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

**Biological Opinion**

**Agencies:** NOAA's National Marine Fisheries Service-Office of Protected Resources-Permits, Conservation, and Education Division

**Activities Considered:** Issuance of permit to Scott Kraus, New England Aquarium (Permit number 15415) for research on North Atlantic right whales (*Eubalaena glacialis*) within waters of the Western North Atlantic Ocean.

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

**Approved by:** _____

**Date:** MAR 0 8 2011

Section 7(a)(2) of the Endangered Species Act (ESA)(16 U.S.C. 1531 *et seq.*) requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a federal agency "may affect" a listed species or critical habitat designated for them, that agency is required to consult with either the NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service, depending upon the listed resources that may be affected. For the actions described in this document, the action agency is the NMFS' Office of Protected Resources-Permits, Conservation, and Education Division (Permits Division), which proposes to authorize research on North Atlantic right whales in Cape Cod Bay, the Gulf of Maine, and New York Bight. The consulting agency for these proposals is the NMFS' Office of Protected Resources – Endangered Species Division (Endangered Species Division).

This document represents the NMFS' biological opinion (Opinion) of the effects of the proposed actions on endangered and threatened species and designated critical habitat and has been prepared in accordance with section 7 of the ESA. This Opinion is based on information provided in the application, draft permit, environmental assessment, the North Atlantic right whale recovery plan, environmental impact statements from the region, other information provided by the applicant, and other biological opinions involving research.

## Consultation history

On December 10, 2010, the Permits Division published a notice in the Federal Register soliciting public comment on their intent to issue the proposed permit.

On February 2, 2011, NMFS' Endangered Species Division received a request for formal consultation from the Permits Division to authorize Permit Number 15415, Scott Kraus, New

England Aquarium.

## Description of the proposed action

The proposed activities under permit 15415 include the evaluation of visual deterrents to reduce North Atlantic right whale entanglement in fishing gear within waters of the western North Atlantic Ocean. These actions may result in direct "takes[1]" of up to 200 North Atlantic right whales per year for two sampling periods within a five-year period (one control and one test trial for ten trials = 20/day x 10 days = 200 takes/year). Individual animals are proposed to be repeatedly taken up to five times annually. Activities would occur during springtime (April and May), but may also occur during September and October. Calves and mother-calf pairs would be avoided, but juveniles and adults would be targeted.

Research would involve the use of a 46-foot inboard diesel-powered research vessel (*R/V Galatea*) with a low-cavitation propeller. Once in the vicinity of potential target individuals, the vessel would operate at a constant throttle speed and not engage in rapid turns or acceleration to minimize impacts to focal individuals. Approaches will occur from alongside with a slowly convergent trajectory. Research trials would begin with the deployment of a four meter length PVC rod (weight on one end and a float on the other) painted in bright colors. PVC rods would also have one of two illumination settings: an LED light that is constantly on or one that flashes. Deployment would ideally occur at evening twilight. Visual contact with target whales would be maintained by the naked eye or night vision equipment as needed. PVC rods would be deployed in front of whales (preferably directly in front) at distances of at least 100 m. The vessel would then move 50-100 m, stop, and observe individual responses (if any) to the rod. Photoidentification would be conducted subsequent to trials. As a control, these same efforts would be conducted without actually deploying the rod. Researchers expect to conduct 10 pairs of two treatments per day for up to 10 days per year. Methodology may be altered in the second year based upon data collected in the first year. Changes could include changes in PVC rod color, color patterns, and illumination patterns, as well as focusing on particular North Atlantic right whale age groups.

## Approach to the assessment

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

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1[1] By MMPA regulation, "take" means to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal.

whether and how those listed resources are likely to respond given their exposure (these represent our *response analyses*).

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

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

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

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

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

point of reference. If we conclude that reductions in individual fitness are not likely to reduce the viability of the populations those individuals represent, we would conclude our assessment.

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

To conduct these analyses, we rely on all of the evidence available to us. This evidence consists of monitoring reports submitted by past and present permit holders, reports from NMFS Science Centers; reports prepared by natural resource agencies in States and other countries, reports from non-governmental organizations involved in marine conservation issues, the information provided by the Permits Division when it initiates formal consultation, and the general scientific literature.

We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies like the Minerals Management Service, U.S. Coast Guard, and U.S. Navy whose operations extend into the marine environment.

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

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

In this particular assessment, we identify the stressors associated with the action and evaluated which have a significant possibility of occurring based upon previous research. Of the probable stressors, we identify the species that we expect to co-occur with the effects of the action.

## Action area

The applicant proposes to undertake research activities in Cape Cod Bay, the Gulf of Maine, and New York Bight. This includes coastal waters up to 80 km from New York Harbor to the U.S./Canadian border. Activities would be limited to relatively nearshore waters.

## Status of listed resources

The NMFS has determined that the actions considered in this Opinion may co-occur with species listed in Table 1, which are provided protection under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.).

**Table 1.** Listed species in the action area.

| Common name | Scientific name | Status |
|---|---|---|
| **Cetaceans** | | |
| Blue whale | *Balaenoptera musculus* | Endangered |
| Fin whale | *Balaenoptera physalus* | Endangered |
| Humpback whale | *Megaptera novaeangliae* | Endangered |
| Sei whale | *Balaenoptera borealis* | Endangered |
| North Atlantic right whale[2] | *Eubalaena glacialis* | Endangered |
| Sperm whale | *Physeter macrocephalus* | Endangered |
| **Marine turtles** | | |
| Green sea turtle | *Chelonia mydas* | Endangered/ Threatened |
| Hawksbill sea turtle | *Eretmochelys imbricate* | Threatened |
| Leatherback sea turtle | *Dermochelys coriacea* | Endangered |
| Loggerhead sea turtle | *Caretta caretta* | Threatened |
| Olive ridley sea turtle | *Lepidochelys olivacea* | Endangered/ Threatened |
| **Anadromous fishes** | | |
| Atlantic salmon (Gulf of Maine) | *Salmo salar* | Endangered |
| Atlantic sturgeon (Gulf of Maine) | *Asipenser oxyrinchus* | Proposed Threatened |
| Atlantic sturgeon (New York Bight) | | Proposed Endangered |

We expect blue, fin, sei, humpback, and sperm whales to co-occur in time and space with the proposed action, introducing the possibility of ship-strike and acoustic disturbance. Personnel onboard research vessels would be continually observing for whales and actively avoid approaching non-target North Atlantic right whales or other whale species. This, combined with the thousands of hours that researchers have spent in vessel-based research effort in the region without an incident of ship-strike make the possibility of ship-strike discountable. The research vessel would produce noise in the acoustic environment which has the potential to mask the vocalizations produced by these species or other significant acoustic information, introducing the possibility that important sounds may not be perceived by individuals near the research vessel (particularly when operating at high speed). However, the research vessel is equipped with a

[2] Denotes critical habitat in the action area.

low-cavitation propeller and researchers would be visually searching for whales and avoiding close approaches of all but target North Atlantic right whales. The relatively large size of the research vessel also reduces the amplitude of its propulsion noise compared to smaller research vessels. These factors, combined with the large amount of vessel traffic in area, makes the potential impact of the research vessel's acoustic signature discountable.

Sea turtles would be exposed to these same potential stressors. As with marine mammals, sea turtles have not been documented to be struck by researchers in the area and the possibility of this occurring is discountable. Sea turtles have a hearing range that is generally less than marine mammals, with hearing thresholds below the frequency and sound source amplitudes expected to be emitted by boats similar to those used by the applicants (Hunt 2007; Lenhardt 1994; Lenhardt et al. 1983; Moein Bartol and Ketten 2006; Moein Bartol et al. 1999; O'Hara and Wilcox 1990; Ridgway et al. 1969). Therefore, we discount the possibility of the proposed activities to impact sea turtles.

Atlantic salmon may occur near the ocean surface, but we expect individuals to be easily capable of moving out of the direct path of even a fast-moving vessel. Atlantic sturgeon tend to be epibenthic in the marine environment and unlikely to be found near the ocean surface. We therefore find the potential for direct strike to listed fishes to be insignificant. As with sea turtles, Atlantic salmon and Atlantic sturgeon have hearing ranges that are generally low (<1 kHz), which does not significantly overlap with frequencies over which most energy is emitted by vessels like those proposed for use by the researchers (Popper 2005). Therefore, we do not expect the proposed actions to impact listed fishes in the action area.

