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

Biological Opinion

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

Activity Considered: Biological Opinion on the proposal to issue Permit Numbers 15575 to Robert DiGiovanni and 16109 to GeoMarine, Inc. to authorize research on marine mammals and sea turtles in the Atlantic Ocean from Massachusetts to North Carolina, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

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

Approved by: [signature]

Date: May 1, 2012

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

This document represents the NMFS' biological opinion (Opinion) of the effects of the proposed research on listed whales and sea turtles and has been prepared in accordance with Section 7 of the ESA. This Opinion is based on our review of the Permits and Conservation Division's draft Environmental Assessment, draft permits 15575 and 16109, the permit applications from Robert DiGiovanni and GeoMarine, Inc., the most current marine mammal stock assessment reports, recovery plans for listed species, scientific and technical reports from government agencies, peer-reviewed literature, biological opinions on similar research, and other sources of information.

Consultation history

The NMFS' Permits and Conservation Division (Permits Division) requested consultation with the NMFS' Endangered Species Act Interagency Cooperation Division on the proposal to issue scientific research permit authorizing studies on listed whales and sea turtles. Issuance of the permit constitutes a federal action, which may affect marine species listed under the ESA.

On November 15, 2011, the Permits Division requested initiation of Section 7 consultation to issue a new permit to Robert DiGiovanni and GeoMarine, Inc. In response, the Endangered Species Act Interagency Cooperation Division formally initiated consultation with the Permits Division.

Description of the proposed action

NMFS' Office of Protected Resources – Permits and Conservation Division proposes to issue a permit for scientific research pursuant to Section 10(a)(1)(A) of the ESA and to the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 et seq., Section 104). Issuance of permits 15575 to Robert DiGiovanni and 16109 to GeoMarine, Inc. would authorize research on marine mammals and sea turtles in the Atlantic Ocean from New Jersey to Virginia. Table 1 lists the number of species that would be authorized to be "taken" under the two proposed permits.

Permit 15575 – Robert DiGiovanni

Aerial Surveys

Aerial surveys would occur at 600-1000 ft at 100 knots in fixed wing aircraft lasting up to seven hours per flight. Surveys would follow standardized aerial survey protocols established by the Northeast Fisheries Science Center and would not be flown with a sea state greater than Beaufort 6 or visibility less than two miles. The aircraft may circle up to six times over sighted animals (except for haul outs) for identification and photography.

Researchers would attempt to minimize disturbance to animals during aerial surveys by:

- Limiting circling to the minimum time necessary to achieve objectives.
- Terminating activities if avoidance behavior is observed.
- Avoiding over flights of pinniped haul outs.
- Avoiding known pinniped rookeries.

Close vessel approach for photo-identification

Opportunistic sighting and photo-identification data of all requested species would be collected during transits to and from the haul-out locations of non-listed pinnipeds. Surveys would be conducted on vessels up to 24 ft in length at a survey speed of 10 knots, lasting up to 12 hours. In transit, target species, including right whales, may be approached to a minimum of 20 yards if sighted, for species confirmation and photo-identification. Surveys of inhabited pinniped haul outs would last no longer than 30 minutes at a minimum distance of 20 yards.

Researchers would attempt to minimize disturbance to animals during close vessel approach by:

- Approaching at minimal speeds from behind or beside the group.
- Terminating activities if active avoidance is occurring.

Research would occur along the mid-Atlantic inshore waters out to the continental shelf break as well as bays and estuaries from Massachusetts to North Carolina. Bays and estuaries would include Long Island Sound, Great South Bay Estuary Reserve, Peconic Bay Estuary in New York and the Chesapeake Bay, Virginia. The area would not extend greater than 110 miles offshore in northern waters and 70 miles in the southern regions.

Aerial surveys would occur up to six times per month per 350 square mile survey area which is the average limit of available survey area during a single flight. Vessel surveys will occur approximately once per month.

Permit 16109 – GeoMarine, Inc.

Close vessel approach for photo-identification and behavioral observations

Surveys would be conducted at approximately 10 knots along random tracklines in a saw-tooth pattern from the University of Delaware's R/V Sharp (146 ft) to collect data for estimating abundance of cetaceans. The University of Delaware designed and constructed an observation deck on the R/V Sharp specifically for marine mammal surveys for the New Jersey Department of Environmental Protection Environmental Baseline Study.

Visual observations would be recorded from the flying bridge (10 m above water) during daylight hours. The vessel would remain in passing mode if species identification and group estimates can be obtained while remaining on the trackline. If necessary, the vessel would veer off the trackline to approach the individual or group (closing mode) to obtain this information. A minimum approach distance of 50 yards would be maintained for listed sea turtles; endangered whales would have a minimum approach distance of 100 yards, unless not practicable. The duration of observations would be limited to 30 minutes. Approaches would be limited to once per day for an individual if they are able to confirm the identity of the individual. Approaches would be made at less than 10 knots and would parallel the course and speed of the animals. Some animals or species listed in the take table may be unintentionally harassed when approaching other species for behavioral observations.

Researchers would attempt to minimize disturbance to animals during close vessel approaches by:

- Approaching at minimal speeds from behind or beside the group.
- Remaining parallel to the animals.
- Matching speed with the group and minimizing changes in speed.
- Terminating activities if active avoidance is occurring.
- Not conducting activities if other vessels are in the immediate vicinity of whales.
- Consulting with other researchers in the area to: avoid harassing the same animals, explore collaborations, contribute to the cumulative research in the area, and share photo-identification images.

Research would occur along the 30 m isobath since this is the depth limit for the wind turbines that are planned for development along the east coast. The width of the action area ranges from 19 to 36 NM offshore from New Jersey to North Carolina.

Surveys would be conducted once per season to maximize survey time during known migration periods: July (summer survey), November (fall survey), February (winter survey), and April (spring survey). Each survey is anticipated to take approximately eight days to complete depending on the hours of available daylight.

Table 1: Proposed permitted "take" levels for Permits 15575 and 16109.

Species	**MMPA Stock/ ESA Listing Unit/**	**Permit 15575 Aerial or Vessel Survey**	**Permit 16109 Vessel Survey**
Blue whale	Western North Atlantic Stock	20	10
Fin whale	Western North Atlantic Stock	400	125
Humpback whale	Gulf of Maine Stock	370	100
North Atlantic right whale	Western North Atlantic Stock	350	50
Sei whale	Nova Scotia Stock	240	50
Sperm whale	North Atlantic Stock	200	10
Unidentified rorqual	N/A	100	--
Unidentified baleen	N/A	100	--
Unidentified fin/sei	N/A	300	--
Green sea turtle	Range-wide	475	--
Hawksbill sea turtle	Range-wide	2	--
Kemp's ridley sea turtle	Range-wide	125	--
Leatherback sea turtle	Range-wide	80	100
Loggerhead sea turtle	Range-wide	1400	--
Unidentified sea turtle	N/A	1115	300*

*Unidentified sea turtles for Permit 16109 would include any hardshell sea turtles approached. Researchers would include in annual report breakdown of species, if identifications to species level were made.

Permit conditions

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

- In the event of serious injury or mortality or if the permitted "take" is exceeded, researchers must suspend permitted activities and contact the Permits Division by phone within two business days, and submit a written incident report. The Permits Division may grant authorization to resume permitted activities.
- Permit holders must exercise caution when approaching animals and must retreat from animals if behaviors indicate the approach may be interfering with reproduction, feeding, or other vital functions.
- During aerial surveys flown at an altitude below 1,000 ft, any cetacean or pinniped observed should be counted and reported as a take. Behavioral reactions should be recorded and reported.
- Any "approach," defined as a continuous sequence of maneuvers (episode) involving a vessel, including drifting, directed toward a cetacean or group of cetaceans closer than 100 yards for large whales, constitutes a "take" by harassment under the MMPA and must be counted and reported. No individual animal may be "taken" more than 3 times in one day.
- When females with calves are authorized to be taken, researchers must terminate efforts if there is any evidence that the activity may be interfering with pair-bonding or other vital functions; must not position the research vessel between mother and calf; must approach mothers and calves gradually to minimize or avoid any startle response; and must not approach when calf is actively nursing.
- The Permit Holder must submit annual, final, and incident reports to the Permits Division.

Approach to the assessment

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

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

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

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

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

- reports from the 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 NMFS Permits Division when it initiates formal consultation
- 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.

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

Action Area

The overall action area for the two proposed permits is the Atlantic Ocean from Massachusetts to North Carolina.

DiGiovanni's proposed research would take place throughout the year, with the majority of effort likely to be in the New York Bight and surrounding waters. Additional effort would occur along the east coast from Massachusetts to North Carolina.

Research under GeoMarine's proposed permit would occur along the 30 m isobath (the depth limit for wind turbines planned for development along the east coast). The width of the action area ranges from 19 to 36 NM offshore from New Jersey to North Carolina. Surveys would be conducted once per season to maximize survey time during known migration periods: July (summer survey), November (fall survey), February (winter survey), and April (spring survey). Each survey is anticipated to take approximately eight days to complete depending on the hours of available daylight.

Status of listed resources

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

Cetaceans		
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
North Atlantic right whale*	*Eubalaena glacialis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Sea Turtles		
Green sea turtle – most areas	*Chelonia mydas*	Threatened
Florida and Mexico's Pacific coast breeding colonies		Endangered
Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelyts coriacea*	Endangered
Loggerhead sea turtle Northwest Atlantic Ocean DPS	*Caretta caretta*	Threatened
Fish		
Atlantic salmon Gulf of Maine DPS	*Salmo salar*	Endangered
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Threatened and endangered
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered

* Critical habitat exists for these species within the action area.

Species not considered further in this opinion

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

Critical habitat has been designated for the endangered North Atlantic right whale in the Great South Channel, Cape Cod Bay, and off the states of Georgia and Florida (50 FR 28793). The critical habitat designation encompasses three primary feeding and nursery habitats in the United States used by right whales during their annual migration. The physical, chemical, and biotic features that form right whale critical habitat include the composition of zooplankton in feeding areas, the topographic and seasonal oceanographic characteristics conducive to zooplankton growth; and water depth, water temperatures, and distance from shore for calving and nursery areas. The action would not alter the physical and biological features that were the basis for determining this habitat to be critical; therefore this habitat is not considered further.

ESA-listed Atlantic salmon, Atlantic sturgeon, and shortnose sturgeon may be present in the action area; however the proposed activities would target other species and would be conducted in a manner that is not expected to adversely affect these species.

Although these listed resources may occur in the action area, we believe they are either not likely to be exposed to the proposed research or are not likely to be adversely affected. Therefore, they will not be considered further in this Opinion.

Status of species considered in this opinion

The species narratives that follow focus on attributes of life history and distribution that influence the manner and likelihood that these species may be exposed to the proposed action, as well as the potential response and risk when exposure occurs. Consequently, the species' narrative is a summary of a larger body of information on localized movements, population structure, feeding, diving, and social behaviors. Summaries of the status and trends of humpback whales are presented to provide a foundation for the analysis of the species as a whole. We also provide a brief summary of the species' status and trends as a point of reference for the jeopardy determination, made later in this Opinion. That is, we rely on a species' status and trend to determine whether an action's direct or indirect effects are likely to increase the species' probability of becoming extinct. Similarly, each species narrative is followed by a description of its critical habitat with particular emphasis on any essential features of the habitat that may be exposed to the proposed action and may warrant special attention.

Blue whale

Description of the species

Blue whales occur primarily in the open ocean from tropical to polar waters worldwide. They are highly mobile, but their migratory patterns are not well known (Perry *et al.* 1999; Reeves *et al.* 2004). Blue whales migrate toward the warmer waters of the subtropics in fall to reduce energy costs, avoid ice entrapment, and reproduce (NMFS 1998). They typically occur alone or in groups of up to five animals, although larger foraging aggregations of up to 50 have been reported including aggregations mixed with other rorquals such as fin whales (Corkeron *et al.* 1999; Shirihai 2002).

Stock designations

Little is known about population and stock structure of blue whales. Studies suggest a wide range of alternative population and stock scenarios based on movement, feeding, and acoustic data.

Until recently, blue whale stock structure had not been tested using molecular or nuclear genetic analyses (Reeves et al. 1998). A recent study by Conway (2005) suggested that the global population could be divided into four major subdivisions, which roughly correspond to major ocean basins: eastern North and tropical Pacific Ocean, Southern Indian Ocean, Southern Ocean, and western North Atlantic Ocean. The eastern North/tropical Pacific Ocean subpopulation includes California, western Mexico, western Costa Rica, and Ecuador, and the western North Atlantic Ocean subpopulation (Conway 2005).

North Atlantic. Blue whales are found from the Arctic to at least mid-latitude waters, and typically inhabit the open ocean with occasional occurrences in the U.S. EEZ (Gagnon and Clark 1993; Yochem and Leatherwood 1985; Wenzel *et al.* 1988). Yochem and Leatherwood (1985) summarized records suggesting winter range extends south to Florida and the Gulf of Mexico. The U.S. Navy's Sound Surveillance System acoustic system has detected blue whales in much of the North Atlantic, including subtropical waters north of the West Indies and deep waters east of the U.S. Atlantic EEZ (Clark 1995). Blue whales are rare in the shelf waters of the eastern U.S. In the western North Atlantic, blue whales are most frequently sighted from the Gulf of St. Lawrence and eastern Nova Scotia and in waters off Newfoundland, during the winter (Sears et al. 1990). In the eastern North Atlantic, blue whales have been observed off the Azores, although Reiner et al. (1993) did not consider them common in that area.

North Pacific. Blue whales occur widely throughout the North Pacific. Acoustic monitoring has recorded blue whales off Oahu and the Midway Islands, although sightings or strandings in Hawaiian waters have not been reported (Barlow *et al.* 1997; Northrop *et al.* 1971; Thompson and Friedl 1982). Nishiwaki (1966) notes blue whale occurrence among the Aleutian Islands and in the Gulf of Alaska, but no one has sighted a blue whale in Alaska for some time, despite several surveys (Stewart *et al.* 1987; Carretta *et al.* 2005; Leatherwood *et al.* 1982; Forney and Brownell 1996). Blue whales are thought to summer in high latitudes and move into the subtropics and tropics during the winter (Yochem and Leatherwood 1985).

Indian Ocean. There is a "resident" population of unknown taxonomic status present in the northern Indian Ocean. Blue whale sightings have occurred in the Gulf of Aden, Persian Gulf, Arabian Sea, and across the Bay of Bengal to Burma and the Strait of Malacca (Mizroch *et al.* 1984; Clapham *et al.* 1999; Mikhalev 1997).

