ids and video and, in the case of North Atlantic right whales, for biopsy sampling, suction cup tagging, passive acoustic recording, fecal sampling, and prey mapping and sampling. This section will cover the expected responses to vessel transit and close approaches. Other research activities to be performed in conjunction with the close approaches will be addressed in the sections that follow.

Vessel approaches have the potential to disturb listed whale species and induce behavioral and possibly physiological stress to whales targeted by the approach as well as other whales in the vicinity of the vessel. Whales may respond differently to vessel surveys depending on what behavior the animals are engaged in before the vessel approaches (Würsig et al., 1998; Hooker et al., 2001; Jahoda et al., 2003) and the degree to which they become accustomed to vessel traffic (Lusseau, 2004; Richter et al., 2006). Reactions include little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation, diving and time spent submerged, foraging, respiratory patterns, and also may include aerial displays like breaching and lobtailing (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005). Reactions to vessel noise have been observed when engines are started at distances of 3,000 ft (Malme et al., 1983; Richardson et al., 1995), suggesting that some level of disturbance may result even if the vessel does not undergo a close approach. In addition, changes in whale behavior have also been reported to correspond to vessel speed, size, and distance from the whale, as well as the number of vessels operating in the proximity (Baker et al., 1988; Koehler, 2006). Several studies identify immediate responses of specific baleen whale species involved in the proposed research activities. These studies are described in detail below.

For humpback whales, studies on summering grounds as summarized by Baker and Herman (1989) and Baker et al. (1983), and on wintering grounds as summarized by Bauer (1986), found patterns of disturbance in response to vessel activity that indicate

such approaches are probably stressful to the humpback whales, but the consequences of this stress on the individual whales remains unknown. Baker et al. (1983) described two responses of whales to vessels, including: (1) "horizontal avoidance" of vessels 2,000 to 4,000 m away characterized by faster swimming and fewer long dives; and (2) "vertical avoidance" of vessels from 0 to 2,000 m away during which whales swam more slowly, but spent more time submerged. Hall (1982) reported that humpback whales closely approached by survey vessels in Prince William Sound, Alaska, often reacted by diving and surfacing further from the vessel or with an altered direction of travel. The author noted that whale feeding activity and social behavior did not appear to be disturbed by the approaches; however, cow-calf pairs appeared to be wary and avoided the vessel. Other studies have found that humpbacks respond to the presence of boats by increasing swimming speed (e.g., Au and Green, 2000; Scheidat et al., 2004; Koehler, 2006), with some evidence that swimming speed then decreased after boats left the area. In an annual permit report submitted to NMFS, Glockner-Ferrari and Ferrari (2006) noted several female humpback whales that had been subjected to close vessel approaches multiple times during the last 20 years were resighted in the same area and were known to have reproduced several times during this period. This information indicates the close vessel approaches on these whales did not affect survival or prevent reproduction in these individuals.

The slow and careful approach to humpback whales is important and is supported by studies conducted by Clapham and Mattila (1993) on the reactions of humpback whales to close approaches for biopsy sampling in Caribbean breeding areas. The investigators concluded that the way a vessel approached a group of whales had a major influence on the whale's response to the approach, particularly for cow-calf pairs. Smaller pods and pods with calves also seem more responsive to approaching vessels (Bauer, 1986; Bauer and Herman, 1986). Based on their experiments with different approach strategies, researchers concluded that experienced, trained personnel approaching humpback whales slowly would result in fewer whales exhibiting responses that might indicate stress.

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

Detection of vessel noise is dependent on several factors, including weather, vessel engine type and size, habituation, and other ambient noise. All vessels to be used are below 50 ft in length, so the sound generated is expected to be at higher frequencies than larger vessels like supply ships, container/cargo ships, and cruise vessels operating in the action area (OSPAR, 2009). Since large cetaceans tend to hear and vocalize at lower frequencies, the contribution of marine ambient noise generated by the research vessels is expected to be minimal and would not adversely affect listed whales' ability to hear mates and other conspecifics. Therefore, the threat of vessel noise to listed whales that hear and vocalize at lower frequencies is sufficiently low and therefore discountable.

The probability of a vessel collision during transit and actual vessel surveys depends, in part, on the size and speed of the vessel. Pace and Silber (2005) found that the probability of death or serious injury increased rapidly with increasing vessel speed. According to Jensen and Silber (2003) the majority (79 percent) of records of vessels striking large whales occurred when the vessel was traveling at speeds of 13 knots or greater with 18.6 knots representing the average speed that resulted in serious injury or death. Although background information contained in the *Status of the Species* and *Environmental Baseline* sections suggest that vessel strikes are a major threat to North Atlantic right, fin, and humpback whales, given the procedures to be followed in the proposed research activities (e.g. slow transit speeds and slow, converging course technique during close approaches), we expect that the probability of whales being struck by research vessels is extremely unlikely and, therefore, discountable.

Annual reports from CCS' current permit indicate that no evasive behaviors were observed from North Atlantic right whales during close approaches for photo-identification, behavioral observation, and habitat sampling. However, given the information available on other whales species and recognizing the conditions of the proposed permit for researchers involved in close approaches, we provisionally assume that the proposed vessel approaches would produce the same results as those reported by Clapham and Mattila (1993): short- to mid-term stress responses that generate no long-term behavioral changes that might result in fitness consequences for individual whales.

For vessel surveys conducted in critical habitat designated for the North Atlantic right whale, we considered the effects that research vessels would have on the quantity, quality, and availability of the essential features of the habitat (specifically the quantity and availability of zooplankton patches in the northeast critical habitat areas and behavioral reactions that could cause whales to leave areas sufficient for feeding). Mayo and Marx (1990) found that the density of surface zooplankton samples collected in the path of feeding right whales during mid-winter was significantly higher than for the samples taken where whales were absent (median = 3,904 organisms/m^3) and that the threshold value below which feeding by North Atlantic right whales is not likely to occur in Cape Cod Bay is approximately 1,000 organisms/m^3. Also, Mayo (1999) reported a range of 3-43 percent of the total habitat area in Cape Cod Bay (with a mean of 26 percent) contained zooplankton densities rich enough to surpass the feeding threshold each year (Mayo, 1999). Close approaches to actively feeding whales may cause some

level of turbulence at the surface that can break up dense zooplankton patches. Therefore, vessels approaching actively feeding whales have the potential to reduce the availability of prey to whales in the immediate area in the event that densities fall below the level that right whales can detect the prey. Also, Jahoda et al. (2003) reported that actively feeding fin whales that had been disturbed by close approaches had not resumed feeding when the exposure ended, although the presence or absence of prey after the disturbance was unknown. While studies on actively feeding North Atlantic right whales is limited, the reactions seen for other cetacean species suggest that close approaches to actively feeding right whales may disrupt foraging behavior and may cause whales to temporarily leave areas sufficient for feeding thereby temporarily reducing the quantity and availability of this essential feature of the critical habitat.

However, NMFS expects that the slow approach techniques employed by the researchers should minimize surface turbulence and would not be expected to reduce zooplankton densities to the degree that right whales could not detect the prey. Also, while temporary changes in whale behavior have been reported during close approaches that could impact foraging or could cause whales to leave areas of high zooplankton densities, studies done by Jahoda et al. (2003) and Clapham and Mattila (1993) concluded that approaching vessels maneuvering at slower speeds were less likely to cause visible reactions in large whales than those approaching at higher speeds. Both Dr. Kraus and CCS expect to approach whales at a slow and converging course that should minimize the stress response of the close approach to listed whales during their respective research activities. Furthermore, vessel surveys would not affect topographic or oceanographic characteristics, water depth, water temperature, or distance of the critical habitat areas from shore nor would they affect the population ecology or population dynamics of prey species, predators, or competitors of right whales.

Responses to Biopsy Sampling

Under the proposed permit for Dr. Kraus (Permit no. 14233), up to 50 North Atlantic right whales would be biopsied annually, 20 of which would be calves atleast 1 month old. Biopsy attempts would be made from distances of 5 to 15 m using crossbows and small diameter darts fitted with biopsy tips measured at 0.7 mm in diameter and 2.5 cm deep, fitted with a stop-collar backing to prevent deeper penetration.