We do not expect that the proposed actions will impact the primary constituent elements of critical habitat in the area. This includes the value of feeding habitat for North Atlantic right whales. We therefore find risk to critical habitat to be insignificant.

The biology and ecology of North Atlantic right whales, the only listed resource that may be affected by this action is presented below. Summaries of the global status and trends of this species provides a foundation for the analysis of species as a whole.

## North Atlantic right whale

**Description of the species.** All North Atlantic right whales compose a single population. Although not all individuals undergo the same migratory pattern, no subpopulation structuring has been identified.

**Distribution.** Right whales occur in sub-polar to temperate waters in all major ocean basins in the world, with a clear migratory pattern of high latitudes in summer and lower latitudes in winter (Cummings 1985; Perry et al. 1999; Rice 1998). The historical range of North Atlantic right whales extended as far south as Florida and northwestern Africa, and as far north as Labrador, southern Greenland, Iceland, and Norway (Cummings 1985; Reeves et al. 1978; Rice 1998). Most sightings in the western North Atlantic are concentrated within five primary habitats or high-use areas: coastal waters of the southeastern U.S., Cape Cod and Massachusetts Bays, the Great South Channel, the Bay of Fundy, and the Scotian Shelf (Winn et al. 1986). In 1994, the first three of these areas were designated as critical habitat for the North Atlantic right whale.

North Atlantic right whales have been observed from the mid-Atlantic Bight northward through the Gulf of Maine year-round, but are primarily found along the northeast U.S. during summer

and Florida during winter, with migratory routes in between. In New England, peak abundance of North Atlantic right whales in feeding areas occurs in Cape Cod Bay beginning in late winter. In early spring (Late February to April), peak North Atlantic right whale abundance occurs in Jordan and Wilkinson basins to the Great South Channel (Kenney et al. 1995; Nichols et al. 2008; Pace III and Merrick 2008). In late June and July, North Atlantic right whale distribution gradually shifts to the northern edge of Georges Bank. In late summer (August) and fall, much of the population is found in waters in the Bay of Fundy, the western Gulf of Maine and around Roseway Basin (Kenney et al. 2001; Kenney et al. 1995; Pace III and Merrick 2008; Winn et al. 1986). However, year-to-year variation in space and time are known and likely result from patchy prey distribution (Nichols et al. 2008). Variation in the abundance and development of suitable food patches appears to modify the general patterns of movement by reducing peak numbers, stay durations and specific locales (Brown et al. 2001; Kenney 2001). In particular, large changes in the typical pattern of food abundance will dramatically change the general pattern of North Atlantic right whale habitat use (Kenney 2001).

**Migration and movement.** North Atlantic right whales exhibit extensive migratory patterns, traveling along the eastern seaboard of the U.S. and Canada between calving grounds off Georgia and Florida to northern feeding areas off of the northeast U.S. and Canada in March/April and the reverse direction in November/December. The longest tracking of a North Atlantic right whale was a migration of 1,200 miles in 23 days the Bay of Fundy to Georgia (Mate and Baumgartner 2001). Migrations are typically within 30 nautical miles of the coastline and in waters less than 160 feet deep. Although this pattern is well-known, most of the population, particularly the males and non-pregnant females, is not found in the calving area and may not follow this pattern. It is unknown where the majority of the non-calving population spends the winter.

There have been a few recent sightings of North Atlantic right whales far offshore, including those from Dutch ships indicating some individuals occur between 40° and 50°N, in waters influenced by the North Atlantic Current (the broad, eastward-flowing extension of the Gulf Stream). Right whales have been sighted offshore (greater than 30 miles) during surveys flown off the coast of northeastern Florida and southeastern Georgia from 1996 to 2001. These include three sightings in 1996, one in 1997, 13 in 1998, six in 1999, 11 in 2000, and six in 2001 (within each year, some were repeat sightings). Mate et al. (1997) recorded radio-tagged animals making extensive movements from the Gulf of Maine into deeper waters off the continental shelf (Mate et al. 1997). The frequency with which North Atlantic right whales occur in offshore waters in the southeastern U.S. remains unclear. Occasionally, individuals are observed in distant locations, including the Gulf of Mexico, Bermuda, the Gulf of St. Lawrence, Newfoundland, Greenland, Iceland, and northern Norway (an area known as a historical North Atlantic right whale feeding area Smith et al. 2006). The Norwegian sighting (September 1992) represents one of only two sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described.

**Reproduction and demography.** Data through the 1990s suggests that mean calving interval increased since 1992 from 3.67 years to more than five years, a significant trend that hampers North Atlantic right whale recovery (Best et al. 2001a; Kraus et al. 2007). This reproductive rate was approximately half that reported from studied populations of southern right whales (Best et al. 2001b). This has been attributed to several possible causes, including higher abortion or

perinatal losses (Browning et al. 2009). An analysis of the age structure of North Atlantic right whales suggests that the population contains a smaller proportion of juvenile whales than expected, which may reflect lowered recruitment and/or high juvenile mortality (Best et al. 2001a; Hamilton et al. 1998). In addition, it is possible that the apparently low reproductive rate is due in part to unstable age structure or to reproductive senescence on the part of some females. However, knowledge on either factor is poor. Even though investment in calves is high for North Atlantic right whales, an incident of calf exchange (probably accidentally and soon after birth) and subsequent adoption through weaning has been found (Frasier et al. 2010). Although North Atlantic right whales historically separated from their calves within one year, a shift appears to have taken place around 2001 where mothers (particularly less experienced mothers) return to wintering grounds with their yearling at a much greater frequency (71% overall)(Hamilton and Cooper. 2010). The significance of this change is unknown.

**Habitat.** Available evidence from North Atlantic right whale foraging and habitat studies shows that North Atlantic right whales focus foraging activities where physical oceanographic features such as water depth, current, and mixing fronts combine to concentrate copepods (Baumgartner et al. 2003; Mayo and Marx 1990; Murison and Gaskin 1989; Wishner et al. 1988).

**Feeding.** North Atlantic right whales fast during the winter and feed during the summer, although some may opportunistically feed during migration. North Atlantic right whales use their baleen to sieve copepods from dense patches, 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 of northern U.S. and Canada (Pendleton et al. 2009). The primary prey of North Atlantic right whales is zooplankton, especially shrimp-like copepods such as *Calanus* (Beardsley et al. 1996; Kenney et al. 1985). North Atlantic right whales feed largely by skimming these prey from the ocean surface (Mayo and Marx 1990; Pivorunas 1979), but may feed anywhere in the water column (Goodyear 1993; Watkins and Schevill 1976; Watkins and Schevill 1979; Winn et al. 1995). Feeding behavior has only been observed in northern areas and not on calving grounds or during migration (Kraus et al. 1993).

**Diving.** Although North Atlantic right whales are known to be primarily surface feeders, foraging dives frequently extend to the deepest layers of the water column (Baumgartner et al. 2003; Goodyear 1993; Mate et al. 1997). North Atlantic right whale feeding dives are characterized by a rapid descent from the surface to between 260 and 575 feet, where dives level off and individuals remain for 5 to 14 minutes before rapidly ascending back to the surface (Baumgartner and Mate 2003b). Dive depth has been shown to be strongly correlated with the depth of peak copepod abundance (Baumgartner and Mate 2003b). Prolonged periods at the surface have been noted for mothers and calves (Baumgartner and Mate 2003b). Shallow foraging dives in the Great South Channel average 2 minutes and 20 to 25 feet (Winn et al. 1995). However, dives along the outer shelf average 7 minutes (CETAP 1982). Although North Atlantic right whales are not champion divers, they can dive to over 1,000 feet (Mate et al. 1992). Group size varies, but is generally less than one dozen and singletons and pairs are most frequently observed (Jefferson et al. 1993).

**Acoustics and hearing.** North Atlantic right whales produce vocalizations of 100-800 Hz {Schevill, 1962 #62079}{Thompson, 1979 #6544}(Vanderlaan et al. 2003){Caldwell, 1971 #7620}(Laurinolli et al. 2003; Matthews et al. 2001); typical sounds are in the 120 to 500 Hz range with up- and down-sweeping modulations (Vanderlaan et al. 2003). Source levels have been estimated only for pulsive calls of North Atlantic right whales, which are 172-187 dB re 1

μPa-m (Thomson and Richardson 1995).