Southern Hemisphere. Blue whales range from the edge of the Antarctic pack ice (40^o-78^oS) during the austral summer north to Ecuador, Brazil, South Africa, Australia, and New Zealand during the austral winter (Shirihai 2002). The IWC has designated Southern

Hemisphere stock areas for management purposes based upon feeding areas. However, the overall population structure is unknown (Sears and Larsen 2002).

Reproduction

Gestation takes 10-12 months, followed by a 6-7 month nursing period. Sexual maturity occurs at 5-15 years of age and calves are born at 2-3 year intervals (COSEWIC 2002; NMFS 1998; Yochem and Leatherwood 1985). Blue whales may reach 70–80 years of age (COSEWIC 2002; Yochem and Leatherwood 1985).

Feeding

Data indicate that some summer feeding takes place at low latitudes in upwelling-modified waters, and that some whales remain year-round at either low or high latitudes (Yochem and Leatherwood 1985; Reilly and Thayer 1990; Clarke and Charif 1998; Hucke-Gaete *et al.* 2004). One population feeds in California waters from June to November and migrates south in winter/spring (Calambokidis *et al.* 1990; Mate *et al.* 1999). Prey availability likely dictates blue whale distribution for most of the year (Clapham *et al.* 1999; Burtenshaw *et al.* 2004). The large size of blue whales requires higher energy requirements than smaller whales and potentially prohibits fasting (Mate et al. 1999). Krill are the primary prey of blue whales in the North Pacific (Yochem and Leatherwood 1985; Kawamura 1980).

Status and trends

Blue whales (including all subspecies) were originally listed as endangered in 1970 (35 FR 18319), and this status continues since the inception of the ESA in 1973.

Estimates of blue whale abundance are uncertain. Globally, blue whale abundance has been estimated at between 5,000-13,000 animals (COSEWIC 2002; Yochem and Leatherwood 1985); a fraction of the 200,000 or more that are estimated to have populated the oceans prior to whaling (Maser *et al.* 1981; U.S. Department of Commerce 1983).

North Atlantic. Commercial hunting had a severe effect on blue whales, such that they remain rare in some formerly important habitats, notably in the northern and northeastern North Atlantic (Sigurjónsson and Gunnlaugsson 1990). The actual size of the blue whale population in the north Atlantic is uncertain, but estimates range from a few hundred individuals to about 2,000 (Allen 1970; Mitchell 1974; Sigurjónsson 1995; Sigurjónsson and Gunnlaugsson 1990). Sigurjónsson and Gunnlaugsson (1990) concluded that the blue whale population had been increasing since the late 1950s.

North Pacific. Prior to whaling, Gambell (1976) reported there may have been as many as 4,900 blue whales. In the eastern North Pacific, the minimum population is thought to be 1,384 whales, but no minimum population has been established (Carretta et al. 2006). Although blue whale abundance has likely increased since its protection in 1966, the possibility of unauthorized harvest by Soviet whaling vessel, incidental ship strikes, and gillnet mortalities make this uncertain.

Calambokidis and Barlow (2004) estimated roughly 3,000 blue whales inhabit waters off California, Oregon, and Washington based on line-transect surveys and 2,000 based on capture-recapture methods. Carretta et al.(2006) estimated an abundance of 1,744 for the same area, based on line-transect and capture-recapture estimates. Barlow (2003) reported mean group sizes of 1.0–1.9 during surveys off California, Oregon, and Washington. A density estimate of 0.0003 individuals/km^2 was given for waters off Oregon/Washington, and densities off California ranged from 0.001-0.0033 individuals/km^2 (Barlow 2003).

Southern Hemisphere. Blue whales were the mainstay of whaling in the region once the explosive harpoon was developed in the late nineteenth century (Shirihai 2002). Approximately 330,000–360,000 blue whales were harvested from 1904 to 1967 in the Antarctic alone, reducing their abundance to <3% of their original numbers (Reeves *et al.* 2003; Perry *et al.* 1999). Estimates of 4-5% for an average rate of population growth have been proposed (Yochem and Leatherwood 1985). However, a recent estimate of population growth for all blue whales throughout the Antarctic was 8.2% (Branch et al. 2007).

Critical habitat

NMFS has not designated critical habitat for blue whales.

Fin whale

Description of the species

The fin whale is the second largest baleen whale and is widely distributed in the world's oceans. Most fin whales in the Northern Hemisphere migrate seasonally from Antarctic feeding areas in the summer to low-latitude breeding and calving grounds in winter. Fin whales tend to avoid tropical and pack-ice waters, with the high-latitude limit of their range set by ice and the lower-latitude limit by warm water of approximately 15° C (Sergeant 1977). Fin whale concentrations generally form along frontal boundaries, or mixing zones between coastal and oceanic waters, which corresponds roughly to the 200 m isobath (the shelf edge; Nasu 1974).

Stock designations

North Atlantic. Fin whales are common off the Atlantic coast of the U.S. in waters immediately off the coast seaward to the continental shelf (about the 1,800 m contour).

Little is known about the winter habitat of fin whales, but in the western North Atlantic, the species has been found from off Newfoundland south to the Gulf of Mexico and Greater Antilles, and in the eastern North Atlantic the winter range extends from the Faroes and Norway south to the Canary Islands. In the Atlantic Ocean, a general migration in the fall from the Labrador and Newfoundland region, south past Bermuda, and into the West Indies has been theorized (Clark 1995).

North Pacific. Fin whales undertake migrations from low-latitude winter grounds to high-latitude summer grounds and extensive longitudinal movements both within and between years (Mizroch et al. 1999). Fin whales are sparsely distributed during November-April, from 60° N, south to the northern edge of the tropics, where mating and calving may take place (Mizroch et al. 1999). However, fin whales have been sighted as far north as 60° N throughout winter (Mizroch et al. 1999).

Fin whales are observed year-round off central and southern California with peak numbers in the summer and fall (Barlow 1997; Forney *et al.* 1995; Dohl *et al.* 1983). Peak numbers of fin whales are seen during the summer off Oregon, and in summer and fall in the Gulf of Alaska and southeastern Bering Sea (Perry *et al.* 1999; Moore *et al.* 2000). Fin whales are observed feeding in Hawaiian waters during mid-May, and their sounds have been recorded there during the autumn and winter (Northrop *et al.* 1968; Shallenberger 1981; Thompson and Friedl 1982; Balcomb 1987). Fin whales in the western Pacific winter in the Sea of Japan, the East China, Yellow, and Philippine seas (Gambell 1985a).

Southern Hemisphere. Fin whales range from near 40° S (Brazil, Madagascar, western Australia, New Zealand, Colombia, Peru, and Chile) during austral winter southward to Antarctica (Rice 1998). Fin whales in the action area likely would be from the New Zealand stock, which summers from 170º E to 145º W and winters in the Fiji Sea and adjacent waters (Gambell 1985a).

Reproduction

Fin whales reach sexual maturity between 5-15 years of age (Gambell 1985a; COSEWIC 2005; Lockyer 1972). Mating and calving occurs primarily from October-January, gestation lasts approximately 11 months, and nursing occurs for 6-11 months (Hain *et al.* 1992; Boyd *et al.* 1999). The average calving interval in the North Atlantic is estimated at about 2-3 years (Agler *et al.* 1993; Christensen *et al.* 1992). The location of winter breeding grounds is uncertain but mating is assumed to occur in pelagic mid-latitude waters (Perry et al. 1999). Fin whales live 70-80 years (Kjeld et al. 2006). Aguilar and Lockyer (1987) suggested annual natural mortality rates in northeast Atlantic fin whales may range from 0.04 to 0.06.

Feeding

Fin whales feed on euphausiids and large copepods in addition to schooling fish (Nemoto 1970; Kawamura 1982; Watkins *et al.* 1984) although their diet varies seasonally and geographically (Watkins *et al.* 1984; Shirihai 2002). They feed by filtering large volumes of water for the associated prey. The movements and distribution of fin whales may be based on prey availability, as Payne et al. (1990) concluded that fin whales are less stressed by fluctuations in prey availability than other species such as humpback whales due to their greater ability to exploit patchy prey aggregations. Feeding may occur in waters as shallow as 10 m when prey are at the surface, but most foraging is observed in high-productivity, upwelling, or thermal front marine waters (Gaskin 1972; Sergeant 1977).

Status and trends

Fin whales were originally listed as endangered in 1970 (35 FR 18319), and this status continues since the inception of the ESA in 1973. Although fin whale population structure remains unclear, various abundance estimates are available. Pre-exploitation fin whale abundance is estimated at 464,000 individuals worldwide; the estimate for 1991 was roughly 25% of this (Braham 1991). Historically, worldwide populations were severely depleted by commercial whaling, with more than 700,000 whales harvested in the twentieth century (Cherfas 1989).

North Atlantic. Sigurjónsson (1995) estimated that between 50,000 and 100,000 fin whales once populated the North Atlantic, although he provided no data or evidence to support that estimate. However, over 48,000 fin whales were caught between 1860- 1970 (Braham 1991). Although protected by the IWC, from 1988-1995 there have been 239 fin whales taken from the North Atlantic. Recently, Iceland resumed whaling of fin whales despite the 1985 moratorium imposed by the IWC. The western Mediterranean fin whale population is estimated at 3,583 individuals (95% CI = 2,130- 6,027; Forcada et al. 1996).

North Pacific. The status and trend of fin whale populations is largely unknown. Over 26,000 fin whales were harvested between 1914-1975 (Braham 1991 as cited in Perry et al. 1999). NMFS estimates roughly 3,000 individuals occur off California, Oregon, and Washington based on ship surveys in summer/autumn of 1996, 2001, and 2005, of which estimates of 283 and 380 have been made for Oregon and Washington alone (Barlow 2003; Barlow and Taylor 2001; Forney 2007). Barlow (2003) noted densities of up to 0.0012 individuals/km^2 off Oregon and Washington and up to 0.004 individuals/km^2 off California.

Southern Hemisphere. The Southern Hemisphere population was one of the most heavily exploited whale populations under commercial whaling. From 1904 to 1975, over 700,000 fin whales were taken in Antarctic whaling operations (IWC 1990). Harvests increased substantially upon the introduction of factory whaling ships in 1925, with an average of 25,000 caught annually from 1953-1961 (Perry et al. 1999). Current estimates are a tiny fraction of former abundance.

Critical habitat

NMFS has not designated critical habitat for fin whales.

Humpback whale

Description of the species

Humpback whales are a cosmopolitan species that occur in the Atlantic, Indian, Pacific, and Southern oceans. Humpback whales migrate seasonally between warmer, tropical or sub-tropical waters in winter months and cooler, temperate or sub-Arctic waters in summer months (Gendron and Urban 1993). In both regions, humpback whales tend to occupy shallow, coastal waters. However, migrations are undertaken through deep, pelagic waters (Winn and Reichley 1985).

Stock designations

North Atlantic. Humpback whales range from the mid-Atlantic bight and the Gulf of Maine across the southern coast of Greenland and Iceland to Norway in the Barents Sea. Whales migrate to the western coast of Africa and the Caribbean Sea during the winter. Humpback whales aggregate in four summer feeding areas: Gulf of Maine and eastern Canada, west Greenland, Iceland, and Norway (Katona and Beard 1990; Smith et al. 1999).

The principal breeding range for Atlantic humpback whales lies from the Antilles and northern Venezuela to Cuba (Balcomb and Nichols 1982; Whitehead and Moore 1982; Winn *et al.* 1975).

The largest breeding aggregations occur off the Greater Antilles where humpback whales from all North Atlantic feeding areas have been photo-identified (Katona and Beard 1990; Clapham *et al.* 1993; Mattila *et al.* 1994; Palsbøll *et al.* 1997; Smith *et al.* 1999; Stevick *et al.* 2003b). However, the possibility of historic and present breeding further north remains plausible (Smith and G.Pike 2009).

Winter aggregations also occur at the Cape Verde Islands in the eastern North Atlantic and along Angola (Reiner *et al.* 1996; Reeves *et al.* 2002; Weir 2007). Accessory and historical aggregations also occur in the eastern Caribbean (Winn *et al.* 1975; Mitchell and Reeves 1983; Reeves *et al.* 2001a; Reeves *et al.* 2001b; Smith and Reeves 2003; Schwartz 2003; Swartz *et al.* 2003; Levenson and Leapley 1978).

North Pacific. Based on genetic and photo-identification studies, NMFS currently recognizes four stocks of humpback whales in the North Pacific Ocean: two Eastern North Pacific stocks, one Central North Pacific stock, and one Western Pacific stock (Hill and DeMaster 1998). Humpback whales summer in coastal and inland waters from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Nemoto 1957; Johnson and Wolman 1984; Tomilin 1967). These whales migrate to Hawaii, southern Japan, the Mariana Islands, and Mexico during winter. The central North Pacific stock winters in the waters around Hawaii while the eastern North Pacific stock (also called the California-Oregon-Washington-Mexico stock) winters along Central America and Mexico. However, Calambokidis et al. (1997) identified individuals from several stocks wintering in the areas of other stocks, highlighting the paucity of knowledge on stock structure and the potential fluidity of stock structure.

Separate feeding groups of humpback whales are thought to inhabit western U.S. and Canadian waters, with the boundary between them located roughly at the U.S./Canadian border (Carretta et al. 2006). Humpback whales primarily feed along the shelf break and continental slope do not appear to frequent offshore waters in the region (Green et al. 1992; Tynan et al. 2005)

Southern Hemisphere. Eight proposed stocks of humpback whales occur in waters off Antarctica. A separate population of humpback whales appears to reside in the Arabian Sea in the Indian Ocean off the coasts of Oman, Pakistan, and India and movements of this group are poorly known (Mikhalev 1997; Rasmussen et al. 2007).

Reproduction

Humpback whale calving and breeding generally occurs during winter at lower latitudes. Gestation takes about 11 months, followed by a nursing period of up to 1 year (Baraff and Weinrich 1993). Sexual maturity is reached at between 5-7 years of age in the western North Atlantic, but may take as long as 11 years in the North Pacific, and perhaps over 11 years of age in the North Pacific (e.g., southeast Alaska, Gabriele et al. 2007). Females usually breed every 2-3 years, although consecutive calving is not unheard of (Clapham and Mayo 1987; 1990; Weinrich et al. 1993; Glockner-Ferrari and Ferrari 1985).