At the time of this consultation, there is only one published report of a cetacean death following biopsy sampling, when the dart penetrated the muscle mass of a female common dolphin which may have resulted in vertebral trauma and severe shock (Bearzi, 2000). Blubber thickness has been shown in large baleen whales to be positively linked to body length as well as age class, with pregnant females having the thickest blubber, followed by mature females, mature males, immature females, and immature males (Lockyer, 1986). 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 cm and 23 cm. The blubber depths of necropsied North Atlantic right whale calves that died off the coasts of Georgia and Florida ranged from 2.75 cm to 5 cm (Moore et al., 2004). Based on data from these reports, samples taken from the biopsy darts used by Dr. Kraus would not be expected to penetrate the muscle layer of any

sampled right whales that could result in serious injury. However, the thinner blubber to dart size ratio of a young calf as opposed to an adult right whale may increase the calf's risk of injury from the proposed procedure. The applicant has never killed or injured a whale during biopsy sampling and annual reports submitted by NMFS-NEFSC for their current permit (permit No. 775-1875) did not report any deaths or serious injury from biopsying similar age groups of 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.

Behavioral reactions to biopsy sampling are often difficult to differentiate from reactions to close vessel approaches, because in all cases it is necessary to closely approach the whale to obtain a sample. The nature of the close approach to a whale targeted for biopsy sampling may play a role in the extent that whale reacts to the biopsy sample attempt. In addition, whales' behavioral responses to biopsy sampling are also likely influenced by factors such as skin and blubber thickness, innervation, whale size, type of activity at the time of sampling (feeding, resting, traveling, etc.), species, and sex (Weinrich et al., 1991; 1992; Clapham and Mattila, 1993; Brown et al., 1994; Gauthier and Sears, 1999). Several studies identify immediate responses of baleen whale species to biopsying and the results of these studies are described in detail below.

Best et al. (2005) conducted a study on the responses of southern right whale adults and calves (including neonates) to biopsy sampling off South Africa and found no evidence that biopsying affected calf survival, caused whales to emigrate outside the area, or curtailed reproduction in females; however, the authors note the power of the statistical tests for this conclusion was low. The study also assessed short-term behavioral reactions to biopsying and found that calves had reactions indistinguishable from those of adult same sex groupings of two. The authors conducted repeat biopsies on 20 cow-calf pairs and were unable to detect a trend of increased or decreased sensitivity of calves to biopsy sampling although in the case of mothers, reactions were stronger when the calf was biopsied first compared to the mother being biopsied before the calf. Best et al. (2005) note that studies on the longer-term responses of large whales to biopsy sampling are few; however, resightings of biopsied whales have been documented and so far provide no evidence of any long-term effects (Weinrich et al., 1991; Clapham and Mattila, 1993).

Weinrich et al. (1991) measured a variety of parameters to assess the reactions of humpback whales to biopsy procedures. The authors found the few "strong reactions" (3.3 percent) all involved unusual instances such as a biopsy dart retrieval line being snagged on a fluke (biopsy darts during the proposed activities would be untethered). Also, observations in the days and years following darting indicated no long-term behavioral responses to the procedure. They concluded the biopsy procedure was momentarily painful or startling to the animals, but there were no long-term effects. Importantly, the study also indicated that mother/calf pairs were no more sensitive to biopsy procedures than other groups, although mothers tended to be more evasive of approaching boats.

Weinrich et al. (1992) studied the behavioral responses of humpback whales in the Gulf of Maine (specifically Jeffrey's Ledge and Stellwagen Bank), classifying the responses into the following categories: (1) no reaction, (2) low-level reaction (immediate dives but no other overtly forceful behavior), (3) moderate reactions (trumpet blows, hard tail flicks, but no prolonged evidence of behavioral disturbance), and (4) strong reactions (surges, tail slashes, numerous trumpet blows). Out of 71 biopsy attempts, 7.0 percent resulted in no behavioral responses, 26.8 percent resulted in low-level behavioral responses, 60.6 percent involved a moderate reaction, and 5.6 percent involved a strong reaction. The authors concluded the responses they observed probably depended on the specific activity of the animal prior to the approach. They also recognized that continuous or repeated exposure to stimuli that produce moderate, adverse responses could produce alarm reactions and possible stress responses.

Clapham and Mattila (1993) also concluded that humpback whales exhibited low to moderate reactions to being struck by biopsy darts. They found that 66.6 percent of humpback whales that had been biopsied showed either no reaction or low-level behavioral reaction to the procedure. The authors noted that studies on biopsy procedures showed no evidence of significant impact on whales although it should also be noted that calves were shown to react to the biopsy procedure significantly more than all other age classes combined.

In addition, annual reports submitted to NMFS for other scientific research permits provide additional information on expected responses of North Atlantic right whales to biopysing. Data in **Table 6** below was pooled together from annual reports submitted by NMFS-NEFSC in association with their previously expired permit (permit No. 775-1600) that was in effect from 2002-2006 and their currently active permit (permit No. 775-1875) that has been in effect since 2008 and runs until 2013.

Table 6. Behavioral Reactions of North Atlantic Right Whales Pre- and Post Biopsy Observations from 2002-2009

Reaction Type	Adults	Juveniles	Calves	Total
No Reaction	18	0	32	50
Mild Reaction	6	0	17	23
Moderate Reaction	0	1	10	11

Source: Data obtained from annual reports associated with NMFS-NEFSC permit no. 775-1600 and permit no. 775-1875.

The data shows that from 2002-2009, 60 percent of the 84 biopsy events resulted in no reactions from right whales, while 27 percent resulted in a mild reaction (e.g. immediate dives but no other overtly forceful behavior) and 13 percent resulted in a moderate reaction (e.g. tail flicks, swimming away from the boat, etc.). Although the sample sizes are quite small, the data showed that calves reacted more strongly to the biopsy

procedures than adults which are similar to the observations seen by Clapham and Mattila (1993) for behavioral reactions in humpback whales.

After reviewing available information on the responses of whales to biopsy darting, we would expect North Atlantic right whales exposed to this activity under permit No. 14233 to exhibit either no visible response to the exposure or short-term behavioral responses with calves more likely to react to the biopsy procedure than adults. Given the available evidence, we assume strong behavioral responses to biopsying would be possible but not frequent. Responses to biopsy sampling may manifest as stress responses, interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combination of these responses. For behavioral responses, Weinrich et al. (1992) associated "moderate" and "strong" responses with alarm reactions and stress responses, respectively. Moderate responses might also be associated with a stress response, but there is no evidence of the magnitude or duration of possible stress responses that would allow us to make inferences about possible fitness consequences for individual whales. Accordingly, we assume that biopsying conducted under the proposed permit may be stressful for a portion of the whales; however, the significance of this stress response and its consequences, if any, on the fitness of individual whales are not known.

For biopsy sampling conducted in North Atlantic right whale critical habitat, we considered the effects that biopsying would have on the quantity, quality, and availability of essential features of the habitat (specifically stress responses that would interrupt feeding or cause whales to leave foraging or calving areas thereby reducing the availability of the essential habitat features that have conservation value to the species). A number of studies involving the close approach of humpback and southern right whales by research vessels for biopsying and tagging indicate that responses are generally minimal to non-existent when approaches were slow and careful and when more pronounced behavioral changes occur, the responses appear to be short-lived (Weinrich et al., 1991; 1992; Clapham and Mattila, 1993; Gauthier and Sears, 1999; Best et al., 2005). Therefore, since behavioral reactions are expected to be temporary and short-lived, we would expect that actively feeding whales in the northeast critical habitat (i.e. Great South Channel and Cape Cod Bay) as well as cow-calf pairs in the southeast critical habitat (off the coasts of Georgia and Florida) would resume normal behavior following the biopsy procedure and would not permanently abandon habitat areas that contain the essential features. Furthermore, biopsying would not affect topographic or oceanographic characteristics, water depth, water temperature, or distance of the critical habitat areas from shore nor would they affect the population ecology or population dynamics of prey species, predators, or competitors of right whales.

