

**National Marine Fisheries Service
Endangered Species Act Section 7 Consultation**

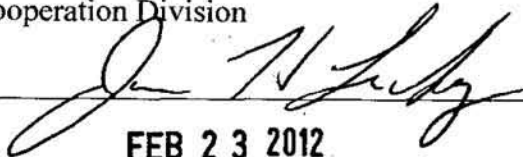
Biological Opinion

Agency: NOAA's National Marine Fisheries Service-Office of Protected Resources-Permits Division

Activities Considered: Issuance of permit to Susan Boudreau, National Park Service, Glacier Bay National Park and Preserve [Permit No. 15844]

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

Approved by:



Date:

FEB 23 2012

Section 7(a)(2) of the Endangered Species Act (ESA)(16 U.S.C. 1531 *et seq.*) requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a federal agency "may affect" a listed species or critical habitat designated for them, that agency is required to consult with either the NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service, depending upon the listed resources that may be affected. For the actions described in this document, the action agency is the NMFS' Office of Protected Resources-Permits Division (Permits Division), which proposes to authorize close approach and biopsy humpback whales in Glacier Bay, Alaska area of the North Pacific Ocean. The consulting agency for these proposals 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 actions on endangered and threatened species and designated critical habitat and has been prepared in accordance with section 7 of the ESA. This Opinion is based on information provided in the application, draft permit, environmental assessment, recovery plan for humpback whales, the most current marine mammal stock assessment reports, past and current research and population dynamics modeling efforts, monitoring reports from prior research, other information provided by the applicant, and biological opinions involving similar marine mammal research.

Consultation history

On May 27, 2011, the Permits Division published a notice in the Federal Register soliciting public comment on their intent to issue the proposed permit.

On August 3, 2011, NMFS' Endangered Species Act Interagency Cooperation Division received a request for formal consultation from the Permits Division to authorize Permit Number 15844, Susan Boudreau, National Park Service, Glacier Bay National Park and Preserve.

On August 5, 2011, the Endangered Species Act Interagency Cooperation Division initiated consultation with the Permit's Division.

On February 2, 2012, the Permits Division informed the Endangered Species Act Interagency Cooperation Division of a permit change that broadened the proposed action.

Description of the proposed action

The National Park Service (NPS) has conducted monitoring of humpback whales for nearly three decades; the proposed permit would facilitate the continuation of these activities as well as authorize a new activity, biopsy sampling. These activities allow researchers to understand long-term ecology, behavior, reproduction, feeding, and status trends of humpback whales using the area. Specific activities would include: approaching individual humpback whales from small research vessels, photographing individually-identifiable characteristics, passively recording whale sounds, collecting prey, skin, and fecal samples, and closely approaching individuals and obtaining a biopsy sample with a rifle-or crossbow-projected dart.

Close approaches would be conducted exclusively by small research vessels following specific line-transects or moving randomly through the region. Upon sighting an individual of interest, the vessel would generally approach to within 10-40 m of the target and spend roughly 10 minutes in close proximity to the target whale (although approaches of groups may last up to one hour). During this time, photographs and/or drawings of distinguishing features would be made as well as observations of physical features, feeding activities, and descriptions of prey patches using an echo-sounder (frequency range 50-200 kHz). While near whales, the vessel would maintain a parallel course and speed along or beside the target, minimize speed changes, terminate activities if avoidance is observed or other vessels are in the immediate vicinity, and avoid revisiting the same site on consecutive days. An individual would not be approached more than three times daily. Subsequent to initial approach, passive acoustic recording may be conducted roughly one body length from a target individual. Fecal or skin material would be skimmed from the water's surface on some occasions in proximity to humpback whales. Prey would be directly sampled in some occasions using a pelagic-fish trawl, Isaacs-Kidd mid-water trawl, modified herring trawl, Tucker trawl, bongo net, or rod-and-reel (these activities would generally occur 100 m or more from whales). A small subset of approached individuals would be targeted for biopsy each year. This would involve the firing of a sterilized 5 mm diameter, 4 cm deep dart from a pneumatic rifle or crossbow roughly 15-30 m from calf, juvenile, or adult whales of either sex. Darts would be aimed at the upper back or flank near the dorsal fin. Darts would bounce off the target subsequent to penetration of the skin and blubber and be collected from the

water's surface. No individual would be biopsied more than once annually (multiple attempts due to failed tries may occur).

The permit places several restrictions on the methods researchers can use. No more than three approaches can be conducted per day, approach with caution, retreat and terminate efforts on target individuals if vital life functions are interfered with, not position the research vessel between mother and calves, and avoid approaching when nursing is occurring. Biopsy darts must be disinfected between uses and not used on individuals estimated at less than one year of age. Biopsy must be discontinued if repetitive strong reactions are observed and biopsy can only be attempted on locations behind the pectoral fin.

Permit Conditions

I. Number and Kind(s) of Protected Species, Location(s) and Manner of Taking

1. The table(s) in Appendix 1 of the proposed permit outline the number of protected species, by species and stock, authorized to be taken, and the locations, manner, and time period in which they may be taken.
2. Researchers working under this permit may collect visual images (*e.g.*, photographs, video) in addition to the photo-identification or behavioral photo-documentation authorized in Appendix 1 as needed to document the permitted activities, provided the collection of such images does not result in takes.
3. The Permit Holder may use visual images and audio recordings collected under this permit, including those authorized in Appendix 1, in printed materials (including commercial or scientific publications) and presentations provided the images and recordings are accompanied by a statement indicating that the activity was conducted pursuant to permit 15844. This statement must accompany the images and recordings in all subsequent uses or sales.
4. Upon written request from the Permit Holder, approval for photography, filming, or audio recording activities not essential to achieving the objectives of the permitted activities, including allowing personnel not essential to the research (*e.g.*, a documentary film crew) to be present, may be granted by the Chief, Permits Division.
 - a. The Permit Holder submits a request to the Permits Division specifying the location and nature of the activity, approximate dates, and number and roles of individuals for which permission is sought.
 - b. Non-essential photography, filming, or recording activities will not influence the conduct of permitted activities or result in takes of protected species.

- c. Persons authorized to accompany the Researchers for the purpose of such non-essential activities will not be allowed to participate in the permitted activities.
 - d. The Permit Holder and Researchers do not require compensation from the individuals in return for allowing them to accompany Researchers.
5. Researchers must comply with the following conditions related to the manner of taking:
- a. Counting and Reporting Takes
 - i. Any “approach”¹ of a cetacean constitutes a take by harassment and must be counted and reported.
 - ii. Regardless of success, any attempt, which includes the associated close approach, to sample an animal constitutes a take and must be counted and reported.
 - iii. No individual animal may be taken more than three times in one day.
 - b. General
 - i. To minimize disturbance of the subject animals the Permit Holder must exercise caution when approaching animals and must retreat from animals if behaviors indicate the approach may be interfering with reproduction, feeding, or other vital functions.
 - ii. Where females with calves are authorized to be taken, Researchers:
 - a. Must immediately terminate efforts if there is any evidence that the activity may be interfering with pair-bonding or other vital functions;
 - b. Must not position the research vessel between the mother and calf;

¹ An "approach" is 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, or 50 yards for smaller cetaceans.

- c. Must approach mothers and calves gradually to minimize or avoid any startle response; and
- d. Must not approach any mother or calf while the calf is actively nursing.

c. Non-target Species

- i. This permit does not authorize takes of any protected species not identified in Appendix 1 of the proposed permit, including those species under the jurisdiction of the USFWS. Should other protected species be encountered during the research activities authorized under this permit, researchers must exercise caution and remain a safe distance from the animal(s) to avoid take, including harassment.

d. Biopsy Sampling

- i. All biopsy tips must be disinfected between and prior to each use.
- ii. Researchers may biopsy sample humpback whale and killer whale adults, calves greater than 1 year old, and females accompanied by these calves. Females accompanied by calves less than one year old but greater than four months old may also be sampled. However, no calf less than 1 year old shall be sampled.
- iii. Before attempting to sample an individual, Researchers must take reasonable measures (e.g., compare photo-identifications) to avoid repeated sampling of any individual.
- iv. A biopsy attempt must be discontinued if an animal exhibits repetitive strong adverse reactions to the activity or the vessel.
- v. In no instance will the Permit Holder attempt to biopsy a cetacean anywhere forward of/anterior to the pectoral fin.