Morphometric analyses of right whale inner ears support an estimated hearing frequency range of approximately 10 Hz to 22 kHz based on established marine mammal models (Parks et al. 2004). Research by Nowacek et al. (2004) on North Atlantic right whales suggests that received sound levels of only 133-148 dB re 1 μPa-m for the duration of the sound exposure to an alert signal are likely to disrupt feeding behavior.

**Status and trends.** The Northern right whale was originally listed as endangered in 1970 (35 FR 18319), and this status remained since the inception of the ESA in 1973. The early listing included both the North Atlantic and the North Pacific populations, although subsequent genetic studies conducted by Rosenbaum (2000) resulted in strong evidence that North Atlantic and North Pacific right whales are separate species. Following a comprehensive status review, NMFS concluded that North Atlantic and North Pacific right whales are separate species. In March 2008, NMFS published a final rule listing North Pacific and North Atlantic right whales as separate species (73 FR 12024).

North Atlantic right whales were formerly abundant, with an estimated 5,500 individuals present in the 16$^{th}$ century throughout the North Atlantic (Reeves 2001; Reeves et al. 2007). A review of the photo-id recapture database in June 2006 indicated that only 313 individually recognized North Atlantic right whales were observed during 2001. This represents a nearly complete census, and the estimated minimum population size. However, no estimate of abundance with an associated coefficient of variation has been calculated for the population. The population growth rate reported for the period 1986 to 1992 by Knowlton et al. (1994) was 2.5%, suggesting the stock was showing signs of slow recovery. However, work by Caswell et al. (1999) suggested that crude survival probability declined from about 0.99 in the early 1980's to about 0.94 in the late 1990s. Additional work conducted in 1999 showed that survival had indeed declined in the 1990s, particularly for adult females (Best et al. 2001a). Another workshop in September 2002 further confirmed the decline in this population (Clapham 2002).

**Natural threats.** Several researchers have suggested that the recovery of North Atlantic right whales has been impeded by competition with other whales for food (Rice 1974; Scarff 1986). Mitchell (1975) analyzed trophic interactions among baleen whales in the western North Atlantic and noted that the foraging grounds of North Atlantic right whales overlapped with the foraging grounds of sei whales. Both species feed preferentially on copepods. Reeves et al. (1978) noted that several species of whales feed on copepods in the eastern North Pacific, so that the foraging pattern and success of right whales would be affected by other whales as well. Mitchell (1975) argued that the North Atlantic right whale population had been depleted by several centuries of whaling before steam-driven boats allowed whalers to hunt sei whales; from this, he hypothesized that the decline of the right whale population made more food available to sei whales and helped their population to grow. He then suggested that competition with the sei whale population impedes or prevents the recovery of the right whale population.

Other natural factors influencing right whale recovery are possible, but unquantified. Right whales have been subjects of killer whale attacks and, because of their robust size and slow swimming speed, tend to fight killer whales when confronted (Ford and Reeves 2008). Similarly, mortality or debilitation from disease and red tide events are not known, but have the potential to be significant problems in the recovery of right whales because of their small population size.

**Anthropogenic threats.** Several human activities are known to threaten North Atlantic right whales: whaling, commercial fishing, shipping, and environmental contaminants. Most of these are discussed in the Environmental baseline, but whaling is discussed here. Historically, whaling represented the greatest threat to every population of right whales and was ultimately responsible for listing right whales as an endangered species. As its legacy, whaling reduced North Atlantic right whales to about 300 individuals in the western North Atlantic Ocean; the number of North Atlantic right whales in the eastern North Atlantic Ocean is probably much smaller, although we cannot estimate the size of that population from the data available.

**Critical habitat.** Critical habitat is designated for right whales in the North Atlantic. NMFS designated three areas in June 1994 as critical habitat for *Eubalaena glacialis* for feeding and calving (59 FR 28805). The critical habitats for feeding cover portions of the Great South Channel (east of Cape Cod), Massachusetts Bay and Cape Cod Bay, and Stellwagen Bank. Northern critical habitat was designated because of the concentration of right whales that feed in the area, apparently associated with complex oceanographic features that drive prey density and distribution. This area has come under considerable scrutiny within the past few years because of the concern over ship strikes in this area. Boston serves as a major port facility and vessels transiting to and from the port cross critical habitat where North Atlantic right whale mortality occurs. Shipping traffic has generally increased in the recent past and could be considered to degrade the habitat due to the additional mortality and injury risk now present in the area. Although voluntary regulations are in place, these are frequently ignored and mandatory regulations are under consideration. The southern critical habitats are along Georgia and northeastern Florida coasts (waters from the coast out 15 nautical miles between the latitudes of 31°15’ N and 30°15’ N and from the coast out five nautical miles between 30°15’ N and 28°00’ N). Southern critical habitat is designated to protected calving and breeding grounds for North Atlantic right whales, which generally calve and breed in shallow coastal waters. This critical habitat has generally faired better than northern critical habitat and significant degradation has not been clearly identified.

## Environmental baseline

By regulation, environmental baselines for Opinions include the past and present impacts of all state, federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR §402.02). The *Environmental baseline* for this Opinion includes the effects of several activities affecting the survival and recovery of ESA-listed species in the action area.

## Climate change

In general, based on forecasts made by the Intergovernmental Panel on Climate Change (IPCC), climate change is projected to have substantial effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the near future (IPCC 2000; IPCC 2001a; IPCC 2001b; IPCC 2002). From 1906 to 2006, global surface temperatures have risen 0.74º C and continue to rise at an accelerating pace; 11 or the 12 warmest years on record since 1850 have occurred since 1995 and the past decade has been the warmest in instrumental history (Arndt et al. 2010; Poloczanska et al. 2009). Furthermore, the Northern Hemisphere (where a greater proportion of ESA-listed species occur) is warming faster than the

Southern Hemisphere, although land temperatures are rising more rapidly than over the oceans (Poloczanska et al. 2009). Climate change will result in increases in atmospheric temperatures, changes in sea surface temperatures, patterns of precipitation, and sea level. Sea levels have risen an average of 1.7 mm/year over the 20$^{th}$ century and 3.3 mm/year between 1993 and 2006 due to glacial melting and thermal expansion of ocean water; this rate will likely increase, which is supported by the latest data from 2009 (Arndt et al. 2010; Hoegh-Guldberg and Bruno 2010; Wilkinson and Souter 2008). Oceanographic models project a weakening of the thermohaline circulation resulting in a reduction of heat transport into high latitudes of Europe, an increase in the mass of the Antarctic ice sheet, and a decrease in the Greenland ice sheet, although the magnitude of these changes remain unknown. Reductions in ozone and subsequent increases in ultraviolet radiation have been linked to possible skin damage and blistering in blue, fin, and sperm whales in the Gulf of California (Martinez-Levasseur et al. 2010).

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

Climate change would result in changes in the distribution of temperatures suitable for whale calving and rearing, the distribution and abundance of prey, and abundance of competitors or predators. For species that undergo long migrations, individual movements are usually associated with prey availability or habitat suitability. If either is disrupted by changing ocean temperature regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott. 2009). Climate change can influence reproductive success by altering prey availability, as evidenced by high survival of northern elephant seal pups during El Niño periods, when cooler, more productive waters are associated with higher first-year pup survival (McMahon and Burton. 2005). Reduced prey availability resulting from increased sea temperatures has also been suggested to explain reductions in Antarctic fur seal pup and harbor porpoise survival (Forcada et al. 2005; Macleod et al. 2007). Primary production is estimated to have declined by 6% between the early 1980s and 2010, making foraging more difficult for marine species (Hoegh-Guldberg and Bruno 2010). Polygamous marine mammal mating systems can also be perturbated by rainfall levels, with the most competitive grey seal males being more successful in wetter years than in drier ones (Twiss et al. 2007). Sperm whale females were observed to have lower rates of conception following unusually warm sea surface temperature periods (Whitehead 1997). Marine mammals with restricted distributions linked to water temperature may be particularly exposed to range restriction (Issac 2009; Learmonth et al. 2006). MacLeod (2009) estimated that, based upon expected shifts in water temperature, 88% of cetaceans would be affected by climate change, 47% would be negatively affected, and 21% would be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters and preferences for shelf habitats, such as North Atlantic right whales (Macleod 2009). Variations in the recruitment of krill and the reproductive success of krill predators correlate to variations in sea-surface temperatures and the extent of sea-ice cover age during winter months. Although the IPCC (2001b) did not detect significant changes in the extent of Antarctic sea-ice using satellite measurements, Curran et al. (2003) analyzed ice-core samples from 1841 to 1995 and concluded Antarctic sea ice cover had declined by about 20% since the 1950s.