However, we do note that the research conducted to identify long-term effects resulting from cow-calf biopsies has been inconclusive to date due to insufficient sample sizes. To inform the question of long-term effects, a 5-year cow-calf biopsy study was authorized in 2003 for North Atlantic right whales and humpback whales to gain a statistically reliable understanding of the long-term impacts of biopsy sampling. Preliminary data indicates that biopsy sampling humpback whales in the western North Atlantic has not had a population level effect measured by survival of calves and reproduction and return

rates of females; however, the North Atlantic right whale study is currently ongoing. Based on the best available information, we would anticipate that biopsying North Atlantic right whales would also not have any long term fitness consequences nor would it cause females to permanently abandon critical habitat areas that contain the essential feature (i.e. water depth, water temperatures, and distance from shore for calving and nursery) based on the preliminary results seen for humpback whales; however, the results of the 5 year study will further inform this analysis.

Responses to Suction Cup Tagging

Under the proposed permit for CCS (permit No. 14603), a maximum of 20 North Atlantic right whale adults/juveniles would be targeted for suction cup tagging efforts to study diving patterns and the whales' vertical orientation with up to 3 attempts made per day for attaching the tag. Either a 10-20 m (30-60 ft) pole cantilevered from the bow or a 7-10 m (21-30 ft) pole would be used to attach the tag on the dorsal surface of the animal posterior of the blowhole and pectoral flippers. After successfully attaching the tag, the survey team will follow the whale until the tag falls off (generally 2 min to 6 hrs with a maximum duration of 24 hrs). The types of tags used would be DTAGs, developed by Woods Hole Oceanographic Institution or Acousonde tags developed by Greenridge Sciences, both of which are around 20 cm long by about 4 cm in diameter.

Tagging involves physical contact, and is generally categorized as having the potential to injure animals that undergo the tagging procedure. The attachment of a device has the potential to generate physiological and/or behavioral effects, depending on factors such as device weight, shape, and attachment location (White and Garrot, 1990; Hawkins, 2004). Attached tagging devices may cause short-term visible behavioral responses or cause effects not detectable in observed behaviors, such as increased energy expenditure by the tagged animal (White and Garrot, 1990; Wilson and McMahon, 2006). Walker and Boveng (1995) concluded the effects of devices on animal behavior are expected to be greatest when the device-to-body size ratio is large, meaning that the weight and size of the device may be of less concern for larger animals such as North Atlantic right whales and other cetaceans. It is possible the proposed tags could introduce some level of hydrodynamic drag; however, the expected proportion of that drag from the tag package to the animal's size and weight is such that the energetic demand on the animal as a result of the proposed tags would likely be insignificant.

While suction-cup tagging has been performed extensively on North Atlantic right whales in the past (Goodyear, 1993; Mate et al., 1997; Slay and Kraus, 1998; Nowacek et al., 2001), few studies have systematically investigated or recorded the long term effects from tagging, with most results limited to visual assessments of behavior at the time of tagging (Walker and Boveng, 1995). In addition, reactions to tagging are difficult to differentiate from reactions to close vessel approaches, because in all cases it is necessary to closely approach the whale to ensure proper tag placement. Evidence available on the short-term effects of tagging whales indicates that responses vary from little to no observable change in behavior to momentary changes such as skin twitching, startle reactions or flinching, altered swimming speed and orientation, diving, rolling, head lifts, high back arching, fluking, and tail swishing (Goodyear, 1981; 1989; 1993; Watkins et

al., 1981; 1984; Baird, 1994; Mate et al., 1997; 1998; Hooker et al., 2001). Infrequently, aerial displays like breaching are also noted (Goodyear, 1989); and Mate et al. (2007) reports other infrequent behavioral responses as including fluke slaps and swishes, head lunges, defecation, decreased surfacing rates, disaffiliation with a group of whales, evasive swimming behavior, or cessation of singing (in the case of humpback whales). Cetaceans frequently react when hit by tags delivered by remote devices such as tagging poles, but are also known to react when tags miss and hit the water. Behavioral responses are noted to be short-term (Mate et al., 2007), with the likelihood of a reaction possibly depending on an individual's behavioral state at the time of tagging (Hooker et al., 2001).

Goodyear (1981) attached a suction cup tag to one humpback whale and found behaviors of the tagged whale and a closely associated whale did not appear to change due to tagging. More recently, Goodyear (1989) tagged 12 humpback whales with suction-cup tags and found responses to tagging were minimal with no long-term changes in behavior detected. Of the tagged whales, 69 percent showed no immediate reaction to tagging, and 31 percent exhibited a detectable reaction including quickened dive, high back arch, and tail swish. After all tagging attempts, the author noted that pre-tagging behavior resumed within a few minutes. Goodyear (1989) also reported the suction-cup did not appear to harm whales' skin. Baird et al. (2000) tagged humpback whales using suction-cup tags and reported that reactions to tagging occurred in only 5 of 31 tagging attempts (17 percent). Two of these were low-level behavioral responses, and three were moderate responses. The authors did not observe any strong responses to suction-cup tagging during this study.

In addition, data from annual reports submitted to NMFS from previous tagging studies on North Atlantic Right whales indicated that of the six right whales that were tagged in 2009 by NMFS-NEFSC under their current permit (permit No. 775-1875), 4 exhibited a mild reaction to the tagging procedure with only one whale exhibiting a moderate response and one whale not appearing to react at all from the procedure (NMFS-NEFSC, 2010).

Sensors and transmitters on suction-cup tags to be used in the proposed action would emit sounds vital to the proper function and retrieval of the tags. Indications are that baleen whales are most sensitive to low-frequency sounds below 1 kHz, but some can hear higher frequency sounds. Baleen whales have been observed to react to sounds at frequencies up to 28 kHz, but did not respond to pingers and sonar at and above 36 kHz (Richardson et al., 1995). The proposed tag units would include a radio tag operating well above the dominant vocalization frequencies used by baleen whales, and above their highest recorded vocalization frequencies (Thomson and Richardson, 1995; Au, 2000). Wartzok and Ketten (1999) suggest that mysticete hearing is most sensitive at the same frequencies at which they vocalize; therefore, the frequency of the radio tag is expected to be outside of the functional hearing range of the target baleen whales. Therefore, it's not expected that North Atlantic right whales will not react to the transmitting signals of the tags.

After reviewing available information on the responses of whales to suction cup tagging, we would expect North Atlantic right whales exposed to this activity under permit No. 14603 to exhibit mild, short-term behavioral responses with no expected long term effects. Just as in biopsy sampling, responses to suction cup tagging may manifest as stress responses, interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combination of these responses; however, the significance of this stress response and its consequences, if any, on the fitness of individual whales are not known.

For suction cup tagging conducted in the Cape Cod Bay designated critical habitat, we considered the effects that tagging would have on the quantity, quality, and availability of essential features of the habitat (specifically stress responses that would interrupt feeding or cause whales to leave foraging areas thereby reducing the availability of the essential habitat features that have conservation value to the species). A number of studies involving the close approach of humpback and southern right whales by research vessels for biopsying and tagging indicate that responses are generally minimal to non-existent when approaches were slow and careful and when more pronounced behavioral changes occur, the responses appear to be short-lived (Weinrich et al., 1991; 1992; Clapham and Mattila, 1993; Gauthier and Sears, 1999; Best et al., 2005). Therefore, since behavioral reactions are expected to be temporary and short-lived, we would expect that actively feeding whales in Cape Cod Bay would resume normal behavior following the suction cup tagging procedure and would not permanently abandon habitat areas that contain the essential zooplankton habitat feature. Furthermore, suction cup tagging would not affect topographic or oceanographic characteristics, water depth, water temperature, or distance of the critical habitat areas from shore nor would they affect the population ecology or population dynamics of prey species, predators, or competitors of right whales.

Responses to Fecal Sampling

Fecal samples would be collected to assess reproductive hormones, stress, parasites, red tide effects, diet composition, energetics, and nutrition. Fecal sampling would not require approaching animals directly, as usually the sample is left floating at the surface after the whale is gone. Researchers would not attempt to contact whales to collect samples. Sampling could occasionally occur within 100 yards (300ft) of an animal, particularly if a known individual has defecated nearby. Samples could be collected from any right whale during vessel surveys in association with other activities that do not involve physical contact, such as photo-identification and passive acoustic recordings. Samples would be collected from a stationary boat with a handheld 333-micron mesh dip net.

Reactions to vessel noise have been observed when engines are started at distances of 3,000 ft (Malme et al., 1983; Richardson et al., 1995), suggesting that some level of disturbance may result even at distances not characterized as a close approach. However, given the expected distances of the vessels from right whales at the time of fecal sample collection, responses are expected to be mild, short-term reactions with no expected long term fitness consequences.