II. Qualifications, Responsibilities, and Designation of Personnel

- 1. At the discretion of the Permit Holder, the following Researchers may participate in the conduct of the permitted activities in accordance with their qualifications and the limitations specified herein:
 - a. Principal Investigator – Christine Gabriele
 - b. Co-Investigator(s) – Janet L. Neilson and Janice Straley

5. Permitted activities may be conducted aboard vessels or aircraft, or in cooperation with individuals or organizations, engaged in commercial activities, provided the commercial activities are not conducted simultaneously with the permitted activities.
6. The Permit Holder cannot require or receive direct or indirect compensation from a person approved to act as PI, CI, or RA under this permit in return for requesting such approval from the Permits Division

III. Reports

1. The Permit Holder must submit written annual, final, and incident reports to the Permits Division. Reports may be submitted
 - through the online system at <https://apps.nmfs.noaa.gov>,
 - by email attachment to the permit analyst for this permit, or
 - by hard copy mailed or faxed to the Chief, Permits Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Suite 13705, Silver Spring, MD 20910; phone (301) 427-8401; fax (301) 713-0376.
2. Written incident reports related to serious injury and mortality events or to exceeding authorized takes, must be submitted to the Chief, Permits Division within two weeks of the incident. The incident report must include a complete description of the events and identification of steps that will be taken to reduce the potential for additional research-related mortality or exceedence of authorized take. In addition to the written report, the Permit Holder must contact the Permits Division by phone (301-427-8401) as soon as possible, but no later than within two business days of the incident.
3. An annual report must be submitted to the Chief, Permits Division at the conclusion of each year for which the permit is valid. The annual report describing activities conducted during the previous permit year must follow the format in Appendix 2 of the permit.
4. A final report must be submitted to the Chief, Permits Division within 180 days after expiration of the permit, or, if the research concludes prior to permit expiration, within 180 days of completion of the research. The final report must follow the format in Appendix 2 of the permit.
5. Research results must be published or otherwise made available to the scientific community in a reasonable period of time. Copies of technical reports, conference abstracts, papers, or publications resulting from permitted research must be submitted the Permits Division.

IV. Notification and Coordination

1. The Permit Holder must provide written notification of planned field work at least two weeks prior to initiation of each field trip/season. If there will be multiple field trips/seasons in a permit year, a single summary notification may be submitted per year.
 - a. Notification must include the
 - locations of the intended field study and/or survey routes
 - estimated dates of activities
 - number and roles of participants (for example: PI, CI, veterinarian, boat driver, safety diver, animal restrainer, Research Assistant “in training”)
 - b. Notification must be sent to the following Assistant Regional Administrator(s) for Protected Resources:

Alaska Region, NMFS, P.O. Box 21668, Juneau, AK 99802-1668;
phone (907)586-7235; fax (907)586-7012.
2. To the maximum extent practical, the Permit Holder must coordinate permitted activities with activities of other Permit Holders conducting the same or similar activities on the same species, in the same locations, or at the same times of year to avoid unnecessary disturbance of animals. Contact the applicable Regional Office(s) listed in F.1.b for information about coordinating with other Permit Holders.
3. Researchers must comply with protocols provided by the Regional Administrators related to coordination of research, including additional measures deemed necessary to minimize unnecessary duplication, harassment, or other adverse impacts from multiple permit holders.

V. Observers and Inspections

1. NMFS may review activities conducted pursuant to this permit. At the request of NMFS, the Permit Holder must cooperate with any such review by:
 - a. Allowing an employee of NOAA or other person designated by the Director, NMFS Office of Protected Resources to observe permitted activities; and
 - b. Providing all documents or other information relating to the permitted activities.

VI. Modification, Suspension, and Revocation

1. Permits are subject to suspension, revocation, modification, and denial in accordance with the provisions of subpart D [Permit Sanctions and Denials] of 15 CFR part 904.
2. The Director, NMFS Office of Protected Resources may modify, suspend, or revoke this permit in whole or in part:
 - a. In order to make the permit consistent with a change made after the date of permit issuance with respect to applicable regulation prescribed under section 103 of the MMPA and section 4 of the ESA;
 - b. In a case in which a violation of the terms and conditions of the permit is found;
 - c. In response to a written request² from the Permit Holder;
 - d. If NMFS determines that the application or other information pertaining to the permitted activities (including, but not limited to, reports pursuant to Section E of this permit and information provided to NOAA personnel pursuant to Section G of this permit) includes false information; and
 - e. If NMFS determines that the authorized activities will operate to the disadvantage of threatened or endangered species or are otherwise no longer consistent with the purposes and policy in Section 2 of the ESA.
3. Issuance of this permit does not guarantee or imply that NMFS will issue or approve subsequent permits or amendments for the same or similar activities requested by the Permit Holder, including those of a continuing nature.

VII. Penalties and Permit Sanctions

1. A person who violates a provision of this permit, the MMPA, ESA, or the regulations at 50 CFR 216 and 50 CFR 222-226 is subject to civil and criminal penalties, permit sanctions, and forfeiture as authorized under the MMPA, ESA, and 15 CFR part 904.

Approach to the Assessment

The NMFS approaches its section 7 analyses of agency actions through a series of steps.

² The Permit Holder may request changes to the permit related to: the objectives or purposes of the permitted activities; the species or number of animals taken; and the location, time, or manner of taking or importing protected species. Such requests must be submitted in writing to the Permits Division in the format specified in the application instructions.

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

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

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

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

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

action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Anderson 2000; Brandon 1978; Mills and Beatty 1979; Stearns 1992). As a result, if we conclude that listed plants or animals are *not* likely to experience reductions in their fitness, we would conclude our assessment.

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

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

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

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

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

We supplemented these searches with electronic searches of doctoral dissertations and master's theses. These searches specifically tried to identify data or other information that supports a particular conclusion (for example, a study that suggests whales will

exhibit a particular response to close vessel approach) as well as data that do not support that conclusion. When data were equivocal or when faced with substantial uncertainty, our decisions are designed to avoid the risks of incorrectly concluding that an action would not have an adverse effect on listed species when, in fact, such adverse effects are likely (i.e., Type II error).

Action Area

The proposed action area includes Glacier Bay National Park and Preserve, especially Glacier Bay and Icy Strait, but may also include nearshore waters of southeastern Alaska and the Alexander Archipelago. Research would be conducted between April and November annually and concentrated from May to September when humpback whales are present in their highest abundance.

Status of Listed Resources

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

Table 1. Listed resources in the action area. Asterisks denote critical habitat in the action area.

<i>Common name (distinct population segment, evolutionarily significant unit, or subspecies)</i>	<i>Scientific name</i>	<i>Status</i>
<i>Cetaceans</i>		
Blue whale	<i>Balaenoptera musculus</i>	Endangered
Fin whale	<i>Balaenoptera physalus</i>	Endangered
Humpback whale	<i>Megaptera novaeangliae</i>	Endangered
North Pacific right whale	<i>Eubalaena japonica</i>	Endangered
Sei whale	<i>Balaenoptera borealis</i>	Endangered
Sperm whale	<i>Physeter macrocephalus</i>	Endangered
<i>Pinnipeds</i>		
Steller sea lion (Eastern)	<i>Eumetopias jubatus</i>	Threatened
<i>Marine Turtles</i>		
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Endangered
<i>Anadromous Fishes</i>		
Chinook salmon (Lower Columbia River)	<i>Oncorhynchus tshawytscha</i>	Threatened
Chinook salmon (Upper Columbia River Spring-run)		Endangered
Chinook salmon (Puget Sound)		Threatened
Chinook salmon (Snake River Fall-run)		Threatened
Chinook salmon (Snake River Spring/Summer-run)		Threatened
Chinook salmon (Upper Willamette River)		Threatened
Chum salmon (Columbia River)	<i>Oncorhynchus keta</i>	Threatened
Chum salmon (Hood Canal Summer-run)		Threatened
Coho salmon (Lower Columbia River)	<i>Oncorhynchus kisutch</i>	Threatened
Coho salmon (Oregon Coast)		Threatened
Sockeye salmon (Ozette Lake)	<i>Oncorhynchus nerka</i>	Threatened
Sockeye salmon (Snake River)		Endangered
Steelhead (Central California Coast)	<i>Oncorhynchus mykiss</i>	Threatened
Steelhead (California Central Valley)		Threatened
Steelhead (Lower Columbia River)		Threatened

<i>Common name (distinct population segment, evolutionarily significant unit, or subspecies)</i>	<i>Scientific name</i>	<i>Status</i>
Steelhead (Middle Columbia River)		Threatened
Steelhead (Northern California)		Threatened
Steelhead (Puget Sound)		Threatened
Steelhead (Snake River)		Threatened
Steelhead (Upper Columbia River)		Threatened
Steelhead (Upper Willamette River)		Threatened

Species not considered further

Blue, fin, sei, North Pacific right, and sperm whales may be incidentally exposed to stressors associated with the proposed action, such as ship-strike and acoustic noise exposure. The presence these species in the action area is rare at best. Personnel onboard research vessels would continually observe for cetaceans and actively avoid approaching non-target individuals. This, combined with the thousands of hours that researchers have spent in vessel-based research effort over several years in the region without an incident of ship-strike make the possibility of ship-strike insignificant. The research vessels would produce noise in the acoustic environment which has the potential to mask the vocalizations produced by listed whales or other significant acoustic information, introducing the possibility that important sounds may not be perceived by individuals near the research vessel (particularly when operating at high speed). However, researchers would be visually searching for cetaceans and avoiding close approaches of all but target individuals. We find that exposure to masking sounds is expected to be brief and insignificant and do not consider blue, fin, sei, North Pacific right, and sperm whales further in this Opinion.

Two Steller sea lion haul-outs are known to exist in the action area, cumulatively numbering roughly 900 individuals. Researchers do not intend to approach these locations closely and have not reported disturbance to Steller sea lions in the past. As with other listed whales, personnel onboard research vessels would continually observe for pinnipeds and actively avoid approaching non-target species. The noise produced by the vessel is not expected to hamper communications by Steller sea lions in water. We find that the risk of ship strike, disturbance, and acoustic interference to Steller sea lions is insignificant and do not consider the species further in this Opinion.