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

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

Concern also exists over climate change and its effect on the ability of North Atlantic right whales to recover (Greene et al. 2003b). Specifically, the variations in oceanography resulting from current shifts and water temperatures can significantly affect the occurrence of the North Atlantic right whale's primary food, copepod crustaceans. If climate changes such that current feeding areas cannot sustain North Atlantic right whales, the population may have to shift 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).

Climactic shifts also occur due to natural phenomenon. In the North Atlantic, this primarily concerns fluctuations in the North Atlantic Oscillation (NAO), which results from changes in atmospheric pressure between a semi-permanent high pressure feature over the Azores and a subpolar low pressure area over Iceland (Curry and McCartney 2001; Hurrell 1995; Stenseth et al. 2002). This interaction affects sea surface temperatures, wind patterns, and oceanic circulation in the North Atlantic (Stenseth et al. 2002). The NAO shifts between positive and negative phases, with a positive phase having persisted since 1970 (Hurrell 1995). North Atlantic conditions experienced during positive NAO phases include warmer than average winter weather in central and eastern North America and Europe and colder than average temperatures Greenland and the Mediterranean Sea (Visbeck 2002). Effects are most pronounced during winter {Taylor, 1998 #4}. The NAO is significant for North Atlantic right whales due to its influence on the species primary prey, zooplankton of the genus *Calanus*, which are more abundant in the Gulf of Maine during positive NAO years (Conversi et al. 2001; Greene and Pershing 2004; Greene et al. 2003a). This subsequently impacts the nutritional state of North Atlantic right whales and the rate at which sexually mature females can produce calves (Greene et al. 2003a).

## Environmental toxicants

North Atlantic right whales, as with many marine mammals, are exposed to numerous toxins in their environment, many of which are introduced by humans. Levels of chromium in North

Atlantic right whale tissues are sufficient to be mutagenic and cause cell death in lung, skin, or testicular cells and are a concern for North Atlantic right whale recovery (Chen et al. 2009; Wise et al. 2008). The organochlorines DDT, DDE, PCBs, dieldrin, chlordane, HCB, and heptachlor epoxide have been isolated from blubber samples and reported concentrations may underestimate actual levels (Woodley et al. 1991). Mean PCB levels in North Atlantic right whales are greater than any other baleen whale species thus far measured, although less than one-quarter of the levels measured in harbor porpoises (Gauthier et al. 1997; Van Scheppingen et al. 1996). Organochlorines and pesticides, although variable in concentration by season, do not appear to currently threaten North Atlantic right whale health and recovery (Weisbrod et al. 2000). Flame retardants such as PBDEs (known to be carcinogenic) have also been measured in North Atlantic right whales (Montie et al. 2010).

## Naval activities

The action area includes elements of the U.S. Navy's Northeastern Operating Areas. In addition to this operating area, North Atlantic right whales transit through several other naval operating areas along the U.S. eastern seaboard on their way to and from feeding and breeding areas. These areas are home to naval exercises that can include munition detonations, active sonar, as well as vessel and aircraft operations. In addition, an instrumented range off northeastern Florida is being developed that requires instrumentation be placed on the seafloor. Although naval vessels represent a small fraction of the total sound energy and are designed to operate quietly, these ships are large and equipped with high-output sonar equipment such as ANISQS-53C tactical sonar, which produces signals at source levels of 235 dB re 1 $\mu Pa_{rms}$ at 1 m. The signals emitted from these devices have the potential to affect marine mammals in the action area; however, empirical data are limited. Munition detonations can be as large as ship shock trials, where large explosives are detonated to test the survival and operation of new vessel classes. These activities produce powerful shockwaves that can cause mortality and injury to marine species within hundreds of meters of the detonation.

## Entanglement

Of the current threats to North Atlantic right whales, entanglement in commercial fishing gear and ship strikes pose the greatest threats of direct mortality. Along the Atlantic coast of the U.S. and the Maritime Provinces of Canada, there were 46 confirmed reports of North Atlantic right whales entangled in fishing gear between 1990 and 2007 (Cole et al. 2005a; Nelson et al. 2007a; Waring et al. 2009). Of the 39 reports that NMFS could confirm, North Atlantic right whales were injured in five of the entanglements and killed in four entanglements. Three of the 24 entangled whales between 2004 and 2008 died and one other resulted in serious injury (Glass et al. 2009). Recent efforts to disentangle right whales have met with success (Anonmyous. 2009b).

## Shipstrike and vessel traffic

The presence of whales in shipping lanes leads to the potential for ship strikes of listed individuals (Fig. 1). Injury is generally caused by the rotating propeller blades, but blunt injury from direct impact with the hull also occurs. Ship strikes are the largest single contributor to North Atlantic right whale deaths, accounting for approximately 35% of all known mortalities (Knowlton and Kraus 2001; Laist et al. 2001). Ship strikes occur even though right whales are theoretically capable of hearing the approaching ships (Ketten 1998; Richardson et al. 1995).

Some anecdotal evidence suggests that right whales only respond when vessels approach within very close proximity (Nowacek et al. 2004). There have been 18 reports of North Atlantic right whales being struck by vessels between 1999 and 2005 (Cole et al. 2005b; Nelson et al. 2007b). Of the 17 reports that NMFS could confirm, right whales were injured in two of the ship strikes and killed in nine. Recent records show that from 2004-2008, there were 17 confirmed reports of North Atlantic right whales being struck with eight whales dying of their wounds and two additional right whales sustaining serious injuries (Glass et al. 2009). Deaths of females are especially deleterious to 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). Voluntary recommendations for slower vessel speeds in the Bay of Fundy appear to be largely ignored (Vanderlaan et al. 2008). Rules for seasonal (varies by location, but January through July) slowing of vessel traffic to 10 knots or changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are predicted to be capable of reducing ship strike mortality by 62% in the Bay of Fundy region; the same rule applies from November through April from Brunswick, Georgia to Jacksonville, Florida, where North Atlantic right whales go for calving and breeding. Speed rules also apply to medium and large ports along the eastern seaboard during this time frame when right whales migrate to and from northern feeding and southern breeding areas.