In calving areas, males sing long complex songs directed towards females, other males, or both. The breeding season can best be described as a floating lek or male dominance polygamy (Clapham 1996). Calving occurs in the shallow coastal waters of continental shelves and oceanic islands worldwide (Perry et al. 1999).

Feeding

During the feeding season, humpback whales form small groups that occasionally aggregate on concentrations of food that may be stable for long-periods of times. Humpbacks use a wide variety of behaviors to feed on various small, schooling prey including krill and fish (Jurasz and Jurasz 1979; Hain et al. 1982; Hain et al. 1995; Weinrich et al. 1992). The principal fish prey in the western North Atlantic are sand lance, herring, and capelin (Kenney et al. 1985). There is good evidence of some territoriality on feeding and calving areas (Tyack 1981; Clapham 1996; Clapham 1994).

Status and trends

Humpback whales were originally listed as endangered in 1970 (35 FR 18319), and this status remains under the ESA. Winn and Reichley (1985) argued that the global humpback whale population consisted of at least 150,000 whales in the early 1900s, mostly in the Southern Ocean. In 1987, the global population of humpback whales was estimated at about 10,000 (NMFS 1987). Although this estimate is outdated, it appears that humpback whale numbers are increasing.

North Atlantic. The best available estimate of North Atlantic abundance comes from 1992-1993 mark-recapture data, which generated an estimate of 11,570 humpback whales (Stevick *et al.* 2003a). Estimates of animals in Caribbean breeding grounds exceed 2,000 individuals (Balcomb and Nichols 1982). The rate of increase for this stock varies from 3.2-9.4%, with rates of increase slowing over the past two decades (Katona and Beard 1990; Barlow and Clapham 1997; Stevick *et al.* 2003a). If the North Atlantic population has grown according to the estimated instantaneous rate of increase ($r = 0.0311$), this would lead to an estimated 18,400 individual whales in 2008 (Stevick *et al.* 2003a).

In the West Indies, the majority of whales are found in the waters of the Dominican Republic, notably on Silver Bank and Navidad Bank, and in Samana Bay (Balcomb and Nichols 1982; Whitehead and Moore 1982; Mattila *et al.* 1989; Mattila *et al.* 1994). Humpback whales are also found at much lower densities throughout the remainder of the Antillean arc, from Puerto Rico to the coast of Venezuela (Winn *et al.* 1975; Mattila and Clapham 1989; Levenson and Leapley 1978; Price 1985).

North Pacific. The pre-exploitation population size of North Pacific humpback whales may have been as many as 15,000 humpback whales, and current estimates are 6,000-8,000 whales (Calambokidis *et al.* 1997; Rice 1978a). From 1905 to 1965, nearly 28,000 humpback whales were taken in whaling operations, reducing the number of all North Pacific humpback whale to roughly 1,000 (Perry et al. 1999). Population estimates have risen over time from 1,407-2,100 in the 1980s to 6,010 in 1997 (Baker 1985; Baker and Herman 1987; Darling and Morowitz 1986; Calambokidis et al. 1997). Tentative estimates of the eastern North Pacific stock suggest an increase of 6-7% annually, but fluctuations have included negative growth in the recent past (Angliss and Outlaw 2005). Based upon surveys between 2004 and 2006, Calambokidis et al. (2008) estimated that the current population of humpback whales in the North Pacific consists of about 18,300 whales, not counting calves. Almost half of these whales likely occur in wintering areas around the Hawaiian Islands.

Southern Hemisphere. The IWC recently compiled population data on humpback whales in the Southern Hemisphere. Approximately 42,000 Southern Hemisphere humpbacks can be found south of 60° S during the austral summer feeding season (IWC 2007).

Critical habitat

NMFS has not designated critical habitat for humpback whales.

North Atlantic right whale

Description of the Species

A western and an eastern population of right whales are recognized in the North Atlantic: (IWC 1986). The western population migrates along the North American coast from Nova Scotia to Florida. Sightings of the eastern North Atlantic population of right whales are very rare (Best *et al.* 2001).

Right whales occur in sub-polar to temperate waters in all major ocean basins in the world. Most sightings in the western north Atlantic are concentrated within five primary habitats or high-use areas: coastal waters off the southeastern U.S., Cape Cod and Massachusetts Bays, the Great South Channel, the Bay of Fundy, and the Nova 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.

Right whales have been observed from the mid-Atlantic Bight northward through the Gulf of Maine during all months of the year. In New England, peak abundance of right whales in feeding areas occurs in Cape Cod Bay beginning in late winter. In early spring, peak right whale abundance occurs in Wilkinson Basin to the Great South Channel (Kenney *et al.* 1995b). In late June and July, right whale distribution gradually shifts to the northern edge of Georges Bank. In late summer and fall, much of the population is found in waters in the Bay of Fundy and around Roseway Basin (Kenney 2001; Kenney *et al.* 1995b; Winn *et al.* 1986).

Reproduction

In the western North Atlantic, calving takes place between December and March in shallow, coastal waters. Females give birth to their first calf at an average age of 9 years (Best and Kishino 1998; Hamilton *et al.* 1998). Gestation lasts from 357 to 396 days in southern right whales, and it is likely similar in the northern species (Best 1994). Weaning seems to be variable, but has been reported to be 8 to 17 months in North Atlantic populations (Hamilton *et al.* 1995). The calving interval for right whales is between 2 and 7 years (Best *et al.* 2001; Burnell 2001; Cooke *et al.* 2001; Knowlton *et al.* 1994). From 2001-2005, a dramatic increase in North Atlantic right whale calving (23 calves per year) indicated that the calving interval may have decreased in this population (Kraus *et al.* 2005).

Feeding

Right whales fast during the winter and feed during the summer, although some may opportunistically feed during migration. Right whales use their baleen to sieve prey, from the water. They rely on dense patches of copepods, 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 northern U.S. and Canada (Baumgartner *et al.* 2003; Mayo and Marx 1990; Murison and Gaskin 1989; Wishner *et al.* 1988). Although right whales feed on copepod aggregations at the surface (Mayo and Marx 1990), they more commonly dive below the surface to exploit areas of high prey density (Kenney *et al.* 1995a; Baumgartner *et al.* 2003).

Status and trends

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

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

Based on a census of individual whales identified using photo-identification techniques and an assumption of mortality of whales not seen in seven years, the western North Atlantic stock size was estimated to be 295 individuals in 1992 (Knowlton *et al.* 1994). An updated analysis using the same method gave an estimate of 299 animals in 1998 (Kraus *et al.* 2001). A more recent review of the photo-id recapture database on June 15, 2006, indicated that 313 individually recognized North Atlantic right whales were known to be alive during 2002 (Waring *et al.* 2008).

Since the early 1990s, NMFS has reported the population size of northern right whales as being around 300 animals. A population of this size is sufficiently small for the population to experience deleterious phenomena such as demographic stochasticity, inbreeding depression and Allee effects. Based on their small population size and population ecology, right whales will have elevated extinction probabilities.

Caswell et al. (1999) determined that the western North Atlantic right whale population is declining at a rate of 2.4% per year. The authors also determined that if the mortality rate as of 1996 is not slowed and reproduction not improved, extinction could occur within 100 years. The population growth rate reported by Knowlton et al (1994) observed a 2.5% growth rate for the period between 1986 to 1992, suggesting some recovery.

However, the work by Caswell et al. (1999) suggested that crude survival probability declined from about 99% in the early 1980's to about 94% in the late 1990s. Additional work conducted in 1999 (Best *et al.* 2001) and 2002 (Clapham 2002) confirmed this decline.

Critical habitat

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 fared better than northern critical habitat and significant degradation has not been clearly identified.

As discussed above, the proposed research under DiGiovanni's permit (No. 15575) could occur within the northern critical habitat of the North Atlantic right whale.

Sei whale

Description of the species

The sei whale occurs in all oceans of the world except the Arctic. The migratory pattern of this species is thought to encompass long distances from high-latitude feeding areas in summer to low-latitude breeding areas in winter; however, the location of winter areas remains largely unknown (Perry et al. 1999). Sei whales are often associated with deeper waters and areas along continental shelf edges (Hain et al. 1985). This general offshore pattern is disrupted during occasional incursions into shallower inshore waters (Waring et al. 2004). The species appears to lack a well-defined social structure and individuals are usually found alone or in small groups of up to six whales (Perry et al. 1999). When on feeding grounds, larger groupings have been observed (Gambell 1985b).

Stock designations

Information suggests that sei whale stocks are dynamic and that individuals are immigrating and emigrating between stocks. Consequently, until further information is available to suggest otherwise, we consider sei whales as forming “open” populations that are connected through the movement of individuals.

North Atlantic. The IWC groups North Atlantic sei whales into three stocks for management purposes: the Nova Scotia, Iceland-Denmark Strait, and Northeast Atlantic stocks, noting that identification of sei whale population structure is difficult and remains a major research problem (Perry *et al.* 1999; Donovan 1991).

North Pacific. The IWC groups all North Pacific sei whales into one management stock (Donovan 1991). However, some mark-recapture, catch distribution, and morphological research indicate more than one population may exist, one between 155°-175° W, and another east of 155° W (Masaki 1976; Masaki 1977). Sei whales have been reported primarily south of the Aleutian Islands, in Shelikof Strait and waters surrounding Kodiak Island, in the Gulf of Alaska, and inside waters of southeast Alaska and south to California to the east and Japan and Korea to the west (Nasu 1974; Leatherwood *et al.* 1982). Sei whales have been occasionally reported from the Bering Sea and in low numbers on the central Bering Sea shelf (Hill and DeMaster 1998). Whaling data suggest that sei whales do not venture north of about 55°N (Gregr et al. 2000).

Southern Hemisphere. Sei whales occur throughout the Southern Ocean during the austral summer, generally between 40°-50° S (Gambell 1985b). During the austral winter, sei whales occur off Brazil and the western and eastern coasts of southern Africa and Australia. However, sei whales generally do not occur north of 30º S in the Southern Hemisphere and no records exist for the action area (Reeves et al. 1999). However, confirmed sighting records exist for Papua New Guinea and New Caledonia, with unconfirmed sightings in the Cook Islands (SPREP 2007).

Reproduction

Reproductive activities for sei whales occur primarily in winter. Gestation is about 12.7 months, calves are weaned at 6-9 months, and the calving interval is about 2-3 years (Gambell 1985b; Rice 1977). Sei whales become sexually mature at about age 10 (Rice 1977).

Feeding

Sei whales are primarily planktivorous, feeding mainly on euphausiids and copepods, although they are also known to consume fish (Waring et al. 2006). In the Northern Hemisphere, sei whales consume small schooling fish such as anchovies, sardines, and mackerel when locally abundant (Rice 1977; Mizroch *et al.* 1984). In the North Pacific, sei whales appear to prefer feeding along the cold eastern currents (Perry et al. 1999), and feed on euphausiids and copepods, which make up about 95% of their diets (Calkins 1986). The dominant food for sei whales off California during June-August is northern anchovy, while in September-October whales feed primarily on krill (Rice 1977). The balance of their diet consists of squid and schooling fish, including smelt, sand lance, Arctic cod, rockfish, pollock, capelin, and Atka mackerel (Nemoto and Kawamura 1977). In the Southern Ocean, analysis of stomach contents indicates sei whales consume *Calanus* spp. and small-sized euphausiids with prey composition showing latitudinal trends (Kawamura 1974).

Status and trends

The sei whale was originally listed as endangered in 1970 (35 FR 18319), and this status remained since the inception of the ESA in 1973.

North Atlantic. No information on sei whale abundance exists prior to commercial whaling (Perry et al. 1999). In 1974, the North Atlantic population was estimated to number about 2,078 individuals, including 965 whales in the Labrador Sea group and 870 whales in the Nova Scotia group (Mitchell and Chapman 1977). The total number of sei whales in the U.S. Atlantic EEZ remains unknown (Waring et al. 2006). Rice (1977) estimated total annual mortality for adult females as 0.088 and adult males as 0.103.

North Pacific. Ohsumi and Fukuda (1975) estimated that sei whales in the north Pacific numbered about 49,000 whales in 1963, had been reduced to 37,000-38,000 whales by 1967, and reduced again to 20,600-23,700 whales by 1973. When commercial whaling for sei whales ended in 1974, the population in the North Pacific had been reduced to an estimated 7,260-12,620 animals (Tillman 1977). There have been no direct estimates of sei whale populations for the eastern Pacific Ocean (or the entire Pacific). During aerial surveys in 1991-2001, there were two confirmed sightings of sei whales along the U.S. Pacific coast. The minimum population estimate based on transect surveys of 300 nautical miles from 1996-2001 was 35, although the actual population along the U.S. Pacific coast was estimated to be 56 (Carretta et al. 2006).

Critical habitat

NMFS has not designated critical habitat for sei whales.

Sperm whale

Description of the species

Sperm whales are distributed in all of the world's oceans, from equatorial to polar waters, and are highly migratory. Mature males range between 70º N in the North Atlantic and 70º S in the Southern Ocean (Reeves and Whitehead 1997; Perry *et al.* 1999), whereas mature females and immature individuals of both sexes are seldom found higher than 50º N or S (Reeves and Whitehead 1997). In winter, sperm whales migrate closer to equatorial waters (Kasuya and Miyashita 1988; Waring *et al.* 1993) where adult males join them to breed.

Stock designations

There is no clear understanding of the global population structure of sperm whales (Dufault et al. 1999). Recent ocean-wide genetic studies indicate low, but statistically significant, genetic diversity and no clear geographic structure, but strong differentiation between social groups (Lyrholm and Gyllensten 1998; Lyrholm *et al.* 1999; Lyrholm *et al.* 1996). The NMFS recognizes six stocks under the MMPA: three in the Atlantic/Gulf of Mexico and three in the Pacific (Alaska, California-Oregon-Washington, and Hawaii; (Perry *et al.* 1999; Waring *et al.* 2004).

North Atlantic. In the western North Atlantic, sperm whales range from Greenland south into the Gulf of Mexico and the Caribbean, where they are common, especially in deep basins north of the continental shelf (Romero *et al.* 2001; Wardle *et al.* 2001). The northern distributional limit of female/immature pods is probably around Georges Bank or the Nova Scotian shelf (Whitehead et al. 1991). Seasonal aerial surveys confirm that sperm whales are present in the northern Gulf of Mexico in all seasons (Mullin *et al.* 1994; Hansen *et al.* 1996). Sperm whales distribution follows a distinct seasonal cycle, concentrating east-northeast of Cape Hatteras in winter and shifting northward in spring when whales are found throughout the Mid-Atlantic Bight.