Leatherback sea turtles could be exposed to vessel strikes. Leatherback sea turtles are known to occur in waters as far north as the action area, although their presence in the action area is unknown. As with marine mammals, sea turtles have not been documented to be struck by researchers in the area and the possibility of this occurring is insignificant. We do not consider leatherback sea turtles further in this opinion.

Listed salmonids may also be exposed to potential stressors from the proposed actions. Salmonids may occur near the ocean surface, but we expect individuals to be easily capable of moving out of the direct path of even a fast-moving vessel. We therefore find the potential for direct strike to listed salmonids to be discountable. We do not consider salmonids further in this Opinion.

No critical habitat has been designated in the action area for species under the NMFS' jurisdiction.

The biology and ecology of species with anticipated exposure below (humpback whales) informs the effects analysis for this Opinion. Summaries of the global status and trends of each species presented provide a foundation for the analysis of species as a whole.

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 (where they breed and give birth to calves, although feeding occasionally occurs) and cooler, temperate or sub-Arctic waters in summer months (where they feed; (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).

Population designations. Populations have been relatively well defined for humpback whales

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 (Boye et al. 2010; Katona and Beard 1990; Smith et al. 1999).

Increasing range and occurrence in the Mediterranean Sea coincides with population growth and may represent reclaimed habitat from pre-commercial whaling (Frantzis et al. 2004; Genov et al. 2009). The principal breeding range for Atlantic humpback whales lies from the Antilles and northern Venezuela to Cuba (Balcomb III 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 (Clapham et al. 1993; Katona and Beard 1990; 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 enigmatic but plausible (Smith and G.Pike 2009). Winter aggregations also occur at the Cape Verde Islands in the eastern North Atlantic and along Angola (Reeves et al. 2002; Reiner et al. 1996; Weir 2007). Accessory and historical aggregations also occur in the eastern Caribbean (Levenson and Leapley 1978; Mitchell and Reeves 1983; Reeves et al. 2001a; Reeves et al. 2001b; Schwartz 2003; Smith and Reeves 2003; Swartz et al. 2003; Winn et al. 1975). To further highlight the “open” structure of humpback whales, a humpback whale migrated from the Indian Ocean to the South Atlantic Ocean, demonstrating that interoceanic movements can occur (Pomilla and Rosenbaum 2005). Genetic exchange at low-latitude breeding groups between Northern and Southern Hemisphere individuals and wider-range movements by males has been suggested to explain observed global gene flow (Rizzo and Schulte 2009). However, there is little genetic support for wide-scale interchange of individuals between ocean basins or across the equator.

North Pacific. Based on genetic and photo-identification studies, the NMFS currently recognizes four stocks, likely corresponding to populations, of humpback whales in the North Pacific Ocean: two in the eastern North Pacific, one in the central North Pacific, and one in the western Pacific (Hill and DeMaster 1998). Gene flow

between them may exist. 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 (Johnson and Wolman 1984; Nemoto 1957; Tomilin 1967). These whales migrate to Hawaii, southern Japan, the Mariana Islands, and Mexico during winter. However, more northerly penetrations in Arctic waters occur on occasion (Hashagen et al. 2009). The central North Pacific population winters in the waters around Hawaii while the eastern North Pacific population (also called the California-Oregon-Washington-Mexico stock) winters along Central America and Mexico. However, Calambokidis et al. (1997) identified individuals from several populations wintering (and potentially breeding) in the areas of other populations, highlighting the potential fluidity of population structure. Herman (1979) presented extensive evidence that humpback whales associated with the main Hawaiian Islands immigrated there only in the past 200 years. Winn and Reichley (1985) identified genetic exchange between the humpback whales that winter off Hawaii and Mexico (with further mixing on feeding areas in Alaska) and suggested that humpback whales that winter in Hawaii may have emigrated from Mexican wintering areas. A “population” of humpback whales winters in the South China Sea east through the Philippines, Ryukyu Retto, Ogasawara Gunto, Mariana Islands, and Marshall Islands, with occurrence in the Mariana Islands, Guam, Rota, and Saipan from January-March (Darling and Mori 1993; Eldredge 1991; Eldredge 2003; Rice 1998). During summer, whales from this population migrate to the Kuril Islands, Bering Sea, Aleutian Islands, Kodiak, Southeast Alaska, and British Columbia to feed (Angliss and Outlaw 2007; Calambokidis 1997; Calambokidis et al. 2001).

Southern Hemisphere. Eight proposed stocks, or populations, of humpback whales occur in waters off Antarctica (Figure 1). Individuals from these stocks winter and breed in separate areas and are known to return to the same areas. However, the degree (if any) of gene flow (i.e., adult individuals wintering in different breeding locations) is uncertain. Based upon recent satellite telemetry, a revision of stocks A and G may be warranted to reflect stock movements within and between feeding areas separated east of 50° W (Dalla Rosa et al. 2008). 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). Areas of the Mozambique Channel appear to be significant calving and wintering areas for humpback whales (Kiszka et al. 2010). In addition to being a breeding area, the west coast of South Africa also appears to serve as a foraging ground due to upwelling of the Benguela Current (Barendse et al. 2010). Females appear in this area in large numbers well before their male counterparts, frequently accompanied by calves (Barendse et al. 2010).

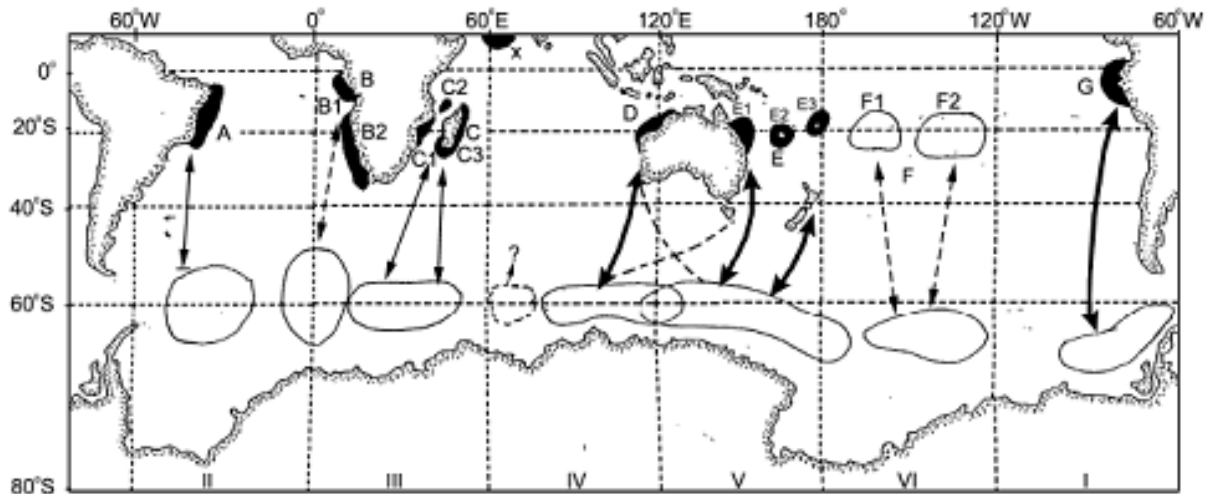


Figure 1. Southern Hemisphere humpback stocks (populations) (IWC 2005).

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 (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; Glockner-Ferrari and Ferrari 1985 as cited in NMFS 2005b; Weinrich et al. 1993). Larger females tend to produce larger calves that may have a greater chance of survival (Pack et al. 2009). In some Atlantic areas, females tend to prefer shallow nearshore waters for calving and rearing, even when these areas are extensively trafficked by humans (Picanco et al. 2009).

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). Males “court” females in escort groups and compete for proximity and presumably access to reproduce females (particularly larger females) (Pack et al. 2009). Although long-term relationships do not appear to exist between males and females, mature females do pair with other females; those individuals with the longest standing relationships also have the highest reproductive output, possibly as a result of improved feeding cooperation (Ramp et al. 2010).

Diving. In Hawaiian waters, humpback whales remain almost exclusively within the 1,800 m isobath and usually within water depths of less than 182 m. Maximum diving depths are approximately 170 m (but usually <60 m), with a very deep dive (240 m) recorded off Bermuda (Hamilton et al. 1997). Dives can last for up to 21 min, although feeding dives ranged from 2.1-5.1 min in the North Atlantic (Dolphin 1987). In southeast Alaska, average dive times were 2.8 min for feeding whales, 3.0 min for non-feeding whales, and 4.3 min for resting whales (Dolphin 1987). In the Gulf of California, humpback whale dive durations averaged 3.5 min (Strong 1990). Because most humpback prey is likely found within 300 m of the surface, most humpback dives are

probably relatively shallow. In Alaska, capelin are the primary prey of humpback and are found primarily between 92 and 120 m; depths to which humpbacks apparently dive for foraging (Witteveen et al. 2008).

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 (Hain et al. 1982; Hain et al. 1995; Jurasz and Jurasz 1979; Weinrich et al. 1992a). 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 (Clapham 1994; Clapham 1996; Tyack 1981). Humpback whales are generally believed to fast while migrating and on breeding grounds, but some individuals apparently feed while in low-latitude waters normally believed to be used exclusively for reproduction and calf-rearing (Danilewicz et al. 2009; Pinto De Sa Alves et al. 2009). Some individuals, such as juveniles, may not undertake migrations at all (Findlay and Best. 1995). Additional evidence, such as songs sung in northern latitudes during winter, provide additional support to plastic seasonal distribution (Smith and G.Pike 2009). Relatively high rates of resighting in foraging sites in Greenland suggest whales return to the same areas year after year (Kragh Boye et al. 2010).