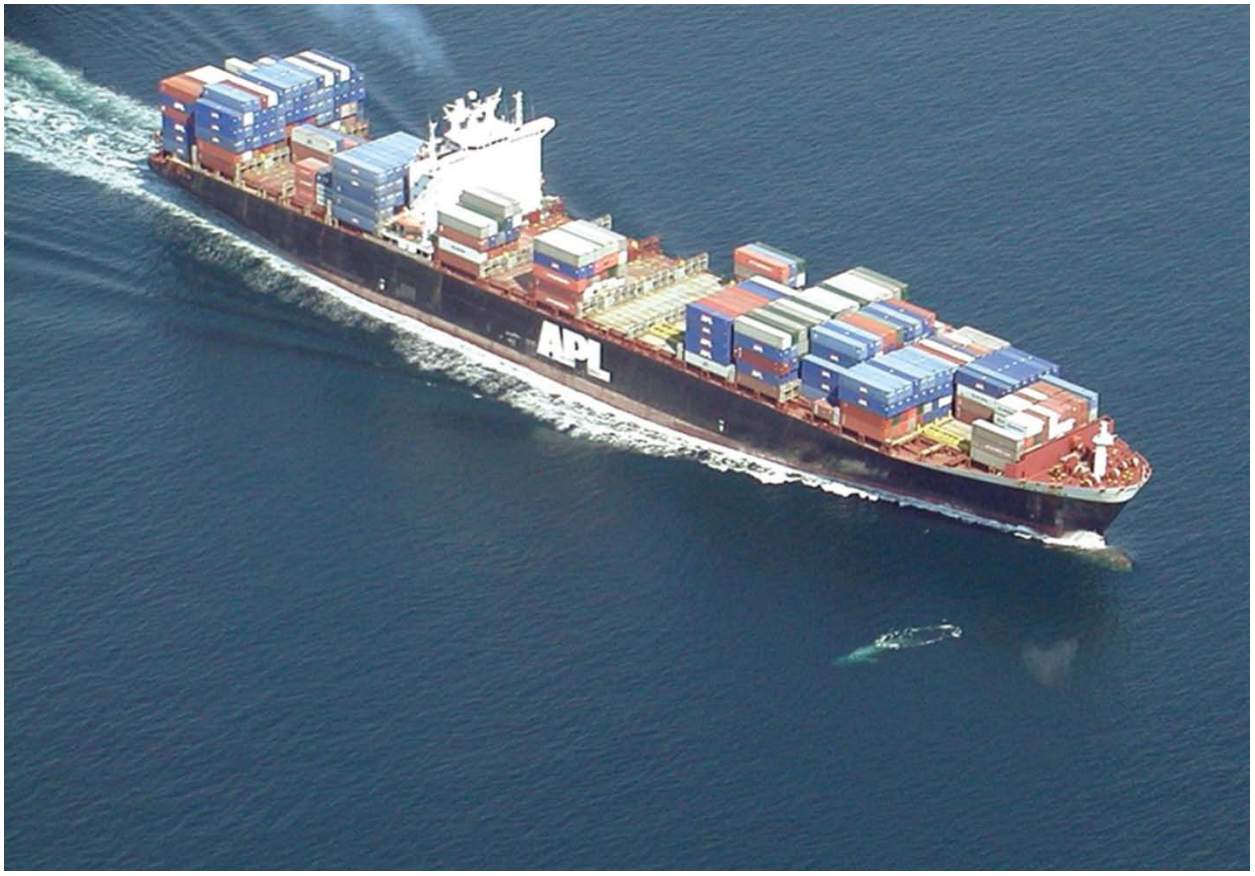


Fig. 1. A near collision between a blue whale and a commercial cargo vessel.

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 (Bejder et al. 1999; Boren et al. 2001; Colburn 1999; Constantine 2001; Cope et al. 1999; Kovacs and Innes. 1990; Kruse 1991; Mann et al. 2000; Nowacek et al. 2001; Samuels et al. 2000; Samuels and Gifford. 1998; Wells and Scott 1997). Vessel avoidance may cause 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. North Atlantic right whales have been found to temporarily modify the amplitude of their calls, making them louder with increased background noise (including noise from vessel traffic), although shifting call frequency may also occur more gradually (Parks et al. 2010). This supports the possibility that vessel traffic may contribute significantly to masking of auditory information used by North Atlantic right whales, such as the calls of conspecifics. This issue is particularly significant in the northeastern U.S., which hosts some of the busiest commercial shipping lanes in the world, including those leading into Boston, Providence, Newark, and New York (MARAD 2011). In addition, the Boston cruise ship terminal is growing rapidly and is currently one of the busiest cruise ship ports in the U.S. {Massport, 2002 #6}. In addition to vessel traffic, marine construction activities occur in the Cape Cod area (liquefied natural gas terminal construction, pile driving, offshore wind farm construction, dredging, cable laying, drilling, and others) that contributes to local and regional background sound levels.

## Whale watching

There is also concern that whales may habituate to increased vessel traffic and become more vulnerable to ship strikes (Swingle et al. 1993; Wiley et al. 1995). Several studies have specifically examined the effects of whale watching on marine mammals, and investigators have observed a variety of short-term responses from animals, ranging from no apparent response to changes in vocalizations, duration of time spent at the surface, swimming speed, swimming angle or direction, respiration rate, dive time, feeding behavior, and social behavior (NMFS 2006). Responses appear to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity (Au and Green. 2000; Corkeron 1995; Erbe 2002; Magalhaes et al. 2002; Richter et al. 2003; Scheidat et al. 2004; Watkins 1986; Williams et al. 2002a; Williams et al. 2002b).

## Scientific and research activities

Scientific research permits issued by the NMFS currently authorize studies on listed species in the Atlantic Ocean, including portions of the action area. Authorized research on ESA-listed whales includes close vessel and aerial approaches, biopsy sampling, implantable satellite tagging, and suction cup tagging. Research activities involve non-lethal “takes” of these whales by harassment, with none resulting in mortality. Since these “takes” have been authorized, we must assume that they will actually occur. However, monitoring of prior research activities suggests that only a fraction of the potential “takes” will actually occur and a variety of responses, including no response, are associated with these activities.

Table 2 describes the cumulative number of takes for each listed species in the action area authorized in scientific research permits.

**Table 2.** North Atlantic right whale takes authorized in the North Atlantic Ocean.

| Year | Approach | Biopsy | Suction cup tagging | Implantable tagging | Exhalation sampling |
|---|---|---|---|---|---|
| 2009 | 1,860 | 60 | 130 | 45 | 0 |
| 2010 | 6,875 | 110 | 230 | 45 | 80 |
| 2011 | 6,775 | 60 | 230 | 45 | 80 |
| 2012 | 5,575 | 50 | 190 | 45 | 80 |
| 2013 | 5,090 | 50 | 100 | 0 | 45 |
| Total | 26,175 | 330 | 880 | 180 | 0 |

Permit numbers: 10014, 1036-1744, 1058-1733, 594-1759, 605-1904, 633-1763, 775-1875, 948-1692, 14791, 14586, 14603, and 14233.

## Effects of the proposed action

Pursuant to section 7(a)(2) of the ESA, federal agencies must ensure, through consultation with the NMFS, that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The proposed issuance of permit 15415 would authorize "takes" by harassment of North Atlantic right whales during the proposed research by Dr. Scott Kraus and associated researchers by directed approach and exposure to an experimental setup. In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed actions, the probability of individuals of listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. As described in the *Approach to the Assessment* section, for any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, or lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the listed species those populations represent. The purpose of this assessment and, ultimately, of this Opinion is to determine if it is reasonable to expect the proposed action to have effects on listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.

For this consultation, we are particularly concerned about behavioral and stress-based physiological 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 ESA does not define harassment nor has the NMFS defined the term pursuant to the ESA through regulation. For this Opinion, we define harassment similar to the U.S. Fish and Wildlife Service's regulatory definition of "harass": 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.

Our analysis considers that behavioral harassment or disturbance is not limited to the "take" definition and may in fact occur in many ways. Fundamentally, if our analysis leads us to conclude that an individual changes its behavioral state (for example, from resting to traveling away from the approaching vessel or from traveling to evading), we consider the individual to have been harassed or disturbed. In addition, individuals may respond in a variety of ways, some of which have more significant fitness consequences than others. For example, evasion of an approaching vessel would be more significant than slow travel away from the same stressor due to increased metabolic demands, stress responses, and potential for habitat abandonment that this response could or would entail. As described in the *Approach to the assessment*, the universe of likely responses is considered in evaluating the fitness consequences to the individual and (if appropriate), the affected population and species as a whole to determine the likelihood of jeopardy.

## Potential stressors

The assessment for this consultation identified several possible stressors associated with the proposed research activities; these include acoustic masking by the motor propelling the research vessel, approach of North Atlantic right whales, and responses to the PVC rod.

## Exposure analysis

Exposure analyses identify the ESA-listed species that are likely to co-occur with the actions' effects on the environment in space and time, and identify the nature of that co-occurrence. The *Exposure analysis* identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the actions' effects and the population(s) or subpopulation(s) those individuals represent. The proposed permit identifies these parameters and would allow for 400 individual North Atlantic right whales to be closely approached up to five times each over a five-year period. It should be noted that the applicant proposes to implement photoidentification to minimize the possibility of re-exposure beyond a single experimental and control trial within a single season and that the applicant claims that only two seasons of research will actually be conducted. Exposure would be limited to adult and juvenile individuals; neonates and mother-calf pairs would not be approached.