Also, fecal sampling occurring in designated critical habitat is not expected to affect the physical, chemical, or biologic features that give the habitat conservation value to North Atlantic right whales. Therefore, critical habitat would not be affected by these activities.

Responses to Passive and Active Acoustics
Passive acoustic recordings allow researchers to associate whale calls with particular observed behaviors. Occasionally, during vessel surveys to be authorized in Dr. Kraus' permit, researchers would drop a hydrophone into the water to listen for right whale calls associated with particular behaviors. These recordings would be done while the vessel is shut down and would generally last no more than an hour. As a passive system, the hydrophone would not emit any sounds or signals into the water column. Passive acoustic recordings are not expected to result in a response to right whale individuals beyond the mild, short-term reactions seen during the normal course of vessel surveys.

For CCS's permit (permit No. 14603), standard fish finders operating at 38 and 200 kHz would be used to assess and map the distribution of copepod prey resources in the Gulf of Maine. On occasion, 120 and 710 kHz would be used as well. Baleen whales are most sensitive to low-frequency sounds below 1 kHz, but some can hear higher frequency sounds. Baleen whales have been observed to react to sounds at frequencies up to 28 kHz, but did not respond to pingers and sonar at and above 36 kHz (Richardson et al., 1995). Frequencies of fish finders that would be used for prey mapping would be a minimum of 38 kHz, above the dominant vocalization frequencies used by baleen whales, and above their highest recorded vocalization frequencies (Thomson and Richardson, 1995; Au, 2000). Wartzok and Ketten (1999) suggest that mysticete hearing is most sensitive at the same frequencies at which they vocalize; therefore, the frequencies of the sonar used by CCS for prey mapping are expected to be outside of the functional hearing range of the target whales and would not result in any measurable reaction.

Also, passive and active acoustic activities occurring in designated critical habitat are not expected to affect the physical, chemical, or biologic features that give the habitat conservation value to North Atlantic right whales. Therefore, critical habitat would not be affected by these activities.

Responses to Prey Sampling
Up to 350 North Atlantic right and up to 20 fin and humpback whales may be harassed by CCS during the course of sampling for copepod prey resources in the Cape Cod Bay region. The depth of the sampling would occur in the upper 50 meters of the water column and would be controlled by computer commands from the vessel. Nets would be 30 and 50 cm in diameter with a 333 micrometer mesh and a ratio of 3:1 or 5:1 towed and tended by ½-inch nylon line behind the research vessel. Sampling at fixed stations would usually be 2 km or more from right whales. However, in some cases (likely less than 10 times per year) data would also be collected in the vicinity of actively feeding whales. A hose and pump system would also be used to sample the vertical characteristics of the zooplankton resource. A 1.5 inch hose would be hung from the vessel with a CTD cage attached and water would be pumped at 15 gallons/min into collection nets on deck.

Pump sampling would be conducted in the regions where whales are aggregated, but would generally occur over a kilometer from the whales themselves.

CCS has been conducting such surveys for years in Cape Cod Bay and adjacent waters to characterize the durability of the resource, as well as to forecast the likelihood of continued whale aggregation and residency in those specific areas. Prey sampling is only occasionally conducted in the vicinity of feeding right whales in order to characterize the abundance, species composition, and spatial extent of the zooplankton resource on which the animals were feeding. Prey sampling by CCS in the vicinity of feeding whales pose risks by disturbing actively feeding whales and potentially causing them to leave important feeding areas. However, annual reports submitted by CCS on their previous permit (permit No. 633-1763) indicate reactions are generally mild with no whales exhibiting any evasive behavior as a result of the prey sampling.

Equipment used by CCS for prey sampling would not be expected to physically interact with any animals, nor would it pose a risk of ingestion or entanglement to actively feeding whales. CCS has reported that in previous surveys, whales have occasionally approached the vessel while the vessel was drifting with the engine running. Entanglement or ingestion as a result of plankton tows has never been observed, and it is considered unlikely that there would be interactions with this gear type as proposed (NMFS, 2009). Also, if a close approach by a whale occurs, the pump hose would be lifted aboard to avoid any unintended disturbance to the whale. Given the information available on effects of close approaches by vessels, we provisionally assume plankton sampling that occurs in the immediate vicinity of actively feeding whales would result in short- to mid-term stress responses that generate no long-term behavioral changes that might result in fitness consequences for individual whales.

For prey sampling occurring in the Cape Cod Bay and Great South Channel critical habitat, we considered the effects that prey sampling would have on the quality, quantity, and availability of the essential features that give the habitat conservation value to the species (specifically the quantity and availability of prey and behavioral reactions that may interrupt foraging or cause whales to abandon importating foraging areas that contain the essential feature). As stated before, Mayo and Marx (1990) found that the density of surface zooplankton samples collected in the path of feeding right whales during mid-winter was significantly higher than for the samples taken where whales were absent (median = 3,904 organisms/m^3) and that the threshold value below which feeding by North Atlantic right whales is not likely to occur in Cape Cod Bay is approximately 1,000 organisms/m^3. CCS' prey sampling activities will physically extract prey from the water, thereby directly reducing the quantity and availability of the essential zooplankton habitat feature.

Wishner et al. (1995) reported a mean patch size around actively feeding whales to be 500 m wide and the applicants note that patch sizes observed from previous sampling efforts were several meters to several kilometers wide and from a few centimeters to several meters thick (CCS, 2010). The applicants note they will be using nets of 30 and 50 cm in diameter for net tows and will use a 1.5 inch hose and pump system that will

pump 15 gallons of water per minute for a period of less than five minutes. NMFS believes the sample sizes taken will be sufficiently low relative to the size of the average zooplankton patch to have a discountable effect on prey quantity and/or availability. The applicants also note that most sampling will not occur in the immediate vicinity of actively feeding whales, although for instances where this is the case (less than 10 times per year), samples will be taken behind the whale as it feeds at a distance of 50 – 100 m or more from the feeding whale. Pump sampling would be conducted in the regions where whales are aggregated, but would generally occur over a kilometer from the whales themselves. CCS has reported that in previous surveys, whales have occasionally approached the vessel while the vessel was drifting with the engine running. If a curious approach by a right whale occurs, the pump hose would be lifted aboard to minimize harassment of the individual.

As stated earlier for responses to vessel surveys, prey sampling performed around actively feeding whales may cause a short to moderate stress response that could interrupt feeding or cause whales to leave the area. Jahoda et al. (2003) reported that actively feeding fin whales that had been disturbed by close approaches had not resumed feeding when the exposure ended, although the presence or absence of prey after the disturbance was unknown. However, Jahoda et al. (2003) also notes that approaching vessels maneuvering at slower speeds were less likely to cause visible reactions in large whales than those approaching at higher speeds. This conclusion was also consistent with those of Clapham and Matilla (2003) for studies on humpback whales. CCS expects to approach whales at a slow and converging course when maneuvering around actively feeding whales that should minimize the stress response and prevent whales from abandoning areas sufficient for foraging. Annual reports submitted by CCS on their previous permit (permit No. 633-1763) indicate reactions were generally mild with no whales exhibiting any evasive behavior as a result of the prey sampling. Furthermore, prey sampling would not affect topographic or oceanographic characteristics, water depth, water temperature, or distance of the critical habitat areas from shore nor would they affect the population ecology or population dynamics of prey species, predators, or competitors of right whales.

Risk Analysis

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

For analyses of critical habitat, we determine if an action is expected to reduce the quality, quantity, or availability of constituent elements or essential physical, chemical, or biological features at a level sufficient to reduce the conservation value of the designated critical habitat for listed species in the action area. In this step of our assessment, we combine information about the contribution of constituent elements (or other essential

features) to the conservation value of those areas of critical habitat that occur in the action area, given the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area. If the conservation value of designated critical habitat in an action area is reduced, the final step of our analyses asks if those reductions are likely to be sufficient to reduce the conservation value of the entire critical habitat designation.

Studies on targeted whales show that harassment occurs as a result of several of the proposed research activities. The evidence suggests that North Atlantic right whale individuals are disturbed by approaches by aircraft and vessels, biopsy sampling, suction cup-tagging, and prey sampling in the vicinity of actively feeding whales while fin and humpback whales are disturbed by aircraft and vessel approaches only from the proposed research activities.