Vocalization and hearing. Humpback whale vocalization is much better understood than is hearing. Different sounds are produced that correspond to different functions: feeding, breeding, and other social calls (Dunlop et al. 2008). Males sing complex sounds while in low-latitude breeding areas in a frequency range of 20 Hz to 4 kHz with estimated source levels from 144-174 dB (Au 2000; Au et al. 2006; Frazer and Mercado 2000; Payne 1970; Richardson et al. 1995; Winn et al. 1970). Males also produce sounds associated with aggression, which are generally characterized as frequencies between 50 Hz to 10 kHz and having most energy below 3 kHz (Silber 1986; Tyack 1983). Such sounds can be heard up to 9 km away (Tyack and Whitehead 1983). Other social sounds from 50 Hz to 10 kHz (most energy below 3 kHz) are also produced in breeding areas (Richardson et al. 1995; Tyack and Whitehead 1983). While in northern feeding areas, both sexes vocalize in grunts (25 Hz to 1.9 kHz), pulses (25-89 Hz), and songs (ranging from 30 Hz to 8 kHz but dominant frequencies of 120 Hz to 4 kHz) which can be very loud (175-192 dB re 1 μ Pa at 1 m; (Au 2000; Erbe 2002a; Payne and Payne 1985; Richardson et al. 1995; Thompson et al. 1986). However, humpbacks tend to be less vocal in northern feeding areas than in southern breeding areas (Richardson et al. 1995).

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. Table 2 provides estimates of historic and current abundance for ocean regions.

Table 2. Summary of past and present humpback whale abundance.

Region	Population, stock, or study area	Pre-exploitation estimate	95% C.I.	Current estimate	95% C.I.	Source
Global	--	1,000,000	--	--	--	(Roman and Palumbi 2003)
North Atlantic	Basinwide	240,000	156,000-401,000*	11,570	10,005-13,135*	(Roman and Palumbi 2003) (Stevick et al. 2001) <i>in</i> (Waring et al. 2004)
	Basinwide - Females	--	--	2,804	1,776-4,463	(Palsbøll et al. 1997)
	Basinwide - Males	--	--	4,894	3,374-7,123	(Palsbøll et al. 1997)
	Western North Atlantic from Davis Strait, Iceland to the West Indies	>4,685*	--	--	--	*circa 1865; (Mitchell and Reeves 1983)
	NMFS - Gulf of Maine stock	--	--	845	CV=0.55	(NMFS 2008b)
	NMFS - Gulf of Maine stock, including a portion of Scotian Shelf	--	--	902	177-1,627*	(Clapham et al. 2003)
	Northeast Atlantic - Barents and Norwegian Seas	--	--	889	331-1,447*	(Øien 2001) <i>in</i> (Waring et al. 2004)
North Pacific	Basinwide	15,000	--	6,000-8,000	--	(Calambokidis et al. 1997)
	NMFS - Western North Pacific stock	--	--	394	329-459*	(Angliss and Allen 2007)
	NMFS - Central North Pacific stock	--	--	4,005	3,259-4,751*	(Angliss and Allen 2007)
	NMFS - Eastern North Pacific stock	--	--	1,391	1,331-1,451*	(Carretta et al. 2008)
Indian Ocean	Arabian Sea	--	--	56	35-255	Minton et al. (Minton et al. 2003) <i>in</i> (Bannister 2005)
Southern Hemisphere	Basinwide	100,000	--	19,851	--	(Gambell 1976; IWC 1996)
	South of 60°S	--	--	4,660	2,897-6,423	(IWC 1996)

*Note: Confidence Intervals (C.I.) not provided by the authors were calculated from Coefficients of Variation (C.V.) where available, using the computation from Gotelli and Ellison (2004).

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). Historical estimates have ranged from 40,000-250,000 (Smith and G.Pike 2009). Estimates of animals on Caribbean breeding grounds exceed 2,000 individuals (Balcomb III and Nichols 1982). Several researchers report an increasing trend in abundance for the North Atlantic population, which is supported by increased sightings within the Gulf of Maine feeding aggregation (Barlow 1997; Katona and Beard 1990; Smith et al. 1999; Waring et al. 2001). The rate of increase varies from 3.2-9.4%, with rates of increase slowing over the past two decades (Barlow 1997; Katona and Beard 1990; 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). Pike et al. (2009) suggested that the eastern and northeastern waters off Iceland are areas of significant humpback utilization for feeding, estimating nearly 5,000 whales in 2001 and proposing an annual growth rate of 12% for the area. The authors suggest that humpback whales in the area had probably recovered from whaling.

North Pacific. The pre-exploitation population size may have been as many as 15,000 humpback whales, and current estimates are 6,000-8,000 whales (Calambokidis et

al. 1997; Rice 1978). It is estimated that 15,000 humpback whales resided in the North Pacific in 1905 (Rice 1978). However, from 1905 to 1965, nearly 28,000 humpback whales were harvested in whaling operations, reducing the number of all North Pacific humpback whale to roughly 1,000 (Perry et al. 1999). Estimates have risen over time from 1,407-2,100 in the 1980s to 6,010 in 1997 (Baker 1985; Baker and Herman 1987; Calambokidis et al. 1997; Darling and Morowitz 1986). Because estimates vary by methodology, they are not directly comparable and it is not clear which of these estimates is more accurate or if the change from 1,407 to 6,010 is the result of a real increase or an artifact of model assumptions. 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). However, based upon surveys between 2004 and 2006, Calambokidis et al. (2008a) estimated that the number of humpback whales in the North Pacific consisted of about 18,300 whales, not counting calves (Barlow et al. (2009) provided a bias-corrected estimate of 20,800 individuals) and the population was growing at 4.9% annually. 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). However, humpback whales in this region experienced severe whaling pressure. Based upon whaling logs, particularly by Soviet vessels, at least 75,542 humpback whales were harvested from Antarctic waters from 1946 through 1973, largely from management areas IV, V, and VI (Clapham et al. 2009). One-third of these catches occurred from 1959-1961 in Area V. These numbers support Southern Hemisphere humpbacks being well below their carrying capacities (Clapham et al. 2009). Recent surveys off the Brazilian breeding grounds suggests a populations of 6,404 individuals in this area (Andriolo et al. 2010).

Natural threats. Natural sources and rates of mortality of humpback whales are not well known. Based upon prevalence of tooth marks, attacks by killer whales appear to be highest among humpback whales migrating between Mexico and California, although populations throughout the Pacific Ocean appear to be targeted to some degree (Steiger et al. 2008). 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 and lone calves have been known to be protected by presumably unrelated adults when confronted with attack (Ford and Reeves 2008). Predation on humpback whales in the action area have been noted, although events appear to be bunched, with several incidents in a given year and none in others (Neilson and Gabriele 2007).

Parasites and biotoxins from red-tide blooms are other potential causes of mortality (Perry et al. 1999). The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in humpback whales and may be preventing some populations from recovering (Lambertsen 1992). Studies of 14 humpback whales that stranded along Cape Cod between November 1987 and January 1988 indicate they apparently died from a toxin produced by dinoflagellates during this period.

Anthropogenic threats. Historically, whaling represented the greatest threat to every

population of whales and was ultimately responsible for listing several species as endangered.

Fisheries interactions are a significant problem for several marine mammal species and particularly so for humpback whales. Aside from the potential of entrapment and entanglement, there is also concern that many marine mammals that die from entanglement in commercial fishing gear tend to sink rather than strand ashore, thus making it difficult to accurately determine the frequency of such mortalities. Entanglement may also make whales more vulnerable to additional dangers, such as predation and ship strikes, by restricting agility and swimming speed.

Between 1998 and 2005, observers identified 12 humpback whales injured or killed by fisheries off the U.S. west coast (NMFS, unpublished data). An estimated 78 orquals were killed annually in the offshore southern California drift gillnet fishery during the 1980s (Heyning and Lewis. 1990). From 1996-2000, 22 humpback whales of the Central North Pacific stock were found entangled in fishing gear (Angliss and Lodge. 2004). In 1996, a vessel from the Pacific Missile Range Facility in Hawaii rescued an entangled humpback, removing two crabpot floats from the whale. A total of 595 humpback whales were reported captured in coastal fisheries in those two provinces between 1969 and 1990, of which 94 died (Lien 1994; Perkins and Beamish 1979). Along the Atlantic coast of the U.S. and the Maritime Provinces of Canada, there were 160 reports of humpback whales being entangled in fishing gear between 1999 and 2005 (Cole et al. 2005; Nelson et al. 2007). Of these, 95 entangled humpback whales were confirmed, with 11 whales sustaining injuries and nine dying of their wounds.