North Pacific. Sperm whales are found throughout the North Pacific and are distributed broadly in tropical and temperate waters to the Bering Sea as far north as Cape Navarin in summer, and occur south of 40^{o} N in winter (Rice 1974; Gosho *et al.* 1984; Miyashita *et al.* 1995). Sperm whales are found year-round in Californian and Hawaiian waters (Rice 1960; Shallenberger 1981; Dohl *et al.* 1983; Lee 1993; Barlow 1995; Forney *et al.* 1995; Mobley *et al.* 2000), but they reach peak abundance from April-mid-June and from the end of August-mid-November (Rice 1974). They are seen in every season except winter (December-February) in Washington and Oregon (Green et al. 1992). Summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993) show that although sperm whales are widely distributed in the tropics, their relative abundance tapers off markedly towards the middle of the tropical Pacific and northward towards the tip of Baja California (Carretta et al. 2006).

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

Southern Hemisphere. All sperm whales of the Southern Hemisphere are treated as a single population with nine divisions, although this designation has little biological basis and is more in line with whaling records (Donovan 1991). Sperm whales that occur off the Galapagos Islands, mainland Ecuador, and northern Peru may be distinct from other sperm whales in the Southern Hemisphere (Wade and Gerrodette 1993; Dufault and Whitehead 1995; Rice 1977). Gaskin (1973) found females to be absent in waters south of 50º and decrease in proportion to males south of 46-47º.

Reproduction

Female sperm whales become sexually mature at an average of 9 years or 8.25-8.8 m (Kasuya 1991). Males reach a length of 10 to 12 m at sexual maturity and take 9-20 years to become sexually mature, but will require another 10 years to become large enough to successfully breed (Kasuya 1991; Würsig *et al.* 2000). Mean age at physical maturity is 45 years for males and 30 years for females (Waring et al. 2004). Adult females give birth after roughly 15 months of gestation and nurse their calves for 2-3 years (Waring et al. 2004). The calving interval is estimated to be every 4-6 years between the ages of 12 and 40 (Kasuya 1991; Whitehead *et al.* 2008).

Sperm whale age distribution is unknown, but sperm whales are believed to live at least 60 years (Rice 1978b). Estimated annual mortality rates of sperm whales are thought to vary by age, but previous estimates of mortality rate for juveniles and adults are now considered unreliable (IWC 1980).

Feeding

Sperm whales appear to feed regularly throughout the year (NMFS 2006b). It is estimated they consume about 3-3.5% of their body weight daily (Lockyer 1981). They seem to forage mainly on or near the bottom, often ingesting stones, sand, sponges, and other non-food items (Rice 1989). A large proportion of a sperm whale's diet consists of low-fat, ammoniacal, or luminescent squids (Clarke 1996; Clarke 1980b; Martin and Clarke 1986). While sperm whales feed primarily on large and medium-sized squids, the list of documented food items is fairly long and diverse. Prey items include other cephalopods, such as octopi, and medium- and large-sized demersal fishes, such as rays, sharks, and many teleosts (Berzin 1972; Clarke 1977; Clarke 1980a; Angliss and Lodge 2004; Rice 1989).

Movement patterns of Pacific female and immature male groups appear to follow prey distribution and, although not random, movements are difficult to anticipate and are likely associated with feeding success, perception of the environment, and memory of optimal foraging areas (Whitehead et al. 2008). Sperm whales are frequently found in locations of high productivity due to upwelling or steep underwater topography, such as continental slopes, seamounts, or canyon features (Jaquet and Whitehead 1996; Jaquet *et al.* 1996).

Status and trends

Sperm whales were originally listed as endangered in 1970 (35 FR 18319), and this status remained with the inception of the ESA in 1973. Although population structure of sperm whales is unknown, several studies and estimates of abundance are available. Sperm whale populations probably are undergoing the dynamics of small population sizes, which is a threat itself. In particular, the loss of sperm whales to directed Soviet takes likely inhibits recovery due to the loss of adult females and their calves, leaving sizeable gaps in demographic and age structuring (Whitehead 2003).

North Atlantic. An estimate of 190,000 sperm whales was made for the entire North Atlantic, but CPUE data from which this estimate is derived are unreliable according to the IWC (Perry et al. 1999). The total number of sperm whales in the western North Atlantic is unknown (Waring *et al.* 2008). The best available current abundance estimate for western North Atlantic sperm whales is 4,804 based on 2004 data. The best available estimate for Northern Gulf of Mexico sperm whales is 1,665, based on 2003-2004 data, which are insufficient data to determine population trends (Waring *et al.* 2008).

North Pacific. There are approximately 76,800 sperm whales in the eastern tropical Pacific, eastern North Pacific, Hawaii, and western North Pacific (Whitehead 2002). Minimum population estimates in the eastern North Pacific are 1,719 individuals and 5,531 in the Hawaiian Islands (Carretta *et al.* 2007). The tropical Pacific is home to approximately 26,053 sperm whales and the western North Pacific has a population of approximately 29,674 (Whitehead 2002). There was a dramatic decline in the number of females around the Galapagos Islands during 1985-1999 versus 1978-1992 levels, likely due to migration to nearshore waters of South and Central America (Whitehead 2003).

Sperm whales are sighted off Oregon in every season except winter (Green et al. 1992). However, sperm whales are found off California year-round (Dohl *et al.* 1983; Forney *et* *al.* 1995; Barlow 1995), with peak abundance from April to mid-June and from August to mid-November (Rice 1974). Barlow (2003) reported mean group sizes of 2.0–11.8 during surveys the western U.S. Barlow (2003) estimated that 440 and 52 sperm whales occurred in Oregonian and Washingtonian waters, depending upon year and area, supported by densities of 0.0002 to 0.0019 individuals/km^2.

Southern Hemisphere. For management purposes, the IWC recognizes sperm whales as one stock, but further subdivides whales into nine geographic divisions: Western Atlantic, Eastern Atlantic, Western Indian, Central Indian, Eastern Indian, Eastern Australia, New Zealand, Central Pacific, and Eastern Pacific (Donovan 1991).

Critical habitat

NMFS has not designated critical habitat for sperm whales.

Green sea turtle

Distribution

Green sea turtles have a circumglobal distribution, occurring throughout tropical, subtropical waters, and, to a lesser extent, temperate waters. Green turtles appear to prefer waters that usually remain around 20º C in the coldest month, but may be found considerably north of these regions during warm-water events, such as El Niño. Stinson (1984) found green turtles to appear most frequently in U.S. coastal waters with temperatures exceeding 18º C. Further, green sea turtles seem to occur preferentially in drift lines or surface current convergences, probably because of the prevalence of cover and higher prey densities that associate with flotsam. For example, in the western Atlantic Ocean, drift lines commonly containing floating Sargassum spp. are capable of providing juveniles with shelter (NMFS and USFWS 1998a). Underwater resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance. Available information indicates that green turtle resting areas are near feeding areas (Bjorndal and Bolten 2000).

Populations are distinguished generally by ocean basin and more specifically by nesting location. Based upon genetic differences, two distinct regional clades are thought to exist in the Pacific: western Pacific and South Pacific islands, and eastern Pacific and central Pacific, including the rookery at French Frigate Shoals, Hawaii. In the eastern Pacific, green sea turtles forage from San Diego Bay, California to Mejillones, Chile. Individuals along the southern foraging area originate from Galapagos Islands nesting beaches, while those in the Gulf of California originate primarily from Michoacán. Green turtles foraging in San Diego Bay and along the Pacific coast of Baja California originate primarily from rookeries of the Islas Revillagigedos (Dutton 2003).

Reproduction

Estimates of reproductive longevity range from 17 to 23 years (Fitzsimmons *et al.* 1995; Carr *et al.* 1978; Chaloupka *et al.* 2004). Considering that mean duration between females returning to nest ranges from 2 to 5 years (Hirth 1997), these reproductive longevity estimates suggest that a female may nest 3 to 11 seasons over the course of her life. Based on reasonable means of three nests per season and 100 eggs per nest (Hirth 1997), a female may deposit 9 to 33 clutches during her lifetime.

Once hatched, sea turtles emerge and orient towards a light source, such as light shining off the ocean. They enter the sea in a "frenzy" of swimming activity, which decreases rapidly in the first few hours and gradually over the first several weeks (Okuyama *et al.* 2009; Ischer *et al.* 2009). Factors in the ocean environment have a major influence on reproduction (Chaloupka 2001; Solow *et al.* 2002; Limpus and Nicholls 1988). It is also apparent that during years of heavy nesting activity, density dependent factors (beach crowding and digging up of eggs by nesting females) may affect hatchling production (Tiwari *et al.* 2005; Tiwari *et al.* 2006). Precipitation, proximity to the high tide line, and nest depth can also significantly affect nesting success (Cheng et al. 2009). Precipitation can also be significant in sex determination, with greater nest moisture resulting in a higher proportion of males (Leblanc and Wibbels 2009). Green sea turtles often return to the same foraging areas following nesting migrations (Broderick *et al.* 2006; Godley *et al.* 2002). Once there, they move within specific areas, or home ranges, where they routinely visit specific localities to forage and rest (Seminoff *et al.* 2002; Seminoff and Jones 2006; Godley *et al.* 2003; Makowski *et al.* 2006; Taquet *et al.* 2006). However, it is also apparent that some green sea turtles remain in pelagic habitats for extended periods, perhaps never recruiting to coastal foraging sites (Pelletier et al. 2003).

In general, survivorship tends to be lower for juveniles and subadults than for adults. Adult survivorship has been calculated to range from 0.82-0.97 versus 0.58-0.89 for juveniles (Seminoff *et al.* 2003; Chaloupka and Limpus 2005; Troëng and Chaloupka 2007), with lower values coinciding with areas of human impact on green sea turtles and their habitats (Bjorndal *et al.* 2003; Campbell and Lagueux 2005).

Movement and migration

Green sea turtles are highly mobile and undertake complex movements through geographically disparate habitats during their lifetimes (Plotkin 2003; Musick and Limpus 1997). The periodic migration between nesting sites and foraging areas by adults is a prominent feature of their life history. After departing as hatchlings and residing in a variety of marine habitats for 40 or more years (Limpus and Chaloupka 1997), green sea turtles make their way back to the same beach from which they hatched (Meylan *et al.* 1990; Carr *et al.* 1978). However, green sea turtles spend the majority of their lives in coastal foraging grounds. These areas include both open coastline and protected bays and lagoons. While in these areas, green sea turtles rely on marine algae and seagrass as their primary dietary constituents, although some populations also forage heavily on invertebrates. There is some evidence that individuals move from shallow seagrass beds during the day to deeper areas at night (Hazel 2009).

Feeding

While offshore and sometimes in coastal habitats, green sea turtles are not obligate plant-eaters as widely believed, and instead consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey (Seminoff *et al.* 2002; Hatase *et al.* 2006; Heithaus *et al.* 2002; Godley *et al.* 1998; Parker and Balazs 2008). However, a shift to a more herbivorous diet occurs when individuals move into neritic habitats, as vegetable mater replaces an omnivorous diet at around 59 cm in carapace length off Mauritania (Cardona et al. 2009). Localized movement in foraging areas can be strongly influenced by tidal movement (Brooks et al. 2009).

Based on the behavior of post-hatchlings and juvenile green turtles raised in captivity, it is presumed that those in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters in depth (NMFS and USFWS 1998a; Hazel *et al.* 2009). The maximum recorded dive depth for an adult green turtle was just over 106 m (Berkson 1967).

Status and trends

Federal listing of the green sea turtle occurred on July 28, 1978, with all populations listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are endangered (43 FR 32800). The International Union for Conservation of Nature (IUCN) has classified the green turtle as "endangered."

No trend data are available for almost half of the important nesting sites, where numbers are based on recent trends and do not span a full green sea turtle generation, and impacts occurring over four decades ago that caused a change in juvenile recruitment rates may have yet to be manifested as a change in nesting abundance. Additionally, these numbers are not compared to larger historical numbers. The numbers also only reflect one segment of the population (nesting females), who are the only segment of the population for which reasonably good data are available and are cautiously used as one measure of the possible trend of populations.

Current nesting abundance is known for 46 nesting sites worldwide (Tables 10). These include both large and small rookeries and are believed to be representative of the overall trends for their respective regions. Based on the mean annual reproductive effort, 108,761-150,521 females nest each year among the 46 sites. Overall, of the 26 sites for which data enable an assessment of current trends, 12 nesting populations are increasing, 10 are stable, and four are decreasing. Long-term continuous datasets of 20 years are available for 11 sites, all of which are either increasing or stable. Despite the apparent global increase in numbers, the positive overall trend should be viewed cautiously because trend data are available for just over half of all sites examined and very few data sets span a full green sea turtle generation (Seminoff 2004).

Green turtles are thought to be declining throughout the Pacific Ocean, with the exception of Hawaii, from a combination of overexploitation and habitat loss (Seminoff *et al.* 2002; Eckert 1993). In the western Pacific, the only major (>2,000 nesting females) populations of green turtles occur in Australia and Malaysia, with smaller colonies throughout the area. Indonesian nesting is widely distributed, but has experienced large declines over the past 50 years. Hawaii green turtles are genetically distinct and geographically isolated, and the population appears to be increasing in size despite the prevalence of fibropapillomatosis and spirochidiasis (Aguirre et al. 1998).

There are no reliable estimates of the overall number of green turtles inhabiting foraging areas within the southeast United States, and it is likely that green turtles foraging in the region come from multiple genetic stocks. However, information from some sites is available. A long-term in-water monitoring study in the Indian River Lagoon of Florida has tracked the populations of juvenile green turtles in a foraging environment and noted significant increases in catch-per-unit effort (more than doubling) between the years 1983-85 and 1988-90. An extreme, short-term increase in catch per unit effort of ~300% was seen between 1995 and 1996 (Ehrhart *et al.* 1996). Catches of benthic immature turtles at the St. Lucie Nuclear Power Plant intake canal, which acts as a passive turtle collector on Florida's east coast, have also been increasing since 1992 (Martin and Ernst 2000).

Critical habitat

On September 2, 1998, critical habitat for green sea turtles was designated in coastal waters surrounding Culebra Island, Puerto Rico (63 FR 46693). Aspects of these areas that are important for green sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for green sea turtle prey. The proposed research would not take place in designated green sea turtle critical habitat.