North Atlantic right, humpback, and fin whales would be exposed to close approaches throughout the action area from the Gulf of Maine and Cape Cod Bay area to waters off the southeastern U.S. Based on a review of available information, we would expect whales exposed to close vessel approaches under the proposed permit to exhibit either no visible response or short-term behavioral responses to a close approach. These responses may result in interruptions of essential behavior and physiological processes such as feeding, mating, nursing, resting, digestion etc., which can result in stress, injury and increased susceptibility to disease and predation (Frid and Dill, 2002; Romero, 2004; Walker et al., 2006). Gill et al., (2001) noted that changes in animal behavior do not necessarily reflect consequences of disturbance at the population level. Therefore, we can not definitively know whether such short-term behavioral responses have long-term consequences, as such consequences would be primarily sub-lethal for individual whales (that is, they would affect their growth, health, or reproductive success), and the associated consequences on whale populations would be delayed in time and concealed by any imprecision in population estimates. We assume close approaches conducted under the proposed permit might still be stressful for some individuals, and might temporarily interrupt behaviors such as foraging, but evidence in the literature (Perry, 1998; Patenaude et al., 2002) and from observations reported by previous investigators for similar actions suggests that responses are expected to be short-lived. Assuming an animal is no longer disturbed after it returns to pre-approach behavior, we do not expect long-term consequences for the fitness of North Atlantic right, humpback, and fin whale individuals as a result of these close aerial or vessel approaches.

NMFS expects that, based on the best available information, North Atlantic right whale individuals including calves and mothers subjected to close approaches and biopsy procedures are expected elicit short-term behavioral changes, with unknown longer term consequences. No tissue or muscle layer below the blubber is expected to be penetrated by the darts used for biopsy sampling. However, tagging or biopsy sampling has the potential to further exacerbate the stress response of whales already harassed by the close approach. We also expect the risk of injuring a calf under 6 months old as a result of biopsying is greater than the risk associated with older animals due to thinner blubber layers, their poor swimming ability, and the unknown impact of stressful events on young

calves. The repeated disturbance of individuals by close approach and other human activities, particularly repeated disturbance of vulnerable life stages as well as during feeding and breeding are not likely to be negligible. Disturbance events and the behaviors elicited may alter an individual's energy demand and could induce stress that further alter's an animals health or makes them more prone to effects from disease. A number of studies involving the close approach of humpback and southern right whales by research vessels for biopsying and tagging indicate that responses are generally minimal to non-existent when approaches were slow and careful and when more pronounced behavioral changes occur, the responses appear to be short-lived (Weinrich et al., 1991; 1992; Clapham and Mattila, 1993; Gauthier and Sears, 1999; Best et al., 2005). Permit conditions will help to minimize long-term effects by avoiding repeat biopsies, ceasing activities if the approach appears to be interrupting nursing behavior or the cow-calf pair bond, and limiting attempts to biopsy the animal at 3 times per day.

The research conducted to identify long-term effects resulting from cow-calf biopsies has been inconclusive to date due to insufficient sample sizes. To inform the question of long-term effects, a 5-year cow-calf biopsy study was authorized in 2003 for North Atlantic right whales and humpback whales to gain a statistically reliable understanding of the long-term impacts of biopsy sampling. Preliminary data indicates that biopsy sampling humpback whales in the western North Atlantic has not had a population level effect measured by survival of calves and reproduction and return rates of females; however, the North Atlantic right whale study is currently ongoing. Based on the best available information, we would anticipate that biopsying North Atlantic right whales would also not have any long term fitness consequences based on the preliminary results seen for humpback whales; however, the results of the 5 year study will further inform this analysis.

No long term studies on the effects of suction-cup tagging on North Atlantic right whales have been completed. Based on a review of available information, we would expect whales exposed to suction cup tagging to react similar to being exposed to close vessel approaches: either no visible response or short-term behavioral responses with unknown long term consequences. Permit conditions will help to minimize long-term effects by limiting the amount of times whale individuals may be tagged, coordinating activities with other researchers doing similar research, ceasing activities if the approach appears to be illiciting an adverse reaction to the tagging, and limiting attempts to tag the animal at 3 times per day. Assuming an animal is no longer disturbed after it returns to pre-tag behavior, we do not expect long-term consequences for the fitness of North Atlantic right whale individuals as a result of suction cup tagging.

Finally, prey sampling in the vicinity of actively feeding whales is expected to result in similar responses as close vessel approaches: either no visible response or short-term behavioral responses with unknown long term consequences. Consequences of whales leaving the feeding area as well as physically removing prey items from the water may result in lower energetic input for right whale individuals. However, based on prior observations, whales are expected to remain in the general vicinity during sampling and are assumed to continue feeding after the vessel leaves the area. Also, according to

documentation submitted by CCS as part of their permit application, the relatively small prey samples to be collected when compared to the expected prey densities in the vicinity of feeding right whales are not expected to appreciably reduce the prey available to right whales or reduce the quality of foraging habitat for right whales in the areas where sampling occurs.

The small population size and low annual mean growth and reproductive rates of North Atlantic right whales suggest that human sources of mortality may have a greater effect relative to population growth than for other whales (Waring et al., 2009). However, based on the best scientific information available, we expect that responses to close vessel approaches and biopsying, suction cup tagging, and prey sampling is not likely to cause a reduction in North Atlantic, humpback, or fin whale individuals's growth, survival, annual reproductive success, or lifetime reproductive success (i.e. fitness). As a result, we do not expect activities authorized by the proposed permits to have an appreciable effect on the extinction risk of the population(s) these individuals represent or the species those populations comprise.

For research activities occurring in critical habitat designated for the North Atlantic right whale, the close vessel approaches for biopsying and suction cup tagging may cause mild to moderate stress responses that may cause some individuals to temporarily leave portions of critical habitat designated in the action area thereby reducing the availability of essential features that give the habitat conservation value for the species. However, while we assume close approaches conducted under the proposed permit to be stressful for some individuals, and might temporarily interrupt behaviors such as foraging, but evidence in the literature (Perry, 1998; Patenaude et al., 2002) and from observations reported by previous investigators for similar actions suggests that responses are expected to be short-lived. Assuming an animal is no longer disturbed after it returns to pre-approach behavior, we do not expect long-term consequences such as right whales permanently abandoning foraging or calving areas that contain the essential features. We would anticipate that biopsying North Atlantic right whale cow-calf pairs in the southeastern U.S. critical habitat would also not cause any long term consequences based on the preliminary results seen for humpback whales; however, the results of the 5 year study will further inform this analysis. Based on the best available information, any reduction in availability of essential physical, chemical, or biological features caused by vessel surveys and the close approach of right whales in critical habitat areas for biopsying and suction cup tagging is not expected to be sufficient to cause a reduction in the conservation value of the critical habitat designated in the action area nor would it reduce the conservation value of the designation as a whole.

Prey sampling conducted by CCS in the Great South Channel and Cape Cod Bay critical habitat would physically extract zooplankton prey resources and would therefore reduce the quantity of this essential feature in those areas. However, as stated in the *Response Analysis* for this Opinion, NMFS believes the sample sizes taken will be sufficiently low relative to the size of the average zooplankton patch to have a discountable effect on prey quantity and/or availability in areas designated as critical habitat. Therefore, the small reduction in the quantity of this essential feature is not sufficient to reduce the

conservation value of the critical habitat designated in the action area nor would it reduce the conservation value of the designation as a whole.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions, including research authorized under ESA Section 10(a)1(A), that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Future cumulative effects from these and other types of federal actions will be investigated in future consultations, most notably in the *Status of the Species* and *Environmental Baseline* sections of Opinions which inform the effects analyses for specific federal actions. Other possible effects that may be acting in conjunction with federal actions and could possibly contribute to a cumulative impact on listed species are described below.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, natural mortality) will continue to influence listed species as well as the conservation value of designated critical habitat for North Atlantic right whales as described in the *Environmental Baseline* section of this Opinion. Climatic variability has the potential to affect listed species in the action area in the future; however, the prediction of any specific effects leading to a decision on the future survival and recovery of listed species is currently speculative. Nevertheless, possible effects of climatic variability for listed whales include the alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, alterations to prey composition and altered timing of breeding (MacLeod et al., 2005; Robinson et al., 2005; Kintisch, 2006; Learmonth et al., 2006; McMahon and Hays, 2006). The effects of climate-induced shifts in productivity, biomass, and species composition of zooplankton on the foraging success of North Atlantic right whales have received little attention. Such shifts in community structure and productivity may alter the distribution and occurrence of foraging right whales in coastal habitats, affect their reproductive potential, and may also reduce the conservation value of the Great South Channel and Cape Cod Bay critical habitat where zooplankton composition makes up one of the essential features of these critical habitat areas. In addition, increases in ocean temperature may cause dramatic shifts in the reproductive rate of North Atlantic right whales (Drinkwater et al., 2003; Greene et al., 2003) and possibly a northward shift in the location of right whale calving areas currently designated in the southeast U.S. (Kenney, 2007).