More humpback whales are killed in collisions with ships than any other whale species except fin whales (Jensen and Silber 2003). Of 123 humpback whales that stranded along the Atlantic coast of the U.S. between 1975 and 1996, 10 (8.1%) showed evidence of collisions with ships (Laist et al. 2001). Between 1999 and 2005, there were 18 reports of humpback whales being struck by vessels along the Atlantic coast of the U.S. and the Maritime Provinces of Canada (Cole et al. 2005; Nelson et al. 2007). Of these reports, 13 were confirmed as ship strikes and in seven cases, ship strike was determined to be the cause of death. In the Bay of Fundy, recommendations for slower vessel speeds to avoid right whale ship strike appear to be largely ignored (Vanderlaan et al. 2008). However, new rules for seasonal (June through December) slowing of vessel traffic to 10 knots and changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are expected to reduce the chance of humpback whales being hit by ships by 9%. Along the Pacific U.S. coast, a humpback whale is known to be killed about every other year by ship-strikes (Barlow et al. 1997). Two whales have been struck offshore of Japan (Jensen and Silber 2003). Along the Pacific coast, a humpback whale is known to be killed about every other year by ship strikes (Barlow et al. 1997).

Organochlorines, including PCB and DDT, have been identified from humpback whale blubber (Gauthier et al. 1997). Higher PCB levels have been observed in Atlantic waters versus Pacific waters along the United States and levels tend to increase with individual age (Elfes et al. 2010). Although humpback whales in the Gulf of Maine and off Southern California tend to have the highest PCB concentrations, overall levels are on par with other baleen whales, which are generally lower than odontocete cetaceans (Elfes et

al. 2010). As with blue whales, these contaminants are transferred to young through the placenta, leaving newborns with contaminant loads equal to that of mothers before bioaccumulating additional contaminants during life and passing the additional burden to the next generation (Metcalf et al. 2004). Contaminant levels are relatively high in humpback whales as compared to blue whales. Humpback whales feed higher on the food chain, where prey carry higher contaminant loads than the krill that blue whales feed on.

Oil spills could have a significant deleterious effect on marine mammals that are exposed to them. Exposure can occur via skin contact, ingestion of oil directly or through contaminated prey, or inspired while at the surface (Geraci 1990). This exposure could result in displacement of marine mammals from an impacted area or produce toxic effects. Perhaps the most famous shipwreck of all time occurred in the Gulf of Alaska when, in 1989, the *Exxon Valdez* released at least 11 million gallons of Alaskan crude oil into one of the largest and most productive estuaries in North America. The spill was the worst in U.S. history until the *Deepwater Horizon* event in 2010. The Alaska Department of Environmental Conservation estimated that 149 km of shoreline was heavily oiled and 459 km were at least lightly oiled. Oil spills, both small and large, occur widely along U.S. shores at refining and transfer facilities and extraction sites.

Naval activity, notably sonar use during training exercises, has gained notoriety for its coincidence with marine mammal strandings. However, other activities (also during training exercises in designated naval operating areas and training ranges) also have the potential to adversely impact marine mammals. Listed individuals travel widely in the North Pacific and could be exposed to naval activities in several ranges, including the Marianas Island Range Complex, Okinawa and Japan Range Complexes, Northwest Training Range Complex, Gulf of Alaska Operating Area, and Hawaiian Islands Operating Area.

Naval activities to which individuals could be exposed include, among others, vessel and aircraft transects, munition detonations, and sonar use. Responses by marine mammals could include no response, short-term and long-term behavioral responses and changes (altered vocal activity, changes in swimming speed and direction, respiration rates, dive times, and social interactions), temporary or permanent hearing loss, debris ingestion, ship-strike injury, and death. Death or injury is not expected to occur as a result of exposure to naval activities. Several unusual incidents of stranding or milling have occurred in association with naval activities on the Hawaii Range complex, but such incidents from other training ranges have not been documented.

Although naval vessels represent a small fraction of the total sound level and are designed to operate quietly, these ships are large and equipped with high-output sonar equipment such as ANISQS-53C tactical sonar, which produces signals at source levels of 235 dB re 1 $\mu\text{Pa}_{\text{rms}}$ at 1 m. The signals emitted from these devices have the potential to affect marine mammals in the action area; however, empirical data are limited. No stranding or mortality events have been documented in or around other operating areas or training ranges within the action area that appear linked to naval sonar, although five beaked whales were discovered stranded or floating dead coincident in time with the Alaska Shield/Northern Edge 2004 exercise between June 17-19, 2004 in the Gulf of Alaska Operating Area. However, no mid-frequency sonar or explosives were used

during this exercise and evidence linking the exercise to mortalities is circumstantial at best.

Whale watching, particularly of humpback whales, is extensive in Hawaiian waters during winter. The interactions that individuals experience in these waters likely influence how they react to approaches by vessels in the future (Herman 1979).

Critical habitat. The NMFS has not designated critical habitat for humpback whales.

Environmental Baseline

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

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

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

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

Foraging is not the only potential aspect that climate change could influence. Acevedo-Whitehouse and Duffus (2009) proposed that the rapidity of environmental changes, such as those resulting from global warming, can harm immunocompetence and reproductive parameters in wildlife to the detriment of population viability and persistence. Altered ranges can also result in the spread of novel diseases to new areas via shifts in host ranges (Simmonds and Elliott. 2009). It has been suggested that increases in harmful algal blooms could be a result of increases in sea surface temperature (Simmonds and Elliott. 2009).

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

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

Habitat degradation

A number of factors may directly or indirectly affecting listed species in the action area by degrading habitat; perhaps most significant among them is anthropogenic noise in the ocean. Natural sources of ambient noise include: wind, waves, surf noise, precipitation, thunder, and biological noise from marine mammals, fishes, and crustaceans.

Anthropogenic sources of ambient noise include: transportation and shipping traffic, dredging, construction activities, geophysical surveys, and sonars. In general, it has been asserted that ocean background noise levels have doubled every decade for the last six decades in some areas, primarily due to shipping traffic (IWC 2004). The acoustic noise that commercial traffic contributes to the marine environment is a concern for listed species because it may impair communication between individuals (Hatch et al. 2008). Shipping and seismic noise generally dominates ambient noise at frequencies from 20 to 300 Hz (Andrew et al. 2002; Hildebrand 2009; Richardson et al. 1995). Background noise has increased significantly in the past 50 years as a result of increasing vessel traffic, and particularly shipping, with increases of as much as 12 dB in low frequency ranges and 20 dB versus preindustrial periods (Hildebrand 2009; Jasny et al. 2005; McDonald et al. 2006; NRC 1994; NRC 2003; NRC 2005; Richardson et al. 1995). Over the past 50 years, the number of commercial vessels has tripled, carrying an estimated six times as much cargo (requiring larger, more powerful vessels) (Hildebrand 2009). Seismic signals also contribute significantly to the low frequency ambient sound field (Hildebrand 2009). Baleen whales may be more sensitive to sound at those low frequencies than are toothed whales. Dunlop et al. (2010b) found that humpback whales shifted from using vocal communication (which carries relatively large amounts of information) to surface-active communication (splashes; carry relatively little information) when low frequency background noise increased due to increased sea state. Sonars and small vessels also contribute significantly to mid-frequency ranges (Hildebrand 2009).

Commercial shipping in the Gulf of Alaska is dominated by cargo transports, container freight, crude oil tankers, and barges. Military vessels, ferries, and other commercial and recreational fishing vessels also converge in the Gulf of Alaska. Two primary shipping lanes radiate from the Gulf of Alaska to Honolulu and San Francisco. Important Alaskan ports include Kodiak, Alaska's largest commercial fishing port, and Valdez, the southern terminus of the 1,300 km trans-Alaska pipeline. Additional minor ports are located throughout the region and include: Anchorage, Cordova, Homer, Kodiak, Nikiski, Seward, Whittier, and Yakutat.

Entrapment/entanglement in fishing gear

Several humpback whales within the action area are reported to be entangled by fishing gear each year, sometimes requiring intervention by disentanglement teams (Neilson and

Gabriele 2007; Neilson and Gabriele 2008; Neilson and Gabriele 2009; Neilson and Gabriele 2010). Direct observations of mortality, debilitation, or poor body condition are not common, however.

Vessel approaches – commercial and private marine mammal watching

Although considered by many to be a non-consumptive use of marine mammals with economic, recreational, educational and scientific benefits, marine mammal watching is not without potential negative impacts. Whale watching has the potential to harass whales by altering feeding, breeding, and social behavior or even injure them if the vessel gets too close or strikes the whale. Another concern is that preferred habitats may be abandoned if disturbance levels are too high. In the Notice of Availability of Revised Whale Watch Guidelines for Vessel Operations in the Northeastern United States (64 FR 29270; June 1, 1999), NMFS noted that whale watch vessel operators seek out areas where whales concentrate, which has led to numbers of vessels congregating around groups of whales, increasing the potential for harassment, injury, or even the death of these animals. In addition to whale watching vessels, large cruise vessels also operate in waters off the coast of Alaska, and may pose a threat to humpback whales.

Several studies have specifically examined the effects of whale watching on marine mammals, and investigators have observed a variety of short-term responses from animals, ranging from no apparent response to changes in vocalizations, duration of time spent at the surface, swimming speed, swimming angle or direction, respiration rate, dive time, feeding behavior, and social behavior (NMFS 2006). Responses appear to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity (Au and Green. 2000; Corkeron 1995; Erbe 2002b; Magalhaes et al. 2002; Richter et al. 2003; Scheidat et al. 2004; Watkins 1986; Williams et al. 2002a; Williams et al. 2002b). Disturbance by whale watch vessels has been noted to cause newborn calves to separate briefly from their mothers' sides, which leads to greater energy expenditures by the calves (NMFS 2006). Although numerous short-term behavioral responses to whale watching vessels are documented, little information is available on whether long-term negative effects result from whale watching (NMFS 2006).