Hawksbill sea turtle

Distribution

The hawksbill sea turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic, Indian, and Pacific oceans. Populations are distinguished generally by ocean basin and more specifically by nesting location. Satellite tagged turtles have shown significant variation in movement and migration patterns. In the Caribbean, distance traveled between nesting and foraging locations ranges from a few kilometers to a few hundred kilometers (Byles and Swimmer 1994; Miller *et al.* 1998; Horrocks *et al.* 2001; Hillis-Starr *et al.* 2000; Prieto *et al.* 2001; Lagueux *et al.* 2003). Hawksbill turtles are considered common in French Polynesian waters, but are not known to nest on the islands. Confirmed sightings have also been made near the proposed study area off Tonga, Fiji, and Niue (SPREP 2007).

Hawksbill sea turtles are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). Small juvenile hawksbills (5-21 cm straight carapace length) have been found in association with *Sargassum* spp. in both the Atlantic and Pacific oceans (Musick and Limpus 1997) and observations of newly hatched hawksbills attracted to floating weed have been made (Hornell 1927; Mellgren and Mann 1996; Mellgren *et al.* 1994). Post-oceanic hawksbills may occupy a range of habitats that include coral reefs or other hard-bottom habitats, sea grass, algal beds, mangrove bays and creeks (Musick and Limpus 1997), and mud flats (R. von Brandis, unpublished data in NMFS and USFWS 2007). Individuals of multiple breeding locations can occupy the same foraging habitat (Bass 1999; Bowen *et al.* 1996; Bowen *et al.* 2007; Diaz-Fernandez *et al.* 1999; Velez-Zuazo *et al.* 2008). As larger juveniles, some individuals may associate with the same feeding locality for more than a decade, while others apparently migrate from one site to another (Musick and Limpus 1997; Mortimer *et al.* 2003; Blumenthal *et al.* 2009). Larger individuals may prefer deeper habitats than their smaller counterparts (Blumenthal et al. 2009).

Reproduction

Hawksbill sea turtles breed while in the water, but eggs are laid on beaches worldwide. Females typically lay 3-5 clutches at 2-week intervals during a single nesting season (Witzell 1983; Mortimer and Bresson 1999; Richardson *et al.* 1999; Beggs *et al.* 2007).

Nesting for each female occurs between 1.8-7 year intervals, depending upon nesting site (Mortimer and Bresson 1999; Richardson *et al.* 1999; Limpus 2004; Pita and Broderick 2005; Beggs *et al.* 2007; Chan and Liew 1999; Pilcher and Ali 1999; Garduño-Andrade 1999). Following incubation, hatchlings emerge from sand-covered pits in which their eggs were laid and enter the sea.

Hawksbill sea turtles reach sexual maturity at >20 years in Atlantic waters (León and Diez 1999; Diez and Dam 2002; Boulon 1983; Boulon 1994). Ages of 30-38 years have been estimated for individuals from Indo-Pacific waters, with males reaching maturity later than females (Limpus and Miller 2000). Duration of reproductive potential in the Caribbean is 14-22 years (Parrish and Goodman 2006). Based on the reasonable means of 3-5 nests per season (Mortimer and Bresson 1999; Richardson *et al.* 1999) and 130 eggs per nest (Witzell 1983), a female may lay 9 to 55 egg clutches, or about 1,170-7,190 eggs during her lifetime. However, up to 276 eggs have been recorded in a single nest (Kamel and Delcroix 2009). In the Cayman Islands, juvenile growth has been estimated at 3.0 cm/year (Blumenthal et al. 2009).

Movement and migration

Upon first entering the sea, neonatal hawksbills in the Caribbean are believed to enter an oceanic phase that may involve long distance travel and eventual recruitment to nearshore foraging habitat (Boulon 1994). In the marine environment, the oceanic phase of juveniles (i.e., the "lost years") remains one of the most poorly understood aspects of hawksbill life history, both in terms of where turtles occur and how long they remain oceanic.

Feeding

Dietary data from oceanic stage hawksbills are limited, but indicate a combination of plant and animal material (Bjorndal 1997). Studies have shown post-oceanic hawksbills to feed on sponges throughout their range (reviewed by Bjorndal 1997), but appear to be especially spongivorous in the Caribbean (Van Dam and Diez 1997; León and Bjorndal 2002; Meylan 1988). Jellyfish are also ingested on occasion (Blumenthal et al. 2009).

Status and trends

Hawksbill sea turtles were protected on June 2, 1970 (35 FR 8495) under the Endangered Species Conservation Act and since 1973 have been listed as endangered under the ESA. This species is currently listed as endangered throughout its range.

Only five regional nesting populations remain with more than 1,000 females nesting annually (Seychelles, Mexico, Indonesia, and two in Australia) (Meylan and Donnelly 1999). Most populations are declining, depleted, or remnants of larger aggregations.

The most significant nesting within the U.S. occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and Buck Island, respectively. Each year, about 500-1000 hawksbill nests are laid on Mona Island, Puerto Rico (Diez and van Dam 2006) and another 100-150 nests on Buck Island Reef National Monument off St. Croix in the U.S. Virgin Islands (Meylan 1999).

Critical habitat

On September 2, 1998, critical habitat was declared for hawksbill sea turtles around Mona and Monito Islands, Puerto Rico (63 FR 46693). Aspects of these areas that are important for hawksbill sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill sea turtle prey. The proposed research would not take place in designated hawksbill sea turtle critical habitat.

Kemp's ridley sea turtle

Distribution

Adult Kemp's ridley turtles are restricted to the Gulf of Mexico in shallow near shore waters, although adult-sized individuals sometimes are found on the eastern seaboard of the United States. Females rarely leave the Gulf of Mexico and adult males do not migrate. Juveniles feed along the east coast of the United States up to the waters off Cape Cod, Massachusetts (Spotila 2004). A small number of individuals reach European waters (Spotila 2004; Brongersma 1972) and the Mediterranean (Pritchard and Mtirquez 1973).

Juvenile Kemp's ridley sea turtles are the second most abundant sea turtle in the mid-Atlantic region from New England, New York, and the Chesapeake Bay, south to coastal areas off North Carolina. Juvenile Kemp's ridley sea turtles migrate into the region during May and June and forage for crabs in submerged aquatic vegetation (Keinath *et al.* 1987; Musick and Limpus 1997). In the fall, they migrate south along the coast, forming one of the densest concentrations of Kemp's ridley sea turtles outside of the Gulf of Mexico (Musick and Limpus 1997).

Reproduction

Mating is believed to occur about three to four weeks prior to the first nesting (Rostal 2007), or late March through early to mid April. It is presumed that most mating takes place near the nesting beach (Morreale *et al.* 2007; Rostal 2007). Females initially ovulate within a few days after successful mating and lay the first clutch approximately two to four weeks later; if a turtle nests more than once per season, subsequent ovulations occur within approximately 48 hours after each nesting (Rostal 2007).

Approximately 60% of Kemp's ridley nesting occurs along an approximate 25-mile stretch of beach near Rancho Nuevo, Tamaulipas, Mexico from April to July, with limited nesting to the north (100 nests along Texas in 2006) and south (several hundred nests near Tampico, Mexico in 2006; USFWS 2006). Nesting at this location may be particularly important because hatchlings can more easily migrate to foraging grounds (Putman *et al.* 2010). The Kemp's ridley sea turtle tends to nest in large aggregations or arribadas (Bernardo and Plotkin 2007). The period between Kemp's ridley arribadas averages approximately 25 days, but the precise timing of the arribadas is unpredictable (Rostal *et al.* 1997; Bernardo and Plotkin 2007). Like all sea turtles, Kemp's ridley sea turtles nest multiple times in a single nesting season. The most recent analysis suggests approximately 3.075 nests per nesting season per female (Rostal 2007). The annual average number of eggs per nest (clutch size) is 94 to 100 and eggs typically take 45 to

58 days to hatch, depending on temperatures (Marquez-M. 1994; USFWS 2000; USFWS 2001; USFWS 2002; USFWS 2003; USFWS 2004; USFWS 2005; USFWS 2006; Rostal 2007). The period between nesting seasons for each female is approximately 1.8 to 2.0 years (Marquez *et al.* 1989; Rostal 2007; TEWG 2000). The nesting beach at Rancho Nuevo may produce a "natural" hatchling sex ratio that is female-biased, which can potentially increase egg production as those turtles reach sexual maturity (Wibbels 2007; Coyne and Landry Jr. 2007).

Kemp's ridleys require approximately 1.5 to two years to grow from a hatchling to a size of approximately 7.9 inches long, at which size they are capable of making a transition to a benthic coastal immature stage, but can range from one to four years or more (Ogren 1989; Caillouet *et al.* 1995; Zug *et al.* 1997; Schmid 1998; Schmid and Witzell 1997; TEWG 2000; Snover *et al.* 2007). Based on the size of nesting females, it is assumed that turtles must attain a size of approximately 23.6 inches long prior to maturing (Marquez-M. 1994). Growth models based on mark-recapture data suggest that a time period of seven to nine years would be required for this growth from benthic immature to mature size (Schmid and Witzell 1997; Snover *et al.* 2007). Currently, age to sexual maturity is believed to range from approximately 10 to 17 years for Kemp's ridleys (Snover *et al.* 2007). However, estimates of 10 to 13 years predominate in previous studies (Caillouet *et al.* 1995; Schmid and Witzell 1997; TEWG 2000).

Movement and migration

These migratory corridors appear to extend throughout the coastal areas of the Gulf of Mexico and most turtles appear to travel in waters less than roughly 164 feet in depth. Turtles that headed north and east traveled as far as southwest Florida, whereas those that headed south and east traveled as far as the Yucatan Peninsula, Mexico (Morreale *et al.* 2007).

Following migration, Kemp’s ridley sea turtles settle into resident feeding areas for several months (Byles and Plotkin 1994; Morreale *et al.* 2007). Females may begin returning along relatively shallow migratory corridors toward the nesting beach in the winter in order to arrive at the nesting beach by early spring.

Stranding data indicate that immature turtles in their benthic stage are found in coastal habitats of the entire Gulf of Mexico and U.S. Atlantic coast (TEWG 2000; Morreale *et al.* 2007). Developmental habitats for juveniles occur throughout the entire coastal Gulf of Mexico and U.S. Atlantic coast northward to New England (Schmid 1998; Wibbels *et al.* 2005; Morreale *et al.* 2007). Key foraging areas in the Gulf of Mexico include Sabine Pass, Texas; Caillou Bay and Calcasieu Pass, Louisiana; Big Gulley, Alabama; Cedar Keys, Florida; and Ten Thousand Islands, Florida (Carr and Caldwell 1956; Ogren 1989; Coyne *et al.* 1995; Schmid 1998; Schmid *et al.* 2002; Witzell *et al.* 2005). Foraging areas studied along the Atlantic coast include Pamlico Sound, Chesapeake Bay, Long Island Sound, Charleston Harbor, and Delaware Bay. Near-shore waters of 120 feet or less provide the primary marine habitat for adults, although it is not uncommon for adults to venture into deeper waters (Byles 1989a; Mysing and Vanselous 1989; Renaud *et al.* 1996; Shaver *et al.* 2005; Shaver and Wibbels 2007).

Benthic coastal waters of Louisiana and Texas seem to be preferred foraging areas for Kemp’s ridley sea turtles (particularly passes and beachfronts), although individuals may travel along the entire coastal margin of the Gulf of Mexico (Landry and Costa 1999; Landry *et al.* 1996; Renaud 1995). Sightings are less frequent during winter and spring, but this is likely due to lesser sighting effort during these times (Shoop and Kenney 1992; Keinath *et al.* 1996).

Feeding

Kemp's ridley diet consists mainly of swimming crabs, but may also include fish, jellyfish, and an array of mollusks. Kemp's ridley sea turtles can dive from a few seconds in duration to well over two and a half hours, although most dives are from 16 to 34 minutes (Mendonca and Pritchard 1986; Renaud 1995). Individuals spend the vast majority of their time underwater; over 12-hour periods, 89% to 96% of their time is spent below the surface (Byles 1989b; Gitschlag 1996).

Status and trends

The Kemp's ridley sea turtle was listed as endangered on December 2, 1970 (35 FR 18319). Internationally, the Kemp's ridley is considered the most endangered sea turtle (USFWS 1999; National Research Council 1990).

In 1947, 40,000 female Kemp's ridley sea turtles were observed nesting on the beaches at Rancho Nuevo on a single day (Carr 1963; Hildebrand 1963). By the early 1970s, the estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. Between the years of 1978 and 1991 only 200 Kemp's ridleys nested annually. Today the Kemp's ridley population appears to be in the early stages of recovery. Nesting has increased steadily over the past decade. During the 2000 nesting season, an estimated 2,000 females nested at Rancho Nuevo, a single arribada of 1,000 turtles was reported in 2001, and an estimated 3,600 turtles produced over 8,000 nests in 2003. In 2006, a record number of nests were recorded since monitoring began in 1978; 12,143 nests were documented in Mexico, with 7,866 of those at Rancho Nuevo. By 2004, the number of adult females in the Gulf of Mexico is estimate to have increased to about 5,000 individuals (Spotila 2004).

The Turtle Expert Working Group (2000) estimated that the population size of Kemp's ridley sea turtles grew at an average rate of l1.3 percent per year (95% C.I. slope = 0.096-0.130) between 1985 and 1998. Over the same time interval, hatchling production increased at a slightly slower rate (9.5% per year).

Critical habitat

NMFS has not designated critical habitat for Kemp's ridley sea turtle.

Leatherback sea turtle

Description of species

Leatherbacks range farther than any other sea turtle species, having evolved physiological and anatomical adaptations that allow them to exploit cold waters (Frair *et al.* 1972; Greer *et al.* 1973; NMFS and USFWS 1995). Leatherbacks typically associate with continental shelf and pelagic environments and are sighted in offshore waters of 7-27˚ C (CETAP 1982). However, juvenile leatherbacks usually stay in warmer, tropical waters >21˚ C (Eckert 2002). Males and females show some degree of natal homing to annual breeding sites (James *et al.* 2005).

Population designations

Leatherbacks break into four nesting aggregations: Pacific, Atlantic, and Indian oceans, and the Caribbean Sea. Detailed population structure is unknown, but is likely dependent upon nesting beach location.