## 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 exposure to an action's effects on the environment or directly on listed species themselves. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal (physiological), or behavioral responses that might result in reducing the fitness of listed individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

There is mounting evidence that wild animals respond to human disturbance in the same way that they respond to predators (Beale and Monaghan 2004; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). These responses manifest

themselves as stress responses (in which an animal perceives human activity as a potential threat and undergoes physiological changes to prepare for a flight or fight response or more serious physiological changes with chronic exposure to stressors), interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). These responses have been associated with abandonment of sites (Sutherland and Crockford 1993), reduced reproductive success (Giese 1996; Mullner et al. 2004), and the death of individual animals (Bearzi 2000; Daan 1996; Feare 1976). Stress is an adaptive response and does not normally place an animal at risk. However, distress involves a stress response resulting in a biological consequence to the individual. The mammalian stress response involves the hypothalamic-pituitary-adrenal (HPA) axis being stimulated by a stressor, causing a cascade of physiological responses, such as the release of the stress hormones cortisol, adrenaline (epinephrine), glucocorticosteroids, and others (Anonmyous. 2009a; Busch and Hayward 2009; Wright et al. 2007)(Gulland et al. 1999; Morton et al. 1995; St. Aubin and Geraci 1988; St. Aubin et al. 1996; Thomson and Geraci 1986). These hormones subsequently can cause short-term weight loss, the liberation of glucose into the blood stream, impairment of the immune and nervous systems, elevated heart rate, body temperature, blood pressure, and alertness, and other responses (Busch and Hayward 2009; NMFS 2006g)(Cattet et al. 2003; Delehanty and Boonstra 2009; Elftman et al. 2007; Fonfara et al. 2007; Kaufman and Kaufman 1994; Mancia et al. 2008; Moe and Bakken 1997; Noda et al. 2007; Thomson and Geraci 1986)(Dierauf and Gulland 2001; Omsjoe et al. 2009). In some species, stress can also increase an individual's susceptibility to gastrointestinal parasitism (Greer et al. 2008). In highly-stressful circumstances, or in species prone to strong "fight-or-flight" responses, more extreme consequences can result, including muscle damage and death (Cowan and Curry 1998; Cowan and Curry 2002; Cowan and Curry 2008; Herraez et al. 2007). The most widely-recognized indicator of vertebrate stress, cortisol, normally takes hours to days to return to baseline levels following a significantly stressful event, but other hormones of the HPA axis may persist for weeks (Dierauf and Gulland 2001). Mammalian stress levels can vary by age, sex, season, and health status (Gardiner and Hall 1997; Hunt et al. 2006; Keay et al. 2006; Kenagy and Place 2000; Nunes et al. 2006; Romero et al. 2008; St. Aubin et al. 1996). Smaller mammals tend to react more strongly to stress than larger mammals (Peters 1983); a trend reflected in data from Gauthier and Sears (1999) where smaller whale species tended to react more frequently to biopsy than larger whales. Stress is lower in immature right whales than adults and mammals with poor diets or undergoing dietary change tend to have higher fecal cortisol levels (Hunt et al. 2006; Keay et al. 2006; Kitaysky and Springer 2004). Little is known about the long-term effects of stress in marine mammals (which can include acute and prolonged exposure to anthropogenic noise), although immune suppression, reproductive failure, accelerated aging, and slowed growth are possible (Anonmyous. 2009a; Wright et al. 2007). The actions proposed have the potential to result in stress responses in targeted North Atlantic right whales.

**Close approaches**

Vessel approaches have the potential to induce behavioral and possibly physiological changes in individuals being pursued. The degree to which individuals are disturbed is highly variable. Whales may respond differently depending upon what behavior the individual or pod is engaged in before the vessel approaches (Hooker et al. 2001; Wursig et al. 1998), the degree to which they have become accustomed to vessel traffic (Richter et al. 2006), and reactions may vary by species or individuals within species (Gauthier and Sears 1999). Overall, 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 may include aerial displays like breaching and lobtailing (Baker and Herman. 1989; Best et al. 2005; Brown et al. 1991; Clapham and Mattila 1993; Jahoda et al. 2003). Only Jahoda et al. (2003) found effects of more than a few minutes, with fin whales failing to return to baseline behaviors after one hour of observation in some cases, in spite of the fact that Gauthier and Sears (1999) found fin whales to be less responsive than humpbacks.

North Atlantic right whales may not respond at all to kayaks, sailing sloops, or steel-hulled diesel-powered vessels approaching within five meters, although other individuals (possibly under different contexts) have responded to the same diesel-powered vessel from 50 m away, usually by turning away from the path of the ship (Goodyear 1993). Baumgartner and Mate (2003a) found that 71% of 42 North Atlantic right whales approached (and sometimes tagged) in a rigged inflatable boat within 10 m did not overtly respond. Of those that did respond, behaviors included head lifts and lunges, back arching, rolling, and fluke beats. Feeding dive durations were also shorter by 13-17% in the dive following approach/tagging, but no difference was found in the duration of subsequent dives. Mate et al. (1997) found that although North Atlantic right whales generally responded to and avoided close approach, the level of response varied. Watkins (1986) found that whales are more responsive to approach when they are inactive and less responsive when feeding or socializing.

Humpback whales have been the best-studied whale species in regards to responses to close approaches by vessels. Numerous studies have documented varied responses of humpback whales to vessel approaches, ranging from no response to evasion (Goodyear 1993; Salden 1993). In response to general (not necessarily researcher) vessel approach, Felix et al. (2001) found that 27 of 86 individuals approached resulted in avoidance of the vessel (50 were indifferent and 9 approached vessels), including long dive, change in heading, tail splashes, altered swimming speed or breathing frequency, and group structure disruption. Approaching vessels may instigate aerial behavior, such as fluke slapping and breaching, behavior recently suggested to be a switch in communication from vocal to surface active signaling (Baker et al. 1983a; Baker et al. 1983c; Baker et al. 1982; Dunlop et al. 2009; Holt et al. 2009). Mizroch et al. (2010) followed-up on several humpback whales that were approached and radio tagged over the course of several decades. They found no basis for substantiating a long-term reaction to approach, including gross measures of growth and reproduction. Hall (1982) did not find social or feeding behavior to be disturbed by vessel traffic or close approaches. However, there is the possibility that humpback whales may habituate to vessel noise if given sufficient time and exposure; a theory assumed by researchers here by following target individuals before close approach (Clapham and Mattila 1993; Watkins 1986). Responses can also change over long timeframes; Watkins (1986) looked at whale responses off Cape Cod over a several decade period and found that humpbacks shifted their general response from being generally evasive to a tendency to approach vessels. Goodyear (1993) did not observe changes in behavior in most cases although an increase in speed did occur on one occasion when a whale was approached within 10 m. Cantor et al. (2010) generally found resting or socializing whales to switch to traveling upon approach of their research vessels. Watkins et al. (1981) found that humpback whales appeared to react to vessel approach by increasing swim speed, exhibiting a startle reaction, and moving away from the vessel with strong fluke motions. Baker and Herman (1989), Baker et al. (1982) and (1983a; 1983c), Bauer (1986), Bauer and Herman (1986), and Green and Green (1990) found that humpbacks spent less time at the surface and altered their

direction of travel in response to approaching vessels. Increased time underwater and decreased swim speed persisted for up to 20 minutes after vessels left the area. Watkins and Goebel (1984) found humpbacks to be very difficult to approach, possibly due to physical ocean features in the area that likely altered sound properties such that vessel noise was difficult to detect unless at close range, resulting in whales suddenly becoming aware of boats in close proximity and reacting strongly as a result. Norris (1994) documented changes in humpback song structure in response to passing vessels, with unit and phrase durations reduced versus control periods. Bauer and Herman (1986) studied the potential consequences of vessel disturbance on humpback whales wintering off Hawaii. They as well as Scheidat et al. (2004) and Hemphill et al. (2006) noted changes in respiration, diving, swimming speed (50-300%) and direction, social exchanges, and other behavior correlated with the number, speed, direction, and proximity of vessels. Agonistic behavior has also been noted (Bauer and Herman 1986). Results of vessel approach were different depending on individual sex and age class (smaller groups and groups with calves appeared more responsive), but humpback whales generally tried to avoid vessels from 500 to 1,000 m away. Similar results were found in Alaskan waters, with increased dive durations and orientation away from the path of moving boats, often at ranges up to 3-4 km (Baker et al. 1983b; Baker and Herman. 1989). Approaches in Alaskan waters closer than 100 m initiated evasive behavior (Hall 1982); Watkins (1986) found little response to approaches outside of 100 m away, although humpbacks regularly reacted to outboard vessels on a collision course even from long distance.