Ship-strike

Shipstrikes are reported nearly every year and frequently several times per year in the action area and surrounding region (Neilson and Gabriele 2006; Neilson and Gabriele 2007; Neilson and Gabriele 2008; Neilson and Gabriele 2009; Neilson and Gabriele 2010). These include some instances of mortality.

Scientific research and permits

Scientific research permits issued by the NMFS currently authorize studies of listed species in the North Pacific Ocean. Authorized research on ESA-listed whales includes close vessel and aerial approaches, biopsy sampling, tagging, ultrasound, and exposure to acoustic activities. Research activities involve non-lethal “takes” of these whales by harassment, with none resulting in mortality. Table 3 describes the cumulative number of takes for each listed species in the action area authorized in scientific research permits.

Table 3. Humpback whale takes in the North Pacific.

Year	Approach	Biopsy	Suction cup tagging	Implantable tagging	Acoustic playback	Exhalation sampling	Ultrasound
2009	44,399*	4,650	392	77	280	10	5
2010	67,371	6,060	1,447	237	970	10	5
2011	41,355	1,975	1,428	195	690	10	5
2012	26,746	1,800	1,095	170	690	0	0
2013	19,712	1,460	1,075	150	390	0	0
Total	199,583	15,945	5,437	829	3,020	30	15

Permit numbers: 0642-1536, 0662-1661, 1049-1718, 1071-1770, 1120-1898, 473-1700, 532-1822, 545-1761, 587-1767, 716-1705, 731-1774, 753-1599, 774-1714, 781-1824, 782-1719, 945-1776, and 965-1821.

Effects of the Proposed Action

Pursuant to section 7(a)(2) of the ESA, federal agencies must ensure, through consultation with the NMFS, that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The proposed issuance of permit 15844 would authorize “takes” by harassment of humpback whales during the proposed research by the NPS by directed approach and biopsy. In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed actions, the probability of individuals of listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. As described in the *Approach to the Assessment* section, for any responses that would be expected to reduce an individual’s fitness (i.e., growth, survival, annual reproductive success, or lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the listed species those populations represent. The purpose of this assessment and, ultimately, of this Opinion is to determine if it is reasonable to expect the proposed action to have effects on listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.

For this consultation, we are particularly concerned about behavioral and physiological disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level consequences. The ESA does not define harassment nor has the NMFS defined the term pursuant to the ESA through regulation. 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)]. The latter portion of this definition (that is, "...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering") is almost identical to the U.S. Fish and Wildlife Service's regulatory definition of "harass"³ pursuant to the ESA. 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.

Individuals may respond to stressors in a variety of ways, some of which have more significant fitness consequences than others. For example, evasion of an approaching vessel would be more significant than slow travel away from the same stressor due to increased metabolic demands, stress responses, and potential for habitat abandonment that this response could or would entail. As described in the *Approach to the assessment*, the universe of likely responses is considered in evaluating the fitness consequences to the individual and (if appropriate), the affected population and species as a whole to determine the likelihood of jeopardy.

Potential stressors

The assessment for this consultation identified several possible stressors associated with the proposed research activities, including

1. surface vessel transit during proposed activities
2. close approaches to listed whales by research vessels
3. collection of blubber biopsy samples
4. operation of an echosounder
5. entanglement in prey sampling gear

Based on a review of available information, this Opinion determined which of these possible stressors would be likely to occur and which would be discountable or insignificant.

We do not expect that vessel transits pose a significant risk of ship strike to humpback whales under the proposed actions. Operators and observers will search for marine mammals while underway. We feel confident in the ability of operators to locate, identify, and avoid direct contact with individuals. While in close proximity to marine mammals, operators would be moving slowly and deliberately near to, but not physically contact, target humpbacks. We therefore discount the potential for ship strike in association with the proposed actions to target species.

The risk of echosounders interfering with hearing or sound production by humpback whales is insignificant. The echosounder proposed for use has a frequency range that is

³ An intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3)

well above the expected hearing range of humpback whales.

It is possible that humpback whales could become entangled in prey sampling gear towed from the research vessel, such as pelagic-fish trawl, Isaacs-Kidd mid-water trawl, modified herring trawl, Tucker trawl, bongo net, or rod-and-reel equipment. The applicant's reports provide evidence that entanglement in fishing gear is a continual problem in the action area, but have not experienced an entangling event associated with their research activities (Doherty and Gabriele 2003; Doherty and Gabriele 2004; Neilson and Gabriele 2005; Neilson and Gabriele 2006; Neilson and Gabriele 2007; Neilson and Gabriele 2008; Neilson and Gabriele 2009; Neilson and Gabriele 2010). The applicants state that they will not deploy these gear types when within 100 m of humpback whales. As the applicants have been deploying prey and oceanographic sampling gear for several years with hundreds of deployments per year without incident, we do not expect entanglement to occur under the proposed permit. Thus, we discount the possibility of entanglement to humpback whales.

Accordingly, this consultation focused on the following stressors likely to occur from the proposed activities and may adversely affect humpback whales: close approaches by research vessels and collection of blubber biopsy samples.

Exposure analysis

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

Our exposure analysis began with identifying the stressors that listed resources are likely to be exposed to, which we did in the preceding section. We continue by identifying the amount or extent of exposure that we believe is reasonably likely to occur. The Permit's Division provided estimated take numbers (Table 4) in their initiation package, representing the amount of exposure it believes will occur. However, these estimates represent a maximum possible level of exposure and the level of exposure that is reasonably likely to occur. We therefore adopted an alternative methodology that relied upon past performance to assess likely exposure. We performed a binomial distribution on the likely exposure calculated to identify the expected range of exposures per individual as well as the most probable number of exposures, based on the number of individuals believed to be available for exposure.

The proposed action is to permit close approach, behavioral observations, and biopsy of humpback whales. These actions and the number of "takes" proposed to be authorized by the Permits Division are outlined in Table 4.

Table 4. Number of individuals proposed to be taken by species, life stage, and action under Permit 15844.

Species-population	Life stage	Number of individuals taken annually	Action
Humpback whale (<i>Megaptera novaeangliae</i>)- North Pacific	All	6,300	Close approach-vessel, behavioral observation, photoidentification, passive acoustic recording
	Juvenile/adult	50	Close approach-vessel, behavioral observation, photoidentification, passive acoustic recording, biopsy attempt (up to 30 successful samples)

Although these activities are proposed to occur, we expect the level of all actions except biopsy to be much less than the levels of “take” requested above (Table 4). This is based upon annual monitoring reports of the applicant’s activities from 1993-present that include activities similar or identical to those proposed. Expected exposure levels for each species and activity were determined by calculating means and standard deviations for close approach to humpback whales. Four standard deviations were added to the mean to encompass a reasonably likely maximum exposure to similar activities for each species in the future. In addition, we assume 6.8% annual growth of the number of individuals available for exposure (Calambokidis et al. 2008b). Expected exposure numbers were rounded to the next highest multiple of 50 to reflect analytical uncertainty. We accept that 50 biopsy attempts on humpback whales are reasonably likely to occur in a given year, but expect that no more than 1,650 close approaches (and the activities associated with this action, excluding biopsy) are reasonably likely to occur in a given year.

Under the proposed permit, an individual of any age class or sex would be allowed to be approached by vessel up to three times daily, with no limit on the annual number of exposures; neither the applicant nor the Permit’s Division specifies the number of re-exposures that are likely to occur. Unfortunately, researchers cannot identify an individual until after it has been approached and photo-identified. A binomial analysis indicates that an individual may be approached up to 12 times annually (up to 34 times over the life of the permit; minimum 5 times), but would most likely be approached three times per year and 18 times over the life of the permit. Based upon field methods used to identify individuals in the field prior to biopsy sampling, we do not expect any individual to be inadvertently re-biopsied under the proposed permit. The permit would be conditioned to minimize harassment from biopsy activities to no more than three times per day and calves under one year of age would not be sampled. Biopsy attempts must be discontinued if repetitive strong reactions are found.