Atlantic Ocean. Nesting aggregations have been documented in Gabon, Sao Tome and Principe, French Guiana, Suriname, and Florida (Márquez 1990; Bräutigam and Eckert 2006; Spotila *et al.* 1996). Widely dispersed but fairly regular African nesting also occurs between Mauritania and Angola (Fretey *et al.* 2007). Many sizeable populations (perhaps up to 20,000 females annually) of leatherbacks are known to nest in West Africa (Fretey 2001).

Pacific Ocean. Leatherbacks are found from tropical waters north to Alaska within the North Pacific and is the most common sea turtle in the eastern Pacific north of Mexico (Eckert 1993; Stinson 1984; Wing and Hodge 2002). The west coast of Central America and Mexico hosts nesting from September-March, although Costa Rican nesting peaks during April-May (Chacón-Chaverri and Eckert 2007; LGL Ltd. 2007). Leatherback nesting aggregations occur widely in the Pacific, including Malaysia, Papua New Guinea, Indonesia, Thailand, Australia, Fiji, the Solomon Islands, and Central America (Limpus 2002; Dutton *et al.* 2007). Significant nesting also occurs along the Central American coast (Márquez 1990).

Indian Ocean. Nesting is reported in South Africa, India, Sri Lanka, and the Andaman and Nicobar islands (Hamann *et al.* 2006).

Caribbean Sea. Nesting occurs in Puerto Rico, St. Croix, Costa Rica, Panama, Colombia, Trinidad and Tobago, Guyana, Suriname, and French Guiana (Márquez 1990; Bräutigam and Eckert 2006; Spotila *et al.* 1996).

Migration

Leatherback sea turtles migrate throughout open ocean convergence zones and upwelling areas, along continental margins, and in archipelagic waters (Morreale *et al.* 1994; Eckert 1998; Eckert 1999). In a single year, a leatherback may swim more than 9,600 km to nesting and foraging areas throughout ocean basins (Eckert 1998; Eckert 2006; Eckert *et al.* 2006; Hays *et al.* 2004; Ferraroli *et al.* 2004; Benson *et al.* 2007a; Benson *et al.* 2007b; Sale *et al.* 2006). However, much of this travel may be due to movements within current and eddy features, moving individuals along (Sale and Luschi 2009). Return to nesting beaches may be accomplished by a form of geomagnetic navigation and use of local cues (Sale and Luschi 2009). Leatherback females will either remain in nearshore waters between nesting events, or range widely, presumably to feed on available prey (Byrne *et al.* 2009; Fossette *et al.* 2009).

Reproduction

Leatherback sea turtles probably mate outside of tropical waters (Eckert and Eckert 1988). Mating may occur starting at 3-6 years (Rhodin 1985). However, this is disputed at least in the western North Atlantic and may not occur until 29 years (Rhodin 1985; Pritchard and Trebbau 1984; Avens and Goshe 2007; Dutton *et al.* 2005; Zug and Parham

1996). Leatherback turtles tend to forage in temperate waters except for nesting females; males are generally absent from nesting areas. Females can deposit up to seven nests per season of 100 eggs or more and return to nest every 2-3 years, although this varies geographically, and some eggs in each clutch are infertile.

Temperature is important to leatherback egg survival, with higher temperatures increasing mortality (Tomillo *et al.* 2009). Along Costa Rica, eggs laid earlier in the nesting season have higher hatching success than those deposited later in the season. Possibly because of this, females who nest more frequently (for more years) appear to lay their nests earlier in the season than leatherback females who nest less frequently. Survival is extremely low in early life, but greatly increases with age.

Feeding

In the western Atlantic, adults routinely migrate between boreal, temperate and tropical waters, presumably to optimize both foraging and nesting opportunities (Bleakney 1965; Lazell 1980). Leatherbacks feed primarily on jellyfish such as *Stomolophus*, *Chryaora*, and *Aurelia* (Rebel 1974) and tunicates (salps, pyrosomas). Leatherbacks are deep divers, with recorded dives to depths in excess of 1000 m (Eckert *et al.* 1989), but they may come into shallow waters if there is an abundance of jellyfish nearshore. TDR data recorded by Eckert *et al.* (1989) indicate that leatherbacks are night feeders.

Status and trends

Leatherback sea turtles were protected on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act and have been listed as endangered under the ESA since 1973. Estimates of total population size for Atlantic leatherbacks are difficult to ascertain due to the inconsistent nature of the available nesting data. In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982). The most recent population estimate for leatherback sea turtles from just the North Atlantic breeding groups is a range of 34,000-90,000 adult individuals (20,000- 56,000 adult females) (TEWG 2007). The species as a whole is declining and local populations are in danger of extinction (NMFS 2001).

Critical habitat

On March 23, 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, U.S.V.I. from the 183 m isobath to mean high tide level between 17° 42’12” N and 65°50’00” W (44 FR 17710). This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity. However, studies do not currently support significant critical habitat deterioration. The proposed research would not take place in designated leatherback sea turtle critical habitat.

On January 5, 2010, NMFS proposed and sought comments on the expansion of critical habitat to include approximately 70,600 square miles (182,854 square km) of marine habitat in the Pacific Ocean off the U.S. coast, including two adjacent areas stretching along the California coast from Point Arena to Point Vincente, and one area stretching from Cape Flattery, Washington, to the Umpqua River-Winchester Bay, Oregon, east of a line approximating the 2,000-meter depth contour (75 FR 319).

Loggerhead sea turtle

Distribution

Loggerheads are circumglobal occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian oceans. Loggerheads are the most abundant species of sea turtle found in U.S. coastal waters.

Loggerhead sea turtles are divided into five groupings that represent major oceans or seas: Atlantic, Pacific, and Indian oceans, as well as Caribbean and Mediterranean seas. As with other sea turtles, populations are frequently divided by nesting aggregation (Hutchinson and Dutton 2007). On September 22, 2011, the NMFS designate nine distinct population segments (DPSs) of loggerhead sea turtles. Four were listed as threatened: Northwest Atlantic Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean; and five were listed as endangered: Northeast Atlantic Ocean, Mediterranean Sea, North Indian Ocean, North Pacific Ocean, and South Pacific Ocean (76 FR 58868). The DPS that could be exposed to the proposed action is the Northwest Atlantic Ocean DPS.

Atlantic Ocean. Western Atlantic nesting locations include The Bahamas, Brazil, and numerous locations from the Yucatán Peninsula to North Carolina (Addison 1997; Addison and Morford 1996; Marcovaldi and Chaloupka 2007). This group comprises five nesting subpopulations: Northern, Southern, Dry Tortugas, Florida Panhandle, and Yucatán. Additional nesting occurs on Cay Sal Bank (Bahamas), Cuba, Quintana Roo (Yucatan Peninsula), Colombia, Brazil, Venezuela, Caribbean Central America, the eastern Caribbean Islands, and the Bahamian Archipelago.

Indian Ocean. Loggerhead sea turtles are known to nest along the Indian Ocean in Oman, Yemen, Sri Lanka, Madagascar, South Africa, and possibly Mozambique.

Pacific Ocean. Pacific Ocean rookeries are limited to the western portion of the basin. These sites include Australia, Indonesia, New Caledonia, Japan, New Zealand, and the Solomon islands.

Population structure in the Pacific is comprised of a northwestern Pacific nesting aggregation in Japan and a smaller southwestern nesting aggregation in Australia and New Caledonia (NMFS and SEFSC 2001). Genetics of Japanese nesters suggest that this subpopulation is comprised of genetically distinct nesting colonies (Hatase et al. 2002). The fidelity of nesting females to their nesting beach is the reason these subpopulations can be differentiated from one another. Nesting beach fidelity reduces the likelihood of recolonization of nesting beaches with sea turtles from other subpopulations.

Reproduction

Loggerhead nesting is confined to lower latitudes temperate and subtropic zones but absent from tropical areas (NMFS and USFWS 1991; Witherington *et al.* 2006; National Research Council 1990). The life cycle of loggerhead sea turtles can be divided into seven stages: eggs and hatchlings, small juveniles, large juveniles, subadults, novice breeders, first year emigrants, and mature breeders (Crouse *et al.* 1987). Hatchling loggerheads migrate to the ocean (to which they are drawn by near-ultraviolet light; Kawamura et al. 2009), where they are generally believed to lead a pelagic existence for as long as 7-12 years. At 15-38 years, loggerhead sea turtles become sexually mature, although the age at which they reach maturity varies widely among populations (NMFS 2001; Witherington *et al.* 2006; Frazer and Ehrhart 1985; Casale *et al.* 2009).

Loggerhead mating likely occurs along migration routes to nesting beaches, as well as in offshore from nesting beaches several weeks prior to the onset of nesting (NMFS and USFWS 1998b; Dodd 1988). Females usually breed every 2-3 years, but can vary from 1-7 years (Dodd 1988; Richardson *et al.* 1978). Females lay an average of 4.1 nests per season (Murphy and Hopkins 1984).

Movement and migration

Loggerhead hatchlings migrate offshore and become associated with *Sargassum* spp. habitats, driftlines, and other convergence zones (Carr 1986). After 14-32 years of age, they shift to a benthic habitat, where immature individuals forage in the open ocean and coastal areas along continental shelves, bays, lagoons, and estuaries (NMFS 2001; Bowen *et al.* 2004). Adult loggerheads make lengthy migrations from nesting beaches to foraging grounds (TEWG 1998). Loggerheads hatched on beaches in the southwest Pacific have been found to range widely in the southern portion of the basin, with individuals from populations nesting in Australia found as far east as Peruvian coast foraging areas still in the juvenile stage (Boyle et al. 2009).

Feeding

Loggerheads are omnivorous and opportunistic feeders (Parker et al. 2005). Hatchling loggerheads feed on macroplankton associated with *Sargassum* spp. communities (NMFS and USFWS 1991). Pelagic and benthic juveniles forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988; Wallace *et al.* 2009). Sub-adult and adult loggerheads prey on benthic invertebrates such as gastropods, mollusks, and decapod crustaceans in hard-bottom habitats, although fish and plants are also occasionally eaten (NMFS and USFWS 1998b).

Status and trends

Loggerhead sea turtles were listed as threatened under the ESA of 1973 on July 28, 1978 (43 FR 32800). However, NMFS recently determined that a petition to reclassify loggerhead turtles in the western North Atlantic Ocean as endangered might be warranted due to the substantial scientific and commercial information presented. Consequently, NMFS has initiated a review of the status of the species and is currently soliciting additional information on the species status and ecology, as well as areas that may qualify as critical habitat (73 FR 11849; March 5, 2008).

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size (Bjorndal et al. 2005). An important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates well. Adult nesting females often account for less than 1% of total population numbers. The global abundance of nesting female loggerhead turtles is estimated at 43,320–44,560 (Spotila 2004).

Atlantic Ocean. The greatest concentration of loggerheads occurs in the Atlantic Ocean and the adjacent Caribbean Sea, primarily on the Atlantic coast of Florida, with other major nesting areas located on the Yucatán Peninsula of Mexico, Columbia, Cuba, South Africa (Márquez 1990).

Among the five subpopulations, it is estimated that 53,000-92,000 nests are laid per year in the southeastern U.S. and the Gulf of Mexico, and the total number of nesting females is 32,000-56,000. All of these are currently in decline or data are insufficient to access trends (NMFS 2001; TEWG 1998).

Pacific Ocean. Abundance has declined dramatically over the past 10-20 years, although loggerheads range widely from Alaska to Chile (NMFS and USFWS 1998b). Pacific nesting is limited to two major locations, Australia and Japan. Eastern Australia supported one of the major global loggerhead nesting assemblages until recently (Limpus 1985). Now, less than 500 females nest annually, an 86% reduction in the size of the annual nesting population in 23 years (Limpus and Limpus 2003). The status of loggerhead nesting colonies in southern Japan and the surrounding region is uncertain, but approximately 1,000 female loggerhead turtles may nest there; a 50-90% decline compared to historical estimates (Bolten *et al.* 1996; Kamezaki *et al.* 2003; STAJ 2002; Dodd 1988). In addition, loggerheads are not commonly found in U.S. Pacific waters, and there have been no documented strandings of loggerheads on the Hawaiian Islands in nearly 20 years (1982-1999 stranding data). There are very few records of loggerheads nesting on any of the many islands of the central Pacific, and the species is considered rare or vagrant in this region (NMFS and USFWS 1998b).

Indian Ocean. The largest known nesting aggregation occurs on Masirah and Kuria Muria Islands in Oman (Ross and Barwani 1982). Extrapolations resulting from partial surveys and tagging in 1977-1978 provided broad estimates of 19,000-60,000 females nesting annually at Masirah Island, while a more recent partial survey in 1991 provided an estimate of 23,000 nesting females (Baldwin 1992; Ross 1979; Ross 1998; Ross and Barwani 1982).

Critical habitat

NMFS has not designated critical habitat for loggerhead sea turtles.

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 humpback whales in the action area. The *Environmental baseline* focuses primarily on past and present impacts to these species.

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

The following discussion summarizes the natural and human phenomena in the action area that may affect the likelihood these species will survive and recover in the wild. These include natural stressors, such as predation, disease, and parasitism; and anthropogenic stressors, including commercial and subsistence harvest, fisheries interactions, ship strikes, noise, contaminants, marine debris, habitat degradation and climate change, and scientific research.

Natural stressors

Predation

Cetaceans. Right whales have been subjects of killer whale attacks and, because of their robust size and slow swimming speed, tend to form small groups and fight killer whales when confronted and may cause killer whale mortality with their flukes (Ford and Reeves 2008).

Adult fin, sei, and blue whales engage in a flight responses (up to 40 km/h) to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Andrews (1916) suggested that killer whales attacked sei whales less frequently than fin and blue whales in the same areas. As the world's largest animals, blue whales are only occasionally known to be taken by killer whales (Tarpy 1979; Sears *et al.* 1990).

Based upon prevalence of tooth marks, attacks by killer whales are known to occur (Whitehead and Glass 1985). Juveniles appear to be the primary age group targeted. Humpback whales engage in grouping behavior, flailing tails, and rolling extensively to fight off attacks. Calves remain protected near mothers or within a group; however, long-term photo-identification studies suggest that nearly all scars on humpback whales in the Gulf of Maine from killer whales were obtained while still calves (Ford and Reeves 2008).

Sperm whales are known to be occasionally preyed upon by killer whales (Jefferson and Baird 1991; Pitman *et al.* 2001) and large sharks (Best et al. 1984) and harassed by pilot whales (Arnbom *et al.* 1987; Palacios and Mate 1996; Weller *et al.* 1996; Rice 1989; Whitehead 1995).