Information on contextual responses is also relatively abundant for humpback whales. Responses by humpback whales likely depend upon a given individual's prior experience and current situation (Clapham and Mattila 1993). The use of smaller, outboard-powered vessels (presumably louder) elicited more frequent and stronger responses to biopsy attempts than larger, inboard-powered vessels; sex was not a factor in response frequency or intensity (Cantor et al. 2010). Sudden changes in vessel speed and direction have been identified as contributors to humpback whale behavioral responses to vessel maneuvering (Watkins 1981). The more active the group, the more easily it was disturbed; however, Cantor et al. (2010) found structuring in the response rate of various individuals in mating groups, with male response becoming progressively less frequent with the degree of dominance in the mating group. Mother-calf pairs were the most easily disturbed group, followed by all adult groups, adult-subadult mixes, and all subadult groups (Felix 2001). Weinrich et al. (1991) and (1992b), Cantor et al. (2010), as well as Krieger and Wing (1984) found feeding animals to be least responsive, although data from these studies was contradictory when evaluating responses while resting or on breeding grounds. Wursig et al. (1998) found milling or resting cetaceans to be more sensitive. The first two cited studies also found that respiratory parameters are not good indicators of responsiveness due to the large natural variance associated with them. However, numerous studies have identified significant changes in respiration and diving in association with vessel traffic (see Bauer and Herman (1986) for a summary). On several occasions, research trips conducted by Krieger and Wing (1984) had to actively avoid collisions with humpbacks, although whales presumably were aware of the vessel's presence. Single or paired individuals may respond more than larger groups (Bauer and Herman 1986).

Repeated exposure can have a cumulative effect that is greater than the sum of individual exposures, eliciting responses that are more significant for individuals and populations, although Cantor et al. (2010) did not find a difference in response based upon re-exposure. However, humpback whales have vacated areas where relatively high boat traffic and human activity

occurs (Herman 1979). Major declines and distributional shifts in Glacier Bay, Alaska were correlated with a rapid and significant increase in vessel traffic from 1976 to 1978, whereas humpback whales in other nearby areas with less traffic did not undergo such changes (Bauer and Herman 1986). It should be noted that potentially reduced prey resources may also have been important in this redistribution (Bauer and Herman 1986). Matkin and Matkin (1981) did not find a correlation between humpback whale behavior and recreational vessels.

Other large whale species have also been investigated for their responses to close vessel approaches. Bowheads seem to be particularly sensitive, with individuals swimming rapidly away (rarely seen as a natural behavior) and reducing dive and surface cycles in response to a crew boat used to study whales in Arctic waters at ranges of 1-4 km, with individuals moving up to 2-3 km away (Richardson et al. 1985). Movement away still occurred when engines were disengaged and idling at ranges greater than 900 m, but no effect was found when engines were off. Individuals would also scatter from their groups, a condition that would persist well after the vessel had vacated the area. Gray whales may be more sensitive to approach while resting; they frequently startle in response to close approach and swim rapidly away (Mate and Harvey 1983). Pettis et al. (1999) found gray whales tended to disperse in the presence of boats and aggregate in their absence. When directly approached, individuals were more likely to change heading, do a fluke-down dive, or slip under water, whereas indirect approaches tended to result in fluke or flipper swishes and head raises. Calf presence did not appear to impact response, although calves tended to respond with bubble release from the blowholes, change their heading, or roll, whereas adults were more likely to dive or slip underwater. Gray whales vacated a wintering (breeding, non-feeding) lagoon apparently in response to increased commercial vessel traffic but reoccupied it after vessel traffic decreased (Reeves 1977). Such impacts can interfere with the reproductive success of individual whales and the populations they represent (Croll et al. 2001). Fin whales were found to accelerate their speed upon vessel approach (Watkins 1981). Fin whales were particularly evasive in a study published by Ray et al. (1978), exhibiting high speed swimming, frequent changes in heading, separation of groups, and irregular breath patterns. As with humpback whales, fin whales have been found to respond by rapid course change, accelerated dive, and speed increases to vessel noise, particularly throttle changes, such as reversing. Recognition (sensitization) of tagging vessels by both humpback and fin whales was not seen to occur.

The close approach of small vessels to North Atlantic right whales also presents the possibility that valuable acoustic information could be missed by the target individual(s) due to masking by the vessel's engines. The acoustic properties of vessels similar to those proposed for use by the applicant are similar to the frequency range utilized by North Atlantic right whales and other baleen whales during vocalization such that communication could be impaired (Clark et al. 2009; Dunlop et al. 2010). Parks et al. (2010) and Anonymous (2010) found that North Atlantic right whales temporarily modify the amplitude of their calls, making them louder with increased background noise (including noise from vessel traffic), as well as shifting call frequency over longer time frames. Killer whales in high traffic areas have been found to increase call duration or call amplitude in response to increased anthropogenic noise in the marine environment (Erbe 2002; Foote et al. 2004; Holt et al. 2009). As a broader issue, increased anthropogenic noise in the marine environment has the potential to reduce the range over which individuals communicate, conceivably increasing calf mortality, altering ideal group or individual spacing, and making identification and selection of mates more difficult or impossible (Croll et al. 2001). At the level of an individual vessel, such as that proposed for use by the applicant, we do not

expect masking to be particularly impactful in the case of the proposed permit for several reasons that will likely mitigate the significance of vessel noise. The applicants will use a vessel that is equipped with quieting technology on the engines, decreasing the loudness of the vessel's noise. In addition, operations would be conducted at low speed with a minimum of throttling and directional changes. Low vessel speed means that less cavitation will occur, which is the primary source of sound energy emitted by motorized vessels (Mazzuca et al. 2001; Ross 1976). Minimization of speed and directional changes will also result in fewer changes in sound characteristics, which are believed to add to the significance of vessel noise and its impact to cetaceans.

Based on the available evidence, we would expect most North Atlantic right whales exposed to close approaches under the proposed permit to exhibit either no visible reaction or short-term low-level to moderate behavioral responses. Available evidence, including approaches of individuals of other species in a variety of locations, leads us to conclude there should be no strong behavioral responses to close approaches.

**PVC rods**

We could not identify any published information regarding the probable response of North Atlantic right whales to novel visual stimuli in the marine environment. Based upon discussions with experts in right whale behavior, we expect North Atlantic right whales to either not respond at all to the PVC rods, possibly resulting in collision with the stimuli, to display a mild aversion to the stimuli such that an individual's movement would change momentarily, or to startle (Clay George, Georgia DNR, pers. comm.; Scott Kraus, New England Aquarium, pers. comm.; Ed Leiman, NMFS, pers. comm.; Doug Nowacek, NMFS, pers. comm.; Lisa Conger, NMFS, pers. comm.). Younger individuals may be more curious and approach the apparatus closely to examine it; calves and juveniles occasionally display this behavior with small boats and biopsy arrows (Clay George, Georgia DNR, pers. comm.). The experimental setup is one that accounts for the possibility of collision; the PVC rod is designed so that it would not become attached or wrapped around to a whale and no traumatic injury could result from the collision itself. Southern right whales may be attracted to the lights from squid-fishing vessels, but tend to stay just outside of the illuminated area (Peter Best, Iziko Museums of Cape Town, pers. comm.). Anecdotally, Lisa Conger, Ed Leiman, and Doug Nowacek described an encounter with an entangled North Atlantic right whale in the proposed action area that, during the course of disentanglement attempts, had a buoy with a strobe attached to it to find the individual later and finish disentanglement procedures. The strobe, which was on the order of one-half million candlepower, appeared to frighten the whale (associated with shortened dives and longer surface intervals), possibly due to the bright flashes that were very apparent underwater. However, the LED lights in the proposed actions would be far less powerful and, we believe, unlikely to cause a similar prolonged response. Based upon this information, we expect a temporary change in behavior as a result of interaction with the PVC rod.

**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. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Sources queried for the information herein include the U.S. Census Bureau and Department of Labor, as well as Lexis-Nexis information system. With the

latter (which was our source for state legislation in Maine, Massachusetts, and New York), we reviewed bills passed in 2010 and pending bills under consideration were included as further evidence that actions "are reasonably certain to occur". Bills that died in process or were vetoed are not included in our review.

Regulatory changes alter the environment under which future actions can occur, including zoning regulation, fishery capacity, environmental standards, and development of commerce and industry. Pending legislation in Maine legislation would provide more funding to enhance seafood sales. Massachusetts legislation is working to reduce phosphorus runoff, promote sustainable fisheries, and protect against nuisance aquatic species. Some New York State legislation would prevent dumping of contaminated solid into marine waters and prevent the release of balloons due to marine life ingestion.

Based upon 2000 U.S. census data (USCB 2005a; USCB 2005b; USCB 2005c), the northeast U.S. was predicted to contain 54.8 million people in 2005, making this region one of the most densely populated regions in the country. Population growth is predicted to decrease over the foreseeable future from 0.41%/year between 2000 and 2010 to 0.24%/year from 2010 to 2020. Much of the regional population is contained in concentrated metropolitan centers. Overall, the northeast U.S. is predicted to have 55.8 million people in 2010, 56.6 million in 2015, and 57.1 million in 2015. It is also likely that whale-watching activities will become more extensive, potentially altering marine mammal habitat use and risk behavioral changes similar to what has been observed in the Pacific northwest (NMFS 2008).