Response analysis

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

There is mounting evidence that wild animals respond to human disturbance in the same way that they respond to predators (Beale and Monaghan 2004; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). These responses manifest themselves as stress responses (in which an animal perceives human activity as a potential threat and undergoes physiological changes to prepare for a flight or fight response or more serious physiological changes with chronic exposure to stressors), interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). These responses have been associated with abandonment of sites (Sutherland and Crockford 1993), reduced reproductive success (Giese 1996; Mullner et al. 2004), and the death of individual animals (Bearzi 2000; Daan 1996; Feare 1976). Stress is an adaptive response and does not normally place an animal at risk. However, distress involves a stress response resulting in a biological consequence to the individual. The mammalian stress response involves the hypothalamic-pituitary-adrenal (HPA) axis being stimulated by a stressor, causing a cascade of physiological responses, such as the release of the stress hormones adrenaline (epinephrine), glucocorticosteroids, and others (Busch and Hayward 2009)(Gulland et al. 1999; Morton et al. 1995; St. Aubin and Geraci 1988; St. Aubin et al. 1996; Thomson and Geraci 1986). These hormones subsequently can cause short-term weight loss, the liberation of glucose into the blood stream, impairment of the immune and nervous systems, elevated heart rate, body temperature, blood pressure, and alertness, and other responses (Busch and Hayward 2009; NMFS 2006g)(Cattet et al. 2003; Delehanty and Boonstra 2009; Elftman et al. 2007; Fonfara et al. 2007; Kaufman and Kaufman 1994; Mancina et al. 2008; Moe and Bakken 1997; Noda et al. 2007; Thomson and Geraci 1986)(Dierauf and Gulland 2001; Omsjoe et al. 2009b). In some species, stress can also increase an individual's susceptibility to gastrointestinal parasitism (Greer et al. 2008). In highly-stressful circumstances, or in species prone to strong "fight-or-flight" responses, more extreme consequences can result, including muscle damage and death (Cowan and Curry 1998; Cowan and Curry 2002; Cowan and Curry 2008; Herraiez et al. 2007). The most widely-recognized indicator of vertebrate stress, cortisol, normally takes hours to days to return to baseline levels following a significantly stressful event, but other hormones of the HPA axis may persist for weeks (Dierauf and Gulland 2001). Mammalian stress levels can vary by age, sex, season, and health status (Gardiner and Hall 1997; Hunt et al. 2006; Keay et al. 2006; Kenagy and Place 2000; Nunes et al. 2006; Romero et al. 2008; St. Aubin et al. 1996). Smaller mammals tend to react more strongly to stress than larger mammals (Peters 1983); a trend reflected in data from Gauthier and Sears (1999) where smaller whale species tended to

react more frequently to biopsy than larger whales. Stress is lower in immature right whales than adults and mammals with poor diets or undergoing dietary change tend to have higher fecal cortisol levels (Hunt et al. 2006; Keay et al. 2006; Kitaysky and Springer 2004).

Close approaches-surface vessel

Vessel approaches have the potential to induce behavioral and possibly physiological changes in individuals being targeted. The degree to which individuals are disturbed is highly variable. Whales may respond differently depending upon what behavior the individual or pod is engaged in before the vessel approaches (Hooker et al. 2001; Wursig et al. 1998), the degree to which they have become accustomed to vessel traffic (Richter et al. 2006), and between species or individuals (Gauthier and Sears 1999). Overall, reactions include little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation, diving and time spent submerged, foraging, respiratory patterns, and may include aerial displays like breaching and lobtailing (Baker and Herman. 1989; Best et al. 2005; Brown et al. 1991; Clapham and Mattila 1993; Jahoda et al. 2003). Only Jahoda et al. (2003) found effects of more than a few minutes, with fin whales failing to return to baseline behaviors after one hour of observation in some cases, in spite of the fact that Gauthier and Sears (1999) found fin whales to be less responsive than humpbacks.

Humpback whales have been the best-studied whale species in regards to responses to close approaches by vessels. Numerous studies have documented varied responses of humpback whales to vessel approaches, ranging from no response to evasion (Goodyear 1993a; Salden 1993). Felix et al. (2001) found that 27 of 86 individuals approached resulted in avoidance of the vessel (50 were indifferent and 9 approached vessels), including long dive, change in heading, tail splashes, altered swimming speed or breathing frequency, and group structure disruption. Approaching vessels may instigate aerial behavior, such as fluke slapping and breaching, behavior recently suggested to be a switch in communication from vocal to surface active signaling (Baker et al. 1983a; Baker et al. 1983c; Baker et al. 1982; Dunlop et al. 2009; Holt et al. 2009). Hall (1982) did not find social or feeding behavior to be disturbed by vessel traffic or close approaches. However, there is the possibility that humpback whales may habituate to vessel noise if given sufficient time and exposure (Clapham and Mattila 1993; Watkins 1986). Goodyear (1993a) did not observe changes in behavior due to vessel approaches in most cases, although an increase in speed did occur on one occasion when a whale was approached within 10 m. Cantor et al. (2010) generally found resting or socializing whales to switch to traveling upon approach of their research vessels. Watkins et al. (1981) found that humpback whales appeared to react to vessel approach by increasing swim speed, exhibiting a startle reaction, and moving away from the vessel with strong fluke motions. Baker and Herman (1989), Baker et al. (1982) and (1983a; 1983c), Bauer (1986), Bauer and Herman (1986), and Green and Green (1990) found that humpbacks spent less time at the surface and altered their direction of travel in response to approaching vessels. Increased time underwater and decreased swim speed persisted for up to 20 minutes after vessels left the area. Watkins and Goebel (1984) found humpbacks to be very difficult to approach, possibly due to physical ocean features in the area that likely altered sound properties such that vessel noise was difficult to detect

except at close range, resulting in whales suddenly becoming aware of boats in close proximity and reacting strongly in consequence. Norris (1994) documented changes in humpback song structure in response to passing vessels, with unit and phrase durations reduced versus control periods.

Bauer and Herman (1986) studied the potential consequences of vessel disturbance on humpback whales wintering off Hawaii. They as well as Scheidat et al. (2004) and Hemphill et al. (2006) noted changes in respiration, diving, swimming speed (50-300%) and direction, social exchanges, and other behavioral changes correlated with the number, speed, direction, and proximity of vessels. Agonistic behavior has also been noted (Bauer and Herman 1986). Results of vessel approach were different depending on individual sex and age class (smaller groups and groups with calves appeared more responsive), but humpback whales generally tried to avoid vessels beginning at 500 to 1,000 m away. Similar results were found in Alaskan waters, with increased dive durations and orientation away from the path of moving boats, often at ranges up to 3-4 km (Baker et al. 1983b; Baker and Herman. 1989). Approaches in Alaskan waters closer than 100 m initiated evasive behavior (Hall 1982); Watkins (1986) found little response to approaches outside of 100 m away, although humpbacks regularly reacted to outboard vessels on a collision course even from long distance.

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

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

aware of the vessel's presence. Single or paired individuals may respond more than larger groups (Bauer and Herman 1986). Würsig et al. (1998) found milling or resting cetaceans to be more sensitive.

Repeated exposure can have a cumulative effect that is greater than the sum of individual exposures, eliciting responses that are more significant for individuals and populations, although Cantor et al. (2010) did not find a difference in response based upon re-exposure. However, humpback whales have vacated areas where relatively high boat traffic and human activity occurs (Herman 1979). Major declines and distributional shifts in Glacier Bay, Alaska were correlated with a rapid and significant increase in vessel traffic from 1976 to 1978, whereas humpback whales in other nearby areas with less traffic did not undergo such changes (Bauer and Herman 1986). It should be noted that potentially reduced prey resources may also have been important in this redistribution (Bauer and Herman 1986). Matkin and Matkin (1981) did not find a correlation between humpback whale behavior and recreational vessels.

Several studies have suggested that stress can adversely impact female reproduction through alterations in the estrus cycle (Herrenkohl and Politch 1979; Moberg 1991; Mourlon et al. 2011; Rivier 1991). Komesaroff et al. (1998) found that estrus may inhibit the stress response to some extent, although several studies suggest estrus and particularly the follicular stage may be susceptible to stress-induced disruption (see (Rivier 1991) and (Moberg 1991) for reviews). Most of these studies were conducted with single or multiple highly invasive and frequent stress methodologies or chronic stress; we do not expect stressors associated with the proposed research to be nearly as stressful. Under less invasive and acutely stressful methods (but more invasive than those proposed by the applicant), Omsjoe et al. (2009a) found no impacts to the percentage of individuals with offspring the following year following chase, capture, and restraint of reindeer (ungulates in general tend to be prone to strong, potentially lethal stress responses). Overall, we do not expect reproduction to be impaired primarily due to the lack of extreme stressors utilized by studies to induce adverse reproductive impacts and the acute nature of the stressors involved.

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

would be conducted at low speed with a minimum of throttling and directional changes. Low vessel speed means that less cavitation will occur, which is the primary source of sound energy emitted by motorized vessels (Mazucca et al. 2001; Ross 1976). Lower speed and fewer directional changes will also result in fewer changes in sound characteristics, which are believed to add to the significance of vessel noise and its impact to cetaceans. Most interactions with target individuals should be brief before the vessel breaks contact following photoidentification, acoustic recording, tagging, exhalation sampling, and/or behavioral documentation.

These data are useful in forming a general understanding of the types and rates of response that humpback whales may undergo to the proposed activities, as well as the conditions where response would be more or less likely. However, the applicant has documented responses by humpback whales to their past activities, providing the best available data on the type, frequency, and intensity of responses by the target species. Based upon data from 2006-2010, responses such as startle, fast dive, and other low-level, ephemeral behavioral responses are what can be expected. Based upon the mean-standard deviation approach described under the *Exposure analysis* section, we expect that up to 55 humpback whales are reasonably likely to respond in these ways to the proposed close approach activities (rounding to the next highest interval of five and not including responses to biopsy sampling). It is plausible that an individual could respond multiple times during a given year to close approach activities.

Biopsy

Biopsy sampling not only has the potential to disrupt behavior, but also breach an individual's integument. Because of this, physiological or pathological responses as well as behavioral ones are possible. We know of only one published report of a cetacean death following biopsy sampling, when the dart penetrated the muscle mass of a female common dolphin (*Delphinus delphis*), which may have resulted in vertebral trauma and severe shock (Bearzi 2000). The individual had relatively thin blubber, permitting deeper penetration than was desired and sticking of the dart. Apart from the one mortality, there is not even evidence of infection at the point of penetration or elsewhere among the many whales sighted in the days following biopsy sampling (Weller 2008). The risk of infection is thought to be minimized by sterilizing dart tips before sampling occurs. In general, healing is rapid (roughly one week, scarring thereafter; Noren and Mocklin 2011).