We also expect anthropogenic effects described in the *Environmental Baseline* will continue, including habitat degradation, vessel traffic and risk of ship strikes, interactions with fishing gear, and tourism activities. Expected increases in vessel traffic would further increase collision risks for large whales by the increased traffic itself and/or through habituation of whales to the sounds of oncoming traffic making them more prone to being struck. The number of vessels and tonnage of goods shipped by the U.S. fleet are increasing (e.g. there has been nearly a 30 percent increase in volume between 1980

and 2000) (NRC, 2003) and will lead to more vessel traffic throughout the action area in the future. The primary concern of increased levels of shipping noise expected from increased vessel traffic is not related to acute exposures, but rather to the general increase in continuous background ambient noise and the potential masking of marine animals' communication systems, their ability to hear mating calls, and their ability to pick up acoustic environmental cues that animals use to navigate and/or sense their surroundings, including sounds that are used to detect predators (OSPAR, 2009). Expanded use of commercial sonars is also expected to increase, further exacerbating these effects (NRC, 2003).

Due to insufficient information on future management regimes associated with commercial and recreational fisheries, we cannot estimate the probability of future injuries or deaths of listed whales due to interactions with these fisheries. However, given whale interactions with fisheries in the action area during the recent past, such interactions remain a major threat to the survival and recovery of listed whale species in the action area.

As the size of human communities increase, there is an accompanying increase in habitat alterations resulting from an increase in housing, roads, commercial facilities, and other infrastructure that result in increased discharge of sediments and pollution into the marine environment. These activities are expected to continue to degrade the habitat of listed whales as well as that of the prey on which they depend. Pollutants may also affect phytoplankton and zooplankton populations in a way that decreases the density and abundance of specific zooplankton patches on which North Atlantic right whales feed. In addition, pollution may affect the feeding patterns and habitat use of other components of the marine ecosystem, which in turn could impact food and habitat availability for other listed whales in the future.

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

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

foreseeable future and could contribute to a cumulative impact on listed species or designated critical habitat.

INTEGRATION AND SYNTHESIS OF EFFECTS

The following text integrates and synthesizes the *Description of the Action, Approach to the Assessment, Status of the Species, Environmental Baseline, Effects of the Proposed Action, and Cumulative Effects* sections of this Biological Opinion as corrected. This information, in addition to any known or expected cumulative effects, was used to assess the risk the proposed research activities pose to the future survival and recovery of North Atlantic right, fin, and humpback whales as well as the conservation value of North Atlantic right whale critical habitat designated in the action area.

As explained in the *Approach to the Assessment* section, risks to listed individuals are measured using changes to an individual's "fitness." When listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). When individuals of listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions can reduce the abundance, reproduction, or growth rates of the populations that those individuals represent (see Stearns, 1992). If we determine that reductions in individual plants' or animals' fitness reduce a population's viability, we consider all available information to determine whether these reductions are likely to appreciably reduce the viability of the species as a whole.

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

The Permits Division proposes to issuance permit No. 14233 to Dr. Scott Kraus of the New England Aquarium and permit No. 14603 to the Provincetown Center for Coastal Studies that would authorize direct "takes" of North Atlantic right, fin, and humpback whales within the U.S. Atlantic EEZ from Florida to Maine. The proposed activities under this permit include aerial and vessel surveys, including close approaches to listed whales for photography, videography, passive acoustic recording, sonar mapping of prey resources, prey sampling, fecal sampling, suction cup tagging, and biopsy sampling.

These activities would also occur within areas designated as critical habitat for North Atlantic right whales, including Cape Cod Bay, the Great South Channel, and the U.S. southeast calving grounds off the coasts of Georgia and Florida. The permits would be valid for five years and would exempt 3,120 annual "takes" of North Atlantic right whales as well as up to 40 annual "takes" of humpback and fin whales as a result of the proposed research. Any single type of "take" or combination thereof can contribute to the total number allowed under the proposed permit. North Atlantic right whales would be taken for all proposed research activities whereas fin and humpback whales would be incidentally harassed during aerial and vessel surveys as well as for close approaches under CCS' permit (permit No. 14603) for opportunistic photographs.

North Atlantic right, fin, and humpback whales were heavily reduced by whaling up to the late 19th century. Other factors currently threatening the survival and recovery of these species include entrapment and entanglement in commercial fishing gear, ship strikes, habitat issues such as pollutants and noise, subsistence harvest, scientific whaling and research, and commercial and private whale watching. Recent increases in North Atlantic right whale calving may indicate that the calving interval for the species is decreasing, although other anthropogenic sources of mortality such as ship strikes and entanglement in fishing gear continue to threaten the species and slow its ability to recover. Numbers for humpback whales appear to be increasing in the North Atlantic and Southern Hemisphere stocks; however, their resilience to anthropogenic stressors is less clear. Fin whale abundance estimates involve a significant level of uncertainty, but the estimates available indicate that current abundance appears to be significantly lower than historical levels across all ocean basins; however, there is insufficient data to determine overall population trends for this species (Carretta et al., 2007).

Critical habitat designated for the North Atlantic right whale encompasses three primary feeding and nursery habitats in the United States used by right whales during their annual migration. The physical, chemical, and biotic features that form right whale critical habitat include the composition of zooplankton in feeding areas, the topographic and seasonal oceanographic characteristics conducive to zooplankton growth; and water depth, water temperatures, and distance from shore for calving and nursery areas (59 FR 28793; June 3, 1994). Threats affecting the status and conservation value of North Atlantic right whale critical habitat are similar to threats affecting North Atlantic right whale individuals and populations occurring within these areas (e.g. vessel noise, fishing gear, etc.); however, additional threats to the conservation value of North Atlantic right whale critical habitat include variations in the NAO index affecting the abundance of zooplankton and possible shifts in the location of right whale calving areas (Kenney, 2007), the presence of commercial and recreational vessels interrupting feeding or nursing behavior, and habitat contamination and pollution from land based sources. These threats are expected to continue to affect the conservation value of foraging grounds and/or calving areas for North Atlantic right whales and remain a significant threat to the recovery of the species as whole.

Taken together, the components of the environmental baseline for the action area include sources of natural mortality – such as predation, disease, and parasites – as well as

influences from natural oceanographic and climatic features in the action area. Circulation and productivity patterns may influence prey distribution and habitat quality for listed whale species as well as possibly affect the conservation value of designated critical habitat for North Atlantic right whales at present and in the future. The baseline also includes human activities resulting in disturbance, injury, or mortality of individuals. These activities include the direct commercial harvest of whales, which significantly lowered population levels of all three species in the past, habitat degradation (e.g., due to contaminants and noise), vessel traffic and risk of ship strikes, entrapment or entanglement in fishing gear, and harassment from other permitted scientific research activities. Conservation and management efforts are ongoing and have a positive effect on the status of listed species and critical habitat found within the action area. Listed whales species and designated critical habitat areas are exposed to all components of the environmental baseline which are affecting the survival and recovery of these species in wild; however, the combined consequences of any effects on the species' status, trend, or demographic processes that drive the status and trends of these whales remain largely undetermined.

The assessment for this consultation identified several possible stressors as a result of the proposed research activities that would be measured and evaluated against the stressors already occurring in the *Environmental Baseline* section. These stressors included noise and visual disturbance during aerial and vessel surveys, noise and visual disturbance during prey sampling activities, the reduction in prey resources taken during sampling, the potential for vessel strikes during transit, biopsy sampling, suction cup tagging, and exposure to active sonar from fish finders used for mapping copepod prey resources.