Nationwide, construction is forecasted to be one of the most extensively growing industries in the U.S. From 2006 to 2016, the construction industry is expected to grow by 1.4%/year and employ an additional 600,000 people during that time (Figueroa and Woods 2007). However, this represents a 30% slow-down from the 1996 to 2006 time period. Construction will be most likely to occur in school, industrial, and medical areas, as well as infrastructure (bridge and road) repair and replacement. An increase in construction will entail additional development in urban and non-urbanized areas that can introduce large amounts of sediment into waterways via run-off. Sediment run-off can also introduce nutrients into marine environments that can cause algal blooms, which have been documented in nearshore habitats of the northeast U.S., and introduce neurotoxins to large areas and cause wide-scale mortality (NMFS 2007; NMFS and USFWS 2004; Vitousek et al. 1997).

Output of the transportation industry is expected to increase by 2.9%/year from 2006 to 2016 (Figueroa and Woods 2007), placing additional pollution pressures on ESA listed species and their habitats. Although this rate is slower than the trend from 1996 to 2006, additional movement of freight by truck, plane, and train introduces pollutants into the environment. Carbon dioxide released from petroleum combustion is a significant component of global warming (EIA 2007; Nordhaus 2007; Vitousek et al. 1997) and increases in transportation will likely mean greater contributions of carbon dioxide and exacerbation of the global warming phenomenon. Based upon these factors, additional hindrance to recovery are likely to occur from the future growth of the transportation industry.

With increasing population, the leisure and hospitality industry is forecasted to grow by 2.1%/year from 2006 to 2016 (Figueroa and Woods 2007). As with other industries, this is a decline from the 1996 to 2006 rate by about 25%. In addition, most growth will likely occur in food services or drinking places, which is not expected to have impacts to listed species.

However, this industry includes personnel and activities that utilize natural and protected areas. Additional use will likely include more debris and pollution discharge into areas frequently used by protected species. The potential for increased whale watching can alter natural behaviors and habitat use of endangered right whales in their critical habitat. It can be contended that additional use of parks and natural areas can increase outreach and public awareness of protected species and their habitats, which can benefit recovery of these species and areas. Therefore, we do not know whether growth in the leisure and hospitality industry will have a net positive or negative impact on ESA listed species, but likely will include both helpful and hurtful aspects.

In contrast to other industries, agriculture is forecasted to increase in rate of growth from 2006 to 2016 versus the growth experienced from 1996 to 2006 (Figueroa and Woods 2007). Growth will increase from 1.3%/year to 2.2%/year, a change of roughly 75%. The increase results from increased efficiency from technological improvements and the rise of ethanol production from crops. In this sector, agriculture accounts for over 80% of production, which masks regionally important factors. Agriculture in the northeast overshadows a projected output decline in forestry (-0.9%/year) and fisheries/hunting/trapping (-2.9%/year). Agriculture is not as extensive as in other regions of the U.S. and growth. However, additional growth will increase pollution and sediment runoff into streams, making bloom conditions more likely in marine areas where rivers discharge. Based upon the declines in fisheries and forestry, it is unlikely that extensive additional pressures will be placed on North Atlantic right whales by these two industries.

Any future scientific studies targeting these species and contributing to their conservation or recovery will require consultation under the ESA and such studies, therefore, are not included in the Cumulative Effects section of this Opinion. Whale watching has the potential to significantly expand, generating an additional 413 million dollars globally and generating an additional 5,700 jobs (Cisneros-Montemayor et al. 2010). Similarly, alternative energy projects such as ocean current, wave, and tidal energy projects are expected to increase within the action area and will require federal permits (e.g., Federal Energy Regulatory Commission (FERC)), so these actions are not included in the Cumulative Effects section of this Opinion. After reviewing available information, NMFS is not aware of effects from any additional future non-federal activities in the action area that would not require federal authorization or funding and are reasonably certain to occur during the foreseeable future.

**Integration and synthesis of effects**

As explained in the *Approach to the assessment* section, risks to listed individuals are measured using changes to an individual's "fitness" – i.e., the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the population(s) those individuals represent or the species those populations comprise (Anderson 2000; Brandon 1978; Mills and Beatty 1979; Stearns 1992). As a result, if the assessment indicates that listed plants or animals are not likely to experience reductions in their fitness, we conclude our assessment. If reductions in individuals' fitness are likely to occur, the assessment considers the risk posed to population(s) to which those individuals belong, and then to the species those population(s) represent.

The *Status of listed resources* discussion describes the biology and ecology of North Atlantic right whales affected by the actions and threats to the species outside the action area have been

adversely affected by human-induced factors such as pollution, contaminants, and whaling. The actions discussed in the baseline (vessel and naval activities, climate change, entanglement in fishing gear and previously-permitted research activity), as well as those considered under *Cumulative effects* all pose the potential to result in stress or adverse sub-lethal impacts.

Our use of behavior as an indicator of a whale's response to approach may or may not accurately reflect the whale's experience, and we cannot definitively know whether such behavioral responses have long-term consequences. Responses to human disturbances, such as close vessel approaches and deployment of PVC rods, 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. Weinrich et al. (1992a) associated "moderate" responses with alarm reactions and "strong" behavioral reactions with stress responses. Wild harbor porpoises restrained and tagged did not show consistent elevations in cortisol nor did heart rate change in ways consistent with a stress reaction (Eskesen et al. 2009); these actions are much more invasive that those proposed for North Atlantic right whales. We do not expect any strong behavioral responses to result from close approach; however, permit conditions (such as discontinuing pursuit if individuals evade the research vessel) are expected to minimize risk in the event such a response should occur. Moderate responses might also be associated with a stress response, given that certain behavioral responses may have metabolic consequences. As a result, we assume the proposed close approaches could 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 definitively known. Recognizing the conditions of the proposed permit and the evidence indicating that behavioral responses would be short-lived, we provisionally assume that the close approach activities and deployment of PVC rods could produce short-lived stress responses in some individuals, but would not lead to reduced foraging opportunities or negatively affect an individual's growth, survival, annual reproductive success, or lifetime reproductive success through a stress response. The action area include important foraging grounds for this species, and the proposed approach activities have the potential to interrupt foraging behaviors. However, we expect any behavioral responses to be short-term, and accordingly we do not anticipate that responses to approaches conducted under this permit would result in reduced foraging opportunities for individual whales. We do not anticipate that the short-term behavioral responses to approach would result in any reduced opportunity for reproduction.

In summary, based on the evidence available, the experience of researchers; the proposed research protocol; as well as the permit conditions to be implemented with the proposed studies, we expect all whales approached under permit 15415 would exhibit either no visible reaction or short-term behavioral responses. Strong behavioral responses are not expected. We assume short-lived stress responses are possible in a few individuals as are short-term interruptions in behaviors such as foraging; however, we do not expect these responses to lead to reduced opportunities for foraging, growth, survival, or reproduction for targeted individuals. Because any responses to approach are expected to be short-lived, and assuming an animal is no longer disturbed after it returns to its pre-approach behavior, we do not expect significant long-term consequences for targeted whales.

**Conclusion**

After reviewing the current status of North Atlantic right whales; the *Environmental baseline* for the action area; the anticipated effects of the proposed activities; and the *Cumulative effects*, it is

the NMFS' Opinion that the actions (the Permits Division's issuance of a permit amendment for research activities on North Atlantic right whales in the western North Atlantic) are not likely to jeopardize the continued existence of this species or destroy/adversely modify designated critical habitat.

## Incidental take statement

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibits 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 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 section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

As discussed in the accompanying Opinion, only the target species will be harassed as part of the proposed actions. Therefore, we do not expect incidental take of non-targeted threatened or endangered species as a result of the proposed actions.

## Conservation recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act 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.

At this time, the Endangered Species Division has no conservation recommendations that would provide information for future consultations involving the issuance of permits that may affect listed resources as well as reduce harassment related to research activities.

In order for NMFS Endangered Species Division to be kept informed of actions minimizing or avoiding adverse effects 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 NMFS' proposal to issue Permit 15415 to Scott Kraus of the New England Aquarium, pursuant to the provisions of section 10 of the ESA and MMPA. 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 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 Permits, Conservation and Education Division must immediately request reinitiation of section 7 consultation.

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