Sea Turtles. Sea turtles face predation primarily by sharks and to a lesser extent by killer whales (Pitman and Dutton 2004). Predators of sea turtles, especially of eggs and hatchlings, also include dogs, pigs, rats, crabs, sea birds, reef fishes, iguanas, coyotes, raccoons, and coatis (Bell *et al.* 1994; Ficetola 2008).

Disease and parasitism

Cetaceans. Urinary tract diseases and kidney failure caused by nematode *Crassicauda boopis* has been suggested to be the primary cause of natural mortality in North Atlantic fin whales and could also affect humpback whale populations (Lambertsen 1986; Lambertsen 1992), and several other species of large whale are known to carry similar parasites (Rice 1977). Endoparasitic helminths (worms) are commonly found in sei whales and can result in pathogenic effects when infestations occur in the liver and kidneys (Rice 1977). Parasites and biotoxins from red-tide blooms are other potential causes of mortality of humpback whales (Perry et al. 1999).

Strandings are also relatively common events for sperm whales, with one to dozens of individuals generally beaching themselves and dying during any single event. Although several hypotheses, such as navigation errors, illness, and anthropogenic stressors, have been proposed (Goold *et al.* 2002; Wright 2005), direct widespread causes remain unclear. Calcivirus and papillomavirus are known pathogens of sperm whales (Smith and Latham 1978; Lambertsen *et al.* 1987).

At this time, there are no data indicating that disease is limiting right whale recovery. However, results of body condition analysis and the occurrence of skin lesions on North Atlantic right whales maybe indicative of health issues within the population (NMFS 2005b).

Sea turtles. For unknown reasons, the frequency of a disease called fibropapillomatosis is much higher in green sea turtles than in other species and threatens a large number of existing subpopulations. Extremely high incidence has been reported in Hawaii, where affliction rates peaked at 47-69% in some foraging areas (Murakawa et al. 2000).

Anthropogenic stressors

Commercial and subsistence harvest

Cetaceans. Directed harvest has affected sei, blue, fin, humpback, sperm, and North Atlantic right whales. U.S. Commercial harvest of these large whale species no longer occurs, and the IWC has moratoriums in place to protect these species from commercial whaling internationally. Nonetheless, historical whaling significantly reduced large whale abundance, and the effects of these reductions likely still persist.

Conclusions based on historical whaling data suggest that the numbers of right whales in the western North Atlantic numbered in the hundreds before commercial exploitation (Reeves and Mitchell. 1987). More recent analysis concluded that these numbers may have been closer to 1,000, and that the greatest population decline occurred in the early 1700s (Reeves et al. in Breiwick *et al.* 1993). However, the authors caution that these estimates were based on incomplete records. Although extensively hunted historically, there has been little hunting of right whales in the 20th century. Hunting in the 19th and early 20th centuries, largely by Norwegian whaling operations, likely irreversibly damaged or extirpated this stock (Collett 1909; Brown 1976).

Historically, whaling represented the greatest threat to every population of sei whales and was ultimately responsible for listing sei whales as an endangered species. Sei whales are thought to not be widely hunted, although harvest for scientific whaling or illegal harvesting may occur in some areas.

Fin whales continue to be hunted in subsistence fisheries off West Greenland. Between 2003 and 2007, the IWC set a catch limit of up to 19 fin whales in this subsistence fishery. In the Antarctic Ocean, fin whales are hunted by Japanese whalers who have been allowed to kill up to 10 fin whales each ear for the 2005-2006 and 2006-2007 seasons under an Antarctic Special Permit NMFS (2006a). The Japanese whalers plan to kill 50 whales per year starting in the 2007-2008 season and continuing for the next 12 years (Nishiwaki *et al.* 2006; IWC 2006).

Sperm whales historically faced severe depletion from commercial whaling operations. From 1800 to 1900, the IWC estimated that nearly 250,000 sperm whales were killed by whalers, with another 700,000 from 1910 to 1982 (IWC Statistics 1959-1983). Others have estimated 436,000 individuals taken between 1800-1987 (Carretta et al. 2005).

Sea turtles. Directed harvest of sea turtles and their eggs for food and other products has existed for years and was a significant factor causing the decline of Kemp's ridley, green, leatherback, hawksbill, and loggerhead sea turtles. At present, despite conservation efforts such as bans and moratoriums by the responsible governments, the harvest of turtles and their eggs still occurs throughout the action area. Countries including Mexico, Peru, and the Philippines have made attempts to reduce the threats to sea turtles, but illegal harvesting still occurs. In Vietnam and Fiji, harvest of turtle meat and eggs remains unregulated.

Fisheries interactions

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

As part of an effort to reduce fishing gear entanglement by whales in the North Atlantic, NMFS developed the Atlantic Large Whale Take Reduction Plan. This plan has improved safety measures in fishing gear in order to reduce entanglements by whales. This plan also expanded restrictions on fishing grounds and prohibited gillnet fishing in restricted areas during the calving season.

Sea turtles. Bycatch, particularly by longline fisheries, is a major source of mortality for leatherback sea turtles (Fossette *et al.* 2009; Crognale *et al.* 2008; Gless *et al.* 2008; Petersen *et al.* 2009). Wallace et al. (2010) estimated that between 1990 and 2008, at least 85,000 sea turtles were captured as bycatch in fisheries worldwide. This estimate is likely at least two orders of magnitude low, resulting in a likely bycatch of nearly half a million sea turtles annually (Wallace et al. 2010). Finkbeiner et al. (2011) provides the following estimates for mean annual bycatch interactions and mortalities for U.S. Atlantic fisheries: Kemp's ridley – 98,300 interactions, 27,000 mortalities; loggerhead – 26,500 interactions, 1400 mortalities; green – 11,400 interactions, 300 mortalities; leatherback – 1400 interactions, 40 mortalities; hawksbill – less than 10 interactions and mortalities.

Ship strikes

Cetaceans. In the Western Atlantic Ocean, various types and sizes of vessels have been involved in ship strikes with large whales, including container/cargo ships/freighters, tankers, steamships, U.S. Coast Guard vessels, Navy vessels, cruise ships, ferries, recreational vessels, fishing vessels, whale-watching vessels, and other vessels (Jensen and Silber 2003). Vessel speed (if recorded) at the time of a large whale collision has ranged from 2 to 51 knots (Jensen and Silber 2003). Vessels can be damaged during ship strikes (occasionally, collisions with large whales have even harmed or killed humans on board the vessels); of 13 recorded vessels that reported damages from a strike, all were traveling at a speed of at least 10 knots (Jensen and Silber 2003).

Ship strikes are considered a serious and widespread threat to whales. This threat is increasing as commercial shipping lanes cross important breeding and feeding habitats and as whale populations recover and populate new areas or areas where they were previously extirpated (Swingle *et al.* 1993; Wiley *et al.* 1995). As ships continue to become faster and more widespread, an increase in ship interactions with whales is to be expected. Studies show that the probability of fatal injuries from ship strikes increases as vessels operate at speeds above 14 knots (Laist *et al.* 2001).

However, ships moving at relatively slow speeds may be a threat as well. On Oct. 19, 2009 a ship mapping the seafloor off CA for NOAA reported a "a shudder underneath the[ir] ship" (NMFS unpublished data). A whale was spotted soon thereafter and was observed to be bleeding profusely. A dead, 20 meter long blue whale was found washed up on Ft. Bragg beach in northern California soon thereafter and was the apparent victim of a ship strike (Unpublished report from Fugro Pelacos, Inc. to NMFS). The vessel that struck the whale was only traveling at approximately 5.5 knots (NMFS unpublished data).

Twenty-one confirmed mortalities of large whales resulted from 42 confirmed ship strikes in the North Atlantic between the years of 2000-2004 alone (Cole *et al.* 2006). Fin whales are the most frequently struck whale, although right whales, humpback whales and sperm whales are also commonly struck (Laist *et al.* 2001). In some locations, one-third of all fin whale and right whale strandings appear to involve ship strikes (Laist *et al.* 2001) and ship strikes are directly implicated in impeding the recovery of North Atlantic right whales (Caswell *et al.* 1999).

In the North Atlantic, NMFS has several programs in place to help reduce ship strikes to whales. One of these measures is the implementation of new rules that limit vessel traffic of ships greater than 65 feet to speeds of 10 knots or less in areas when right whales are known to congregate. Other programs include the modification of shipping lanes from areas of high right whale concentrations. Although these efforts are targeted primarily to help conserve North Atlantic right whales, they are also beneficial to other whales which inhabit the same waters and are subject to similar threats.

Sea turtles. Boat collisions can result in serious injury and death, and may pose a threat to sea turtles in the action area. However, the extent of this threat is unknown.

Noise

Cetaceans. The marine mammals that occur in the action area are regularly exposed to several sources of natural and anthropogenic sounds. Anthropogenic noises that could affect ambient noise arise from the following general types of activities in and near the sea, any combination of which can contribute to the total noise at any one place and time. These noises include transportation, dredging, construction; oil, gas, and mineral exploration in offshore areas; geophysical (seismic) surveys; sonars; explosions; and ocean research activities (Richardson et al. 1995).

Noise in the marine environment has received a lot of attention in recent years and is likely to continue to receive attention in the foreseeable future. Several investigators have argued that anthropogenic sources of noise have increased ambient noise levels in the ocean over the last 50 years (Jasny et al. 2005; NRC 1994; NRC 2000; NRC 2003; NRC 2005; Richardson et al. 1995). Much of this increase is due to increased shipping as ships become more numerous and of larger tonnage (NRC 2003).

Commercial fishing vessels, cruise ships, transport boats, airplanes, helicopters and recreational boats all contribute sound into the ocean (NRC 2003). The military uses sound to test the construction of new vessels, as well as for naval operations. In some areas where oil and gas production takes place, noise originates from the drilling and production platforms, tankers, vessel and aircraft support, seismic surveys, and the explosive removal of platforms (NRC 2003). Many researchers have described behavioral responses of marine mammals to the sounds produced by helicopters and fixed-wing aircraft, boats and ships, as well as dredging, construction, geological explorations, etc. (Richardson et al. 1995). Most observations have been limited to short-term behavioral responses, which included cessation of feeding, resting, or social interactions. Several studies have demonstrated short-term effects of disturbance on humpback whale behavior (Baker et al. 1983; Bauer and Herman 1986; Krieger and Wing 1984; Hall 1982) but the long-term effects, if any, are unclear or not detectable. Carretta et al. (2001) and Jasny et al. (2005) identified the increasing levels of anthropogenic noise as a habitat concern for whales because of its potential effect on their ability to communicate.

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

Contaminants

Cetaceans. The accumulation of stable pollutants is a possible human-induced source of mortality in long-lived high trophic level animals (Waring *et al.* 2004; NMFS 2005a), and some researchers have correlated contaminant exposure to possible adverse health effects in marine mammals. Contaminants may be introduced by rivers, coastal runoff, wind, ocean dumping, dumping of raw sewage by boats and various industrial activities, including offshore oil and gas or mineral exploitation. Due to their large amount of blubber and fat, marine mammals readily accumulate lipid-soluble contaminants (O’Hara and Rice 1996).

Sea turtles. In sea turtles, heavy metals have been found in a variety of tissues in levels that increase with turtle size (Godley *et al.* 1999; Fujihara *et al.* 2003; Storelli *et al.* 2008; Anan *et al.* 2001; Saeki *et al.* 2000; Gardner *et al.* 2006; Garcia-Fernandez *et al.* 2009; Barbieri 2009). Cadmium has been found in leatherbacks at the highest concentration compared to any other marine vertebrate (Gordon *et al.* 1998; Caurant *et al.* 1999).

Newly emerged hatchlings have higher concentrations than are present when laid, suggesting that metals may be accumulated during incubation from surrounding sands (Sahoo et al. 1996). Arsenic has been found to be very high in green sea turtle eggs (van de Merwe et al. 2009).

Sea turtle tissues have been found to contain organochlorines (Keller *et al.* 2004a; Keller *et al.* 2005; Gardner *et al.* 2003; Storelli *et al.* 2007; McKenzie *et al.* 1999; Corsolini *et al.* 2000; Rybitski *et al.* 1995; Alava *et al.* 2006; Monagas *et al.* 2008; Oros *et al.* 2009). PCB concentrations are reportedly equivalent to those in some marine mammals, with liver and adipose levels of at least one congener being exceptionally high (PCB 209: 500-530 ng/g wet weight; Oros *et al.* 2009; Davenport *et al.* 1990). Levels of PCBs found in green sea turtle eggs are considered far higher than what is fit for human consumption (van de Merwe et al. 2009).

Organochlorines have the potential to suppress the immune system of loggerhead sea turtles and may affect metabolic regulation (Keller *et al.* 2006; Keller *et al.* 2004b; Oros *et al.* 2009). These contaminants could cause deficiencies in endocrine, developmental, and reproductive health (Storelli et al. 2007), and are known to depress immune function in loggerhead sea turtles (Keller et al. 2006). Females from sexual maturity through reproductive life should have lower levels of contaminants than males because contaminants are shared with progeny through egg formation.

Exposure to sewage effluent may also result in green sea turtle eggs harboring antibiotic-resistant strains of bacteria (Al-Bahry et al. 2009).

Marine Debris

Sea turtles. Ingestion of marine debris can be a serious threat to sea turtles. When feeding, sea turtles can mistake debris (e.g., tar and plastic) for natural food items. Some types of marine debris may be directly or indirectly toxic, such as oil. Other types of marine debris, such as discarded or derelict fishing gear, may entangle and drown sea turtles. Plastic ingestion is very common in leatherbacks and can block gastrointestinal tracts leading to death (Mrosovsky et al. 2009).

Habitat degradation and climate change

Sea turtles. Coastal development can deter or interfere with nesting, affect nest success, and degrade foraging habitats for sea turtles. Many nesting beaches have already been significantly degraded or destroyed. Nesting habitat is threatened by rigid shoreline protection or “coastal armoring” such as sea walls, rock revetments, and sandbag installations. Many miles of once productive nesting beach have been permanently lost to this type of shoreline protection. Nesting habitat can be reduced by beach renourishment projects, which result in altered beach and sand characteristics, affecting nesting activity and nest success. Beach nourishment also hampers nesting success of loggerhead sea turtles, but only in the first year post-nourishment, after which hatching success increases (Brock et al. 2009). In some areas, timber and marine debris accumulation as well as sand mining reduce available nesting habitat (Bourgeois et al. 2009). Because hawksbills prefer to nest under vegetation (Horrocks and Scott 1991; Mortimer 1982), they are particularly affected by beachfront development and clearing of dune vegetation (Mortimer and Donnelly 2007).