Based on the best available information, it is expected the aerial surveys conducted during the proposed research activites would result in only mild short-term behavioral reactions and would not result in any long term behavioral changes or reduce the fitness of individuals in the action area. In addition, aerial surveys are not expected to reduce the quality, quantity, or availability of essential features of North Atlantic right whale critical habitat designated in the action area.

Vessel approaches have the potential to disturb listed whale species and induce behavioral and possibly physiological stress to whales targeted by the approach as well as other whales in the vicinity of the vessel. Whales may respond differently to vessel surveys depending on what behavior the animals are engaged in before the vessel approaches (Würsig et al., 1998; Hooker et al., 2001; Jahoda et al., 2003) and the degree to which they become accustomed to vessel traffic (Lusseau, 2004; Richter et al., 2006). Reactions include little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation, diving and time spent submerged, foraging, respiratory patterns, and also may include aerial displays like breaching and lobtailing (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005). Given the information available and recognizing the conditions of the proposed permit, we assume the close approaches by research vessels to result in short- to mid-term stress responses that generate no long-term behavioral changes that might result in fitness consequences for individual whales. Also,

given the procedures to be followed in the proposed research activities (e.g. slow transit speeds and slow, converging course technique during close approaches), it's expected that the probability of whales being struck by research vessels is extremely unlikely and, therefore, discountable.

For vessel surveys conducted in critical habitat designated for the North Atlantic right whale, we considered the effects that research vessels would have on the quantity, quality, and availability of the essential features of the habitat (specifically the quantity and availability of zooplankton patches in the northeast critical habitat areas and behavioral reactions that could cause whales to leave areas sufficient for feeding). Close approaches to actively feeding whales may cause some level of turbulence at the surface that can break up dense zooplankton patches, may disrupt foraging behavior, and may cause whales to temporarily leave areas sufficient for feeding thereby temporarily reducing the quantity and availability of this essential feature of the critical habitat. However, NMFS expects that the slow approach techniques employed by the researchers should minimize surface turbulence and would not be expected to reduce zooplankton densities to the degree that right whales could not detect the prey. Also, Both Dr. Kraus and CCS expect to approach whales at a slow and converging course that should minimize the stress response of the close approach to listed whales during their respective research activities. Furthermore, vessel surveys would not affect topographic or oceanographic characteristics, water depth, water temperature, or distance of the critical habitat areas from shore nor would they affect the population ecology or population dynamics of prey species, predators, or competitors of right whales.

Behavioral reactions to biopsy sampling and suction cup tagging are often difficult to differentiate from reactions to close vessel approaches, because in all cases it is necessary to closely approach the whale to obtain a sample. Responses to biopsy sampling may manifest as stress responses, interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combination of these responses. No serious injury or mortality to whales from biopsy darting is expected since the size of the dart is not expected to penetrate the muscle layer of North Atlantic right whale adults, juveniles, or calves; however, the risk of injury is greater for calves due to their thinner blubber layers. Evidence available on the short-term effects of tagging whales indicates that responses vary from little to no observable change in behavior to momentary changes such as skin twitching, startle reactions or flinching, altered swimming speed and orientation, diving, rolling, head lifts, high back arching, fluking, and tail swishing (Goodyear, 1981; 1989; 1993; Watkins et al., 1981; 1984; Baird, 1994; Mate et al., 1997; 1998; Hooker et al., 2001). A number of studies involving the close approach of humpback and southern right whales by research vessels for biopsying and tagging indicate that responses are generally minimal to non-existent when approaches were slow and careful and when more pronounced behavioral changes occur, the responses appear to be short-lived (Weinrich et al., 1991; 1992; Clapham and Mattila, 1993; Gauthier and Sears, 1999; Best et al., 2005). Permit conditions will help to minimize long-term effects. Assuming an animal is no longer disturbed after it returns to pre-tag or pre-biopsy behavior, we do not expect long-term consequences for the fitness of North Atlantic right whale individuals as a result of suction cup tagging or biopsying although

the results of the 5 year North Atlantic right whale study should further inform the analysis on the long term effects of biopsying cow-calf pairs.

For biopsy sampling and suction cup tagging conducted in North Atlantic right whale critical habitat, we considered the effects that these activities would have on the quantity, quality, and availability of essential features of the habitat (specifically stress responses that would interrupt feeding or cause whales to leave foraging or calving areas thereby reducing the availability of the essential habitat features that have conservation value to the species). A number of studies involving the close approach of humpback and southern right whales by research vessels for biopsying and tagging indicate that responses are generally minimal to non-existent when approaches were slow and careful and when more pronounced behavioral changes occur, the responses appear to be short-lived (Weinrich et al., 1991; 1992; Clapham and Mattila, 1993; Gauthier and Sears, 1999; Best et al., 2005). Therefore, since behavioral reactions are expected to be temporary and short-lived, we would expect that actively feeding whales in the northeast critical habitat (i.e. Great South Channel and Cape Cod Bay) as well as cow-calf pairs in the southeast critical habitat (off the coasts of Georgia and Florida) would resume normal behavior following the biopsy or suction cup tagging procedure and would not permanently abandon habitat areas that contain the essential features. Also, based on the best available information, we would anticipate that biopsying North Atlantic right whales would also not have any long term fitness consequences nor would it cause females to permanently abandon critical habitat areas that contain the essential feature (i.e. water depth, water temperatures, and distance from shore for calving and nursery) based on the preliminary results seen for humpback whales; however, the results of the 5 year North Atlantic right whale study will further inform this analysis.

Since the collection of fecal samples would not involve a close approach, right whales are not expected to respond to the fecal sampling activity beyond the mild, short-term reactions seen during the normal course of vessel surveys and would not be expected to appreciably reduce the fitness of right whale individuals. In addition no essential features of North Atlantic right whale critical habitat would be affected.

The proposed sampling of North Atlantic right whale copepod prey resources is not expected to physically interact with any animals, pose a risk of ingestion or entanglement to feeding animals. Given the information available on effects of close approaches by vessels, we provisionally assume plankton sampling that occurs in the immediate vicinity of actively feeding whales would result in short- to mid-term stress responses that generate no long-term behavioral changes that might result in fitness consequences for individual whales. Based on prior observations, whales are expected to remain in the vicinity during sampling and are are assumed to continue feeding after the vessel leaves the area. Also, the relatively small prey samples to be obtained when compared to the expected prey densities in the vicinity of feeding right whales is not expected to appreciably reduce the prey available to right whales or reduce the quality of foraging habitat for right whales in the areas sampled. Also, the frequencies of fish finders that would be used for prey mapping would be a minimum of 38 kHz, above the dominant vocalization frequencies used by baleen whales, and above their highest recorded

vocalization frequencies (Thomson and Richardson, 1995; Au, 2000); therefore, the frequencies of the fish finders are expected to be outside of the functional hearing range of the target whales and would not result in any measurable reaction.

For prey sampling occurring in the Cape Cod Bay and Great South Channel critical habitat, we considered the effects that prey sampling would have on the quality, quantity, and availability of the essential features that give the habitat conservation value to the species (specifically the quantity and availability of prey and behavioral reactions that may interrupt foraging or cause whales to abandon importating foraging areas that contain the essential feature). NMFS believes the sample sizes taken will be sufficiently low relative to the size of the average zooplankton patch to have a discountable effect on prey quantity and/or availability. The applicants also note that most sampling will not occur in the immediate vicinity of actively feeding whales, although for instances where this is the case (less than 10 times per year), samples will be taken behind the whale as it feeds at a distance of 50 – 100 m or more from the feeding whale. Pump sampling would be conducted in the regions where whales are aggregated, but would generally occur over a kilometer from the whales themselves. Annual reports submitted by CCS on their previous permit (permit No. 633-1763) indicate reactions were generally mild with no whales exhibiting any evasive behavior as a result of the prey sampling. Furthermore, prey sampling would not affect topographic or oceanographic characteristics, water depth, water temperature, or distance of the critical habitat areas from shore nor would they affect the population ecology or population dynamics of prey species, predators, or competitors of right whales.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, natural mortality) will continue to influence listed species and designated critical habitat in the action area as described in the *Environmental Baseline* section. Climatic variability has the potential to affect listed species in the action area through alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, alterations to prey composition and altered timing of breeding (MacLeod et al., 2005; Robinson et al., 2005; Kintisch, 2006; Learmonth et al., 2006; McMahon and Hays, 2006). The effects of climate-induced shifts in productivity, biomass, and species composition of zooplankton on the foraging success of North Atlantic right whales may alter their distribution and occurrence in coastal habitats as well as their reproductive potential.