The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the sea (Witherington 1992; Witherington and Bjorndal 1991; Karnad *et al.* 2009).

Coasts can also be threatened by contamination from herbicides, pesticides, oil spills, and other chemicals, as well as structural degradation from excessive boat anchoring and dredging (Waycott *et al.* 2005; Lee Long *et al.* 2000; Francour *et al.* 1999).

At sea, there are numerous potential threats including marine pollution, oil and gas exploration, lost and discarded fishing gear, changes in prey abundance and distribution due to commercial fishing, habitat alteration and destruction caused by fishing gear and practices, agricultural runoff, and sewage discharge (Lutcavage *et al.* 1997; Frazier *et al.* 2007). Hawksbills are typically associated with coral reefs, which are among the world's most endangered marine ecosystems (Wilkinson 2000).

Although climate change may expand foraging habitats into higher latitude waters and increasing ocean temperatures may also lead to reduced primary productivity and eventual food availability, climate change could reduce nesting habitat due to sea level rise, as well as affect egg development and nest success. Rising temperatures may increase feminization of leatherback nests (Hawkes *et al.* 2007b; James *et al.* 2006; Mrosovsky *et al.* 1984; McMahon and Hays 2006). Hawksbill turtles exhibit temperature-dependent sex determination (Wibbels 2003) suggesting that there may be a skewing of future hawksbill cohorts toward strong female bias. Loggerhead sea turtles are very sensitive to temperature as a determinant of sex while incubating. Ambient temperature increase by just 1º-2º C can potentially change hatchling sex ratios to all or nearly all female in tropical and subtropical areas (Hawkes et al. 2007a). Over time, this can reduce genetic diversity, or even population viability, if males become a small proportion of populations (Hulin et al. 2009). Sea surface temperatures on loggerhead foraging grounds has also been linked to the timing of nesting, with higher temperatures leading to earlier nesting (Mazaris *et al.* 2009; Schofield *et al.* 2009). Green sea turtles emerging from nests at cooler temperatures likely absorb more yolk that is converted to body tissue than do hatchlings from warmer nests (Ischer et al. 2009). However, warmer temperatures may also decrease the energy needs of a developing embryo (Reid et al. 2009)

Scientific research

There are currently 22 permits which authorize research on the targeted listed species in the action area. Seven of these permits include both cetaceans and sea turtles, five are for sea turtles only, and ten authorize research on cetaceans.

Effects of the proposed actions

Pursuant to Section 7(a)(2) of the ESA, federal agencies are required to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The proposed permits would expose listed whales and sea turtles to actions that constitute "take". In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed actions, the probability of individuals of listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. As described in the *Approach to the assessment* section, for any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, and lifetime reproductive success), the assessment would consider the risk posed to the viability of the population. The purpose of this assessment is to determine if it is reasonable to expect the proposed studies to have effects on listed species affected by these permits that could appreciably reduce the species' likelihood of surviving and recovering in the wild.

For this consultation, we are particularly concerned about behavioral disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level, and therefore species level, consequences. The proposed permits would authorize non-lethal "takes" by harassment of listed species during research activities. The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. However, the Marine Mammal Protection Act of 1972, as amended, defines harassment as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal population in the wild or has the potential to disturb a marine mammal or marine mammal population in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [16 U.S.C. 1362(18)(A)]. For this Opinion, we define harassment similarly: an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents.

Potential stressors

The assessment for this consultation identified several possible stressors associated with the proposed permitted activities. These include aerial surveys and close approaches by research vessels for the purposes of observation and photo-identification.

Exposure analysis

Exposure analyses identify the co-occurrence of ESA-listed species with the action's effects in space and time, and identify the nature of that co-occurrence. The *Exposure analysis* identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the action's effects and the populations(s) or subpopulation(s) those individuals represent.

The Permits Division proposes to issue a five-year permit No. 15575 for scientific research to Robert DiGiovanni, to annually "take" 20 blue whales, 400 fin whales, 370 humpback whales, 350 North Atlantic right whales, 240 sei whales, 200 sperm whales, 100 unidentified rorquals, 100 unidentified baleen whales, and 300 unidentified fin or sei whales. They also propose to permit the annual "take" of 475 green sea turtles, 2 hawksbill sea turtles, 125 Kemp's ridley sea turtles, 80 leatherback sea turtles, 1400 loggerhead sea turtles, and 1115 unidentified sea turtles. All of these takes would be in the form of aerial or vessel surveys, there would be no invasive procedures done on any listed species.

DiGiovanni based his request for takes on his recorded takes in the winter of 2005, scaled up for increased effort: multiple seasons per year, additional surveys per season, and reduced spacing of transect lines; additionally, the Permits Division method of counting takes has changed to include any approach of an animal, whereas previously, researchers would only count a "take" if the animal changed its behavior.

The proposed take level for North Atlantic right whales would essentially include the entire population. While we consider it unlikely for the applicant to survey every North Atlantic right whale each year, the species is known to engage in an activity known as Surface Active Groups (SAGs), which makes it difficult to predict the expected number of right whales he is likely to see, especially given the number of surveys planned.

Based on DiGiovanni's explanation of how requested take levels were derived, we believe that it is possible that the proposed numbers of animals will be exposed to aerial and vessel surveys, with a few exceptions. We believe it is unlikely for the applicant to "take" as many green turtles and loggerhead turtles as are included in the proposed permit. We estimate approximately 100 green turtles and 500 loggerheads would be exposed to aerial and vessel surveys. However, if the permit is issued as proposed, DiGiovanni would be authorized to approach 475 green and 1400 loggerhead sea turtles without being in violation of his permit.

The Permits Division proposes to issue a five-year permit No. 16109 for scientific research to GeoMarine, to annually "take" 10 blue whales, 125 fin whales, 100 humpback whales, 50 North Atlantic right whales, 50 sei whales, and 10 sperm whales. They also propose to permit the annual "take" of 100 leatherback sea turtles and 300 hard-shelled sea turtles. All of these takes would be in the form of vessel surveys, there would be no invasive procedures done on any listed species.

GeoMarine based its request for takes on its previous permit, scaled up for an increased action area; previously, surveys were limited to New Jersey. The hard-shelled turtle takes proposed by the Permits Division were based on the sum of requested takes: 50 green, 10 hawksbill, 100 Kemp's ridley, and 300 loggerhead sea turtles, and then reduced to 300 combined to be more realistic. Researcher would include in annual reports a breakdown of species, if identifications to species level were made. With only two years of past annual reports, conducted over a smaller action area, it is difficult to predict how many animals will be exposed to the proposed permit. Therefore, we assume that the total number of permitted takes could occur.

Response analysis

As discussed in the *Approach to the assessment* section of this Opinion, response analyses determine how listed resources are likely to respond after being exposed to an action's effects on the environment or directly on listed species themselves. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal (or physiological), or behavioral responses that might reduce the fitness of individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

Evidence indicates that wild animals respond to human disturbance in the same way they respond to predators (Lima 1998; Beale and Monaghan 2004; Frid and Dill 2002; Frid

2003; Gill et al. 2001; Romero 2004). These responses may manifest themselves as stress responses, interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005).

Response to aerial and vessel surveys (including close approaches) for cetaceans

The presence of vessels can lead to disturbance of marine mammals, although the animals' reactions are generally short term and low impact. Reactions range from little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation; diving; time spent submerged; foraging; and respiratory patterns. Responses may also include aerial displays like tail flicks and lobtailing and may possibly influence distribution (Watkins *et al.* 1981; Bauer and Herman 1986; Baker *et al.* 1983; Clapham *et al.* 1993; Jahoda *et al.* 2003). The degree of disturbance by vessel approaches is highly varied. Whales may respond differently depending upon what behavior the individual or pod is engaged in before the vessel approaches (Wursig et al. 1998; Hooker et al. 2001) and the degree to which they have become accustomed to vessel traffic (Lusseau 2004; Richter et al. 2006); reactions may also vary by species or individuals within a species (Gauthier and Sears 1999). In addition, Baker et al. (1988) reported that changes in whale behavior corresponded to vessel speed, size, and distance from the whale, as well as the number of vessels operating in the proximity. Based on experiments conducted by Clapham and Mattila (1993), experienced, trained personnel approaching whales slowly would result in fewer whales exhibiting responses that might indicate stress.

For humpback whales, studies found patterns of disturbance in response to vessel activity that indicate such approaches are probably stressful to the humpback whales, but the consequences of this stress on the individual whales remains unknown (Baker and Herman 1989; Baker et al. 1983). Baker et al. (1983) described two responses of whales to vessels: "horizontal avoidance" of vessels 2,000 to 4,000 meters away characterized by faster swimming and fewer long dives; and "vertical avoidance" of vessels from 0 to 2,000 meters away during which whales swam more slowly, but spent more time submerged.

Hall (1982) reported that humpback whales closely approached by survey vessels in Prince William Sound, Alaska, often reacted by diving and surfacing further from the vessel or with an altered direction of travel. The author noted that whale feeding activity and social behavior did not appear to be disturbed by the approaches; however, cow-calf pairs appeared to be wary and avoided the vessel. Other studies have found that humpbacks respond to the presence of boats by increasing swimming speed, with some evidence that swimming speed then decreased after boats left the area (Au and Green 2000; Scheidat et al. 2004). A number of studies involving the close approach of humpback whales by research vessels for biopsying and tagging indicate that responses are generally minimal to non-existent when approaches were slow and careful.

When more pronounced behavioral changes occur, the responses appear to be short-lived (Gauthier and Sears 1999; Weinrich et al. 1992; Clapham and Mattila 1993; Weinrich et al. 1991). The slow and careful approach to humpback whales is important and is supported by studies conducted by Clapham and Mattila (1993) on the reactions of humpback whales to close approaches for biopsy sampling in Caribbean breeding areas.

The investigators concluded that the way a vessel approached a group of whales had a major influence on the whale's response to the approach, particularly for cow and calf pairs. Smaller pods of whales and pods with calves also seem more responsive to approaching vessels (Bauer and Herman 1986; Bauer 1986). Based on their experiments with different approach strategies, researchers concluded that experienced, trained personnel approaching humpback whales slowly would result in fewer whales exhibiting responses that might indicate stress.

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

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

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

Response to aerial and vessel surveys (including close approaches) for sea turtles

Sea turtles may respond to an aircraft passing overhead depending upon the altitude of the plane, the proximity of the sea turtle to the trackline, and the sea turtle itself. NMFS Southeast Fisheries Science Center (SEFSC) staff have conducted aerial surveys and have conservatively estimated that approximately 30-50% of the sea turtles near the track line react to their survey craft. The reaction rate could be higher for the proposed research as some of the flights would be at lower altitudes than what the SEFSC flies. Sea turtle's reactions to SEFSC aerial surveys indicate that animals would dive as a plane is approaching or passes directly overhead. Similarly, sea turtles might dive in response to close approaches of research vessels.

We are not aware of any studies that have examined stress levels (e.g., blood chemistry changes) in sea turtles after exposure to aerial or vessel surveys to examine stress levels.

These types of studies would be extremely difficult to carry out. While reactions to surveys could result in a change in behavior, it would be similar to other natural behaviors such as predator avoidance. Sea turtles would be exposed very briefly to the survey activity and resume normal behavior, and we do not expect a negative fitness consequence for the individuals approached.

Cumulative effects

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area considered by this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Sources queried include state legislature websites and Nexis.

Recent legislation from Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina includes bills aimed to reduce ocean erosion; restore ocean sanctuaries; promote or regulate commercial and recreational fishing and aquaculture; promote alternative or renewable energy; protect water resources; promote conservation of fish, wildlife, and habitat; control and reduce pollution of the oceans; and prevent the spread of invasive species. These proposed bills are generally aimed at maintaining healthy marine ecosystems with regulated development of industry and regulation of commercial and recreational use of ocean waters.

Integration and synthesis of the effects

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

The NMFS Permits Division proposes to issue a scientific research permits to Robert DiGiovanni and to GeoMarine, Inc. to authorize research on marine mammals and sea turtles in the Atlantic Ocean from Massachusetts to North Carolina.

The *Status of listed resources* described the factors that have contributed to the reduction in population size of the 11 listed species considered in this Opinion. Threats to the survival and recovery of these species, as discussed in the *Environmental baseline*, include predation, disease, commercial harvest, fisheries interactions, noise, contaminants, marine debris, and habitat degradation. NMFS expects that these current natural and anthropogenic threats will continue. Reasonably likely future actions described in the *Cumulative effects* section that could affect the species considered in this opinion include state legislation aimed at maintaining healthy marine ecosystems with regulated development of industry and regulation of commercial and recreational use of ocean waters, and others.

Each year of the five-year proposed permits, the proposed numbers of blue, fin, humpback, North Atlantic right whale, sei, and sperm whales and green, hawksbill, Kemp’s ridley, leatherback, and loggerhead sea turtles could be closely approached by research vessels and photographed, and aerially surveyed. We believe short-lived stress responses due to close approach are possible for a few individuals, as are short-term interruptions in behaviors such as foraging; however, we do not expect these responses to lead to reduced opportunities for foraging or reproduction for targeted individuals. Overall, no individual whale or sea turtle is expected to experience a fitness reduction, and therefore no fitness consequence would be experienced at a population or species level.

Conclusion

After reviewing the current *Status of listed resources*; the *Environmental baseline* for the *Action area*; the anticipated effects of the proposed activities; and the *Cumulative effects*, it is NMFS’ Opinion that the activities authorized by the proposed issuance of scientific research permits 15575 and 16109, as proposed, is not likely to jeopardize the continued existence of listed species, and we do not anticipated the destruction or adverse modification of the designated critical habitat within the action area.

Incidental take statement

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

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

Conservation recommendations

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

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

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

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

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

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

Reinitiation notice

This concludes formal consultation on the proposal to issue scientific research permit No. 15575 to Robert DiGiovanni and permit No. 16109 to GeoMarine, Inc. to authorize research on marine mammals and sea turtles in the Atlantic Ocean from Massachusetts to North Carolina. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, the NMFS Permits Division must immediately request reinitiation of Section 7 consultation.

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