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

as the potential additive effect that multiple stressors acting in conjunction over time have on the survival and recovery of listed whales in the action area.

Based on the best scientific information available, we expect that responses to close vessel approaches and biopsying, suction cup tagging, and prey sampling is not likely to cause a reduction in North Atlantic right, humpback, or fin whale individuals's growth, survival, annual reproductive success, or lifetime reproductive success (i.e. fitness) or contribute to a significant cumulative effect. As a result, we do not expect activities authorized by the proposed permits to have an appreciable effect on the extinction risk of the population(s) these individuals represent or the species those populations comprise. Also, any reduction in availability of essential physical, chemical, or biological features caused by vessel surveys and the close approach of right whales in critical habitat areas for biopsying, suction cup tagging, and prey sampling is not expected to be sufficient to cause a reduction in the conservation value of North Atlantic right whale critical habitat designated in the action area nor would it reduce the conservation value of the designation as a whole.

CONCLUSION

After reviewing the current status of species, the environmental baseline for the action area, the anticipated effects of the proposed activities and the possible cumulative effects, it is the Endangered Species Division's opinion that the Permits Division's proposed action of issuing permit No. 14233 to Dr. Scott Kraus and permit No. 14603 to the Provincetown Center for Coastal Studies, as proposed, is not likely to jeopardize the continued existence of North Atlantic right, humpback, or fin whales and is not likely to destroy or adversely modify critical habitat for North Atlantic right whales under NMFS' authority.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the "take" of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Sections 7(b)(4) and 7(o)(2), taking that is incidental and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement. However, as discussed in the accompanying Opinion, only the species targeted by the proposed research activities will be significantly harassed as part of the intended purpose of the proposed action. Therefore, NMFS does not expect the proposed action will incidentally take threatened or endangered species.

CONSERVATION RECOMMENDATIONS

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

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

1. *Approaching Cow-Calf Pairs that Appear in Poor Health.* The Permits Division should include a permit condition that prohibits researchers from approaching North Atlantic right whale cows with their calves regardless of age when either appear unusually thin or emaciated. Further stress from approach or attempts to biopsy sample a cow or her calf in poor health may cause injury or even death of a whale.

2. *Impacts of Biopsy Sampling*. Given the limited research that has been conducted on the impact of biopsy sampling of North Atlantic right whale calves, and the different age limits authorized among permits for biopsy sampling calves (e.g. age limits of 1 month, 6 months, or 1 year), the Permits Division should work to develop a consistent policy specifying the age at which calves can be biopsy sampled. The Permits Division should base this determination on available scientific information and expert opinion, while ensuring that the policy contributes to the protection and conservation of the species.

3. *Estimation of Actual Levels of "Take."* Before issuing permits with similar actions, the Permits Division should continue to review all annual and final reports submitted by investigators that have conducted whale research as well as any data and results that can be obtained from the permit holders. This should be used to estimate the amount of harassment that occurs given the level of research effort, and how the harassment affects the life history of individual animals. In addition, NMFS-NEFSC's North Atlantic right whale 5 year biopsy study should be completed and evaluated before new levels of "take" from similar actions are authorized for North Atlantic right whales. The results of this study will further inform the analysis of long term effects of biopsying North Atlantic right whales, including cow-calf pairs. The results of these studies should be provided to NMFS Office of Protected Resource – Endangered Species Division for use in future consultations.

4. *Cumulative Impact Analysis*. The Permits Division should work with the Marine Mammal Commission, International Whaling Commission, and the marine mammal research community to identify a research program with sufficient scope and depth to determine cumulative impacts of existing levels of research on listed

whales. This includes the cumulative sub-lethal and behavioral impacts of research permits on listed species.

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

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

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

In order for the Endangered Species Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, listed species or their habitats, the Permits Division should notify the Endangered Species Division of any conservation recommendations they implement in their final action.

REINITIATION NOTICE

This concludes formal consultation on the proposal to issue scientific research permit No. 14233 and permit No. 14603 for research on listed cetaceans within waters of the U.S. Atlantic Exclusive Economic Zone. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of proposed take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, NMFS Office of Protected Resources – Permits, Conservation, and Education Division must immediately request reinitiation of section 7 consultation.

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Appendix A. Active NMFS Scientific Research Permits Authorizing Take of Target Species.

Permit No.	Holder	Start Date	Expiration	Target Species Authorized
633-1763-01	Center for Coastal Studies	4/21/2005	5/1/2011	North Atlantic Right Whales
1036-1744	DiGiovanni	4/21/2005	5/1/2010	North Atlantic Right Whales, Fin Whales, Humpback Whales
594-1759	Georgia DNR	4/21/2005	5/1/2011	North Atlantic Right Whales
948-1692	Pabst	5/5/2006	5/31/2011	North Atlantic Right Whales, Fin Whales, Humpback Whales
633-1778-01	Center for Coastal Studies	6/26/2006	6/30/2011	Fin Whales, Humpback Whales
1058-1733	Baumgartner	6/26/2007	5/31/2012	North Atlantic Right Whales, Fin Whales, Humpback Whales
775-1875	NMFS, NEFSC	1/16/2008	1/15/2013	North Atlantic Right Whales, Fin Whales, Humpback Whales
605-1904	Whale Center of New England	2/14/2009	2/15/2013	North Atlantic Right Whales, Fin Whales, Humpback Whales
1128-1922	Mercado	1/2/2009	1/15/2014	Humpback Whales
779-1633-01	NMFS, SEFSC			North Atlantic Right Whales, Fin Whales, Humpback Whales
369-1757	Mate	5/26/2005	5/31/2011	Fin Whales, Humpback Whales
1128-1922	Mercado			Humpback Whales
13545	Ocean Alliance	2/16/2010	2/15/2015	North Atlantic Right Whales, Fin Whales, Humpback Whales
10014	New Jersey DEP	10/1/2007	9/30/2012	North Atlantic Right Whales, Fin Whales, Humpback Whales

**The SEFSC has been granted an extension of their current permit while the new application is processed.

Appendix B. Annual Takes for Target Species from Active Research Permits and Proposed Research Actions

Target Species	Year	Level B Harassment Only*		Biopsy**		Suction Cup Tagging**		Implantable Satellite Tagging**		Active Acoustics**	
		Current	Proposed	Current	Proposed	Current	Proposed	Current	Proposed	Current	Proposed
North Atlantic Right Whale	2010	1745	2700	60 (30 calf)	50 (20 calf)	130 (15 calf)	20	45	0	0	350
	2011	1645	2700	60 (30 calf)	50 (20 calf)	130 (15 calf)	20	45	0	0	350
	2012	1045	2700	60 (30 calf)	50 (20 calf)	130 (15 calf)	20	45	0	0	350
	2013	695	2700	60 (30 calf)	50 (20 calf)	40 (5 calf)	20		0	0	350
	2014	20	2700	0	50 (20 calf)	0	20	0	0	0	350
TOTAL		5150	13500	240 (120 calf	250 (100 calf)	430 (60 calf)	100	135	0	0	1750
Fin Whale	2010	1868	20	240 (25 calf)	0	223	0	95	0	0	0
	2011	1768	20	240 (25 calf)	0	223	0	95	0	0	0
	2012	1466	20	165 (20 calf)	0	173	0	45	0	0	0
	2013	750	20	165 (20 calf)	0	65	0	0	0	0	0
	2014	0	20	20	0	0	0	0	0	0	0
TOTAL		5852	100	830 (90 calf)	0	684	0	235	0	0	0
Humpback Whale	2010	4086	20	485 (20 calf)	0	223	0	95	0	600	0
	2011	3986	20	485 (20 calf)	0	223	0	95	0	600	0
	2012	2136	20	235 (20 calf)	0	173	0	45	0	600	0
	2013	1445	20	235 (20 calf)	0	65	0	0	0	600	0
	2014	45	20	20	0	0	0	0	0	600	0
TOTAL		11698	100	1460 (80 calf)	0	684	0	235	0	3000	0

* Level B harassment activities are defined as any activity that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild.

** The proposed takes for biopsy sampling, tagging, and active acoustics would occur simultaneously with Level B activities. These tables represent a worst-case scenario for species.