Many researchers claim that biopsy darts or sampling does not result in significant short-term or long-term behavioral disturbance to humpback whales. An IWC working group reviewed biopsy sampling and concluded long-term effects are unlikely, although short-term responses frequently occur (IWC 1991). Clapham and Mattila (1993) found 44% of humpback whales sampled showed no immediate response, while 22.5% reacted in subtle or minor ways. Cerchio (2003) found similar results in 350 biopsy events. Cantor et al. (2010) found that 46% of 542 biopsy attempts on adult or subadult humpback whales from 10-25 m away resulted in a behavioral response (most commonly fluke movement). Neither the use of a tether, the duration of vessel contact with the target individual, nor region of the body hit influenced the likelihood of response, although responses were more frequent and intense from smaller vessels (likely due to their additional noise) than from larger vessels. Weinrich et al. (1991) reached the same conclusions for humpback

whales, although short-term disruption of foraging could occur as well as agonistic behavior and altered dive parameters. Gauthier and Sears (1999) found humpback whales to accelerate, change direction, dive, lobtail, exhale forcefully, submerge, and display tail and flipper movements (the most common response); “moderate” responses were the most common category of response. Weinrich et al. (1992b) also found that of 71 humpback whales biopsied, 7% had no response, 27% exhibited a “low” response, 61% had a “moderate” response, and 6% had a “strong” response. Brown et al. (1994) found 41% of 203 humpbacks biopsied to respond in some way, including fluke movements, tail slaps, and disrupted dives. Humpbacks rarely display tail flicks, but frequently do so in response to biopsy (Weinrich et al. 1992b). Repeated sampling was not found to influence the likelihood of subsequent biopsy responses (Brown et al. 1994).

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

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

The applicant has not been authorized to conduct biopsy sampling of humpback whales under prior permits; we have no prior data from the applicant to determine the frequency, intensity, or types of responses likely to occur. Therefore, we relied upon available literature and expert opinion to determine the number and types of responses under the proposed activities. Humpback whale responses have been documented extensively. Of the available studies, Cantor et al. (2010) and Brown et al. (1994) provide the largest sample sizes and report similar response rates; we use these studies to determine

humpback response rate and the entirety of the literature to inform the expected type of response. Overall, we expect 23 humpback whales are likely to respond behaviorally to biopsy activities as described above (mild- to moderate-behavioral responses). As previously mentioned, individuals re-exposed to proposed activities could also undergo additional responses.

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

Cumulative effects

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area. 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.

The NMFS expects whale watching operations, vessel traffic, climate change, and research activities to continue within the range of the species for the foreseeable future. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on whale populations.

Whale watching has the potential to significantly expand, generating an additional 413 million dollars globally and generating an additional 5,700 jobs (Cisneros-Montemayor et al. 2010). After reviewing available information, NMFS is not aware of effects from any additional future non-federal activities in the action area that would not require federal authorization or funding and are reasonably certain to occur during the foreseeable future.

Integration and synthesis of effects

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

The Permits Division proposes to issue a permit to Susan Boudreau of the NPS for directed take of humpback whales, which are endangered throughout their range. The *Status of listed resources* section identified commercial whaling as the primary reason the population size is a fraction of its former abundance. Other threats to the survival and recovery of humpback whales include ship strike, entanglement in fishing gear, as well as

toxic chemical burden and biotoxins. Humpback whales are expected to face area-specific threats identified in the *Environmental baseline*, including habitat degradation, whale watching, research activities, naval activities, climate change, human noise sources, ship strike, and entanglement. Actions that are reasonably likely to occur were described in the *Cumulative effects* section.

The *Exposure analysis* describes the actions proposed to be undertaken to humpback whales: close approaches by research vessel of any age/sex and/or biopsy. Up to 1,700 exposures to close approach activities are reasonably likely to occur, with multiple exposures per individual. Up to 50 exposures to biopsy activities are also likely to occur, but no repeated sampling is expected.

The *Response analysis* considered that stressors to which targeted individuals would be exposed will likely cause behavioral, physiological, and displacement responses. Aerial surveys are expected to cause no response from any individual. Vessel approaches frequently result in behavioral changes in listed whales, with most approaches resulting in no response or apparently “minor” to “moderate” responses (including, but not limited to head lifts and lunges, back arching, rolling, and fluke beats). Although individual responses are expected to be ephemeral without a fitness consequence, there is compelling evidence that cumulative vessel approaches (Bauer and Herman 1986; Herman 1979) or additive effects of vessel approach and other anthropogenic stressors (Fraker et al. 1982) can have more significant effects, including the displacement of humpback whales from Alaskan foraging areas and gray whales from summer lagoon habitat (Bauer and Herman 1986; Reeves 1977). The presence of additional anthropogenic stressors, such as commercial vessel and cruise ship traffic should induce additional disturbance on potential target individuals (Fraker et al. 1982; NMFS 2008a). This combinations could lead to individuals being displaced from preferable habitat.

To assess this possibility, we relied upon monitoring data from the NPS’ humpback whale monitoring program in the action area, which is specifically designed to address concerns of vessel impacts to humpback whales in the action area, and dates back to 1982. If cumulative impacts of the proposed activities as well as other baseline stressors may be negatively impacting humpback whales in the region, several possible signs of impact could include demographic changes, such as shifts in preferred habitat, reduction in numbers of individuals in the area, lack of annual returns, increased incidence of poor body condition over time, and/or sensitivity of individuals to approaches. Annual reports, particularly for the past decade, generally refute these issues. Recent reports indicate that "popular" aggregation sites appear stable and individuals continue to return year-to-year (including mothers with calves). The incidence of calves is currently at a record high, indicating good body condition by females using the action area for foraging. Residency (extended use of the action area) appears high (i.e., those individuals that choose to occupy the action area also tend to stay for extended periods). The number of individuals using the action area each year that have been photo-identified has been increasing to record numbers each year for several years, indicating more individuals are using the area year-to-year (either due to population growth or immigration). Also documented has been a highly-fecund female known to have produced 13 calves; this individual has been using the action area for foraging since 1984. A single individual has been observed to be of persistently poor body condition

from at least 2003-2008. Several females that use the action area as a foraging area have produced calves in successive years (one individual produced calves in three consecutive years); a relatively rare occurrence for humpback whales. Juveniles have been observed to return to the action area in high numbers versus historical averages since 2007. Based upon these observations, we expect that although the level of exposure to humpback whales in the action area is high, commonly resulting in entanglement and ship strike events and likely repeated exposure to close approaches, there does not appear to be a reduction in key demographic variables, including factors leading to the survival or growth of the group as a whole. On the contrary, the group appears to be showing robust growth in numbers. Based upon this, the continuation of close approach activities under the proposed permit are not expected to measurably hamper survival or recovery of humpback whales in the North Pacific, or by extension, the species as a whole.

In addition to the stressors placed upon targeted individuals from vessel approaches, a portion of the same individuals will be further exposed to stressors associated with biopsy. The *Response analysis* found that responses by whales to these activities are similar to those of vessel approach and are frequently difficult to differentiate (Goodyear 1981; Goodyear 1993b; Hooker et al. 2001; Mate et al. 1997; Watkins 1981b; Watkins et al. 1984). In addition, not all individuals respond to biopsy, meaning that a fraction of targeted individuals are not expected to show an overt response to a combined approach and biopsy action. We do expect all individuals to at least be aware of the vessel's approach and may undergo a low-level stress reaction as a result of a large unknown object in close proximity to individuals. Information available to us does not support behavioral responses by an individual being more severe when additional activities (such as biopsy) are added to vessel approach, although we do expect more frequent responses to the combined activities versus to approach alone.

Overall, we expect all targeted whales to experience some degree of stress response to some approach and biopsy attempts. We also expect some of these individuals to undergo short-term behavioral responses to these activities. We do not expect displacement of individuals from the action area as a result of the proposed action. Individuals responding in such ways may temporarily cease feeding, resting, nursing, or otherwise disrupt vital activities. However, we do not expect that these disruptions will cause a measureable impact to any individual's fitness. We expect all biopsied individuals to experience additional physiological reactions associated with foreign body penetration into the blubber and possibly muscle, including inflammation and scar tissue development. We do not expect any single individual to experience a fitness consequence as a result of the proposed actions and, by extension, do not expect population-level effects.

Conclusion

After reviewing the current status of endangered humpback whales in the *Status of Listed Resources*, the *Environmental Baseline* for the action area, the effects of the proposed research programs, and the *Cumulative Effects*, it is the NMFS' opinion that issuing Permit 15844 (S. Boudreau, NPS) is not likely to jeopardize the continued existence of humpback whales.

Incidental Take Statement

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

We do not expect incidental take of threatened or endangered species as a result of the proposed actions.

Conservation Recommendations

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

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

1. *Determination of take numbers.* The Permits Division should examine its methodologies for determining take numbers and coordinate with the Endangered Species Act Interagency Cooperation Division to ensure that the take numbers better reflect a level of exposure which has occurred in the past under similar or identical NPS-Glacier Bay National Park and Preserve actions as evidenced by annual reports.

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

Reinitiation Notice

Pursuant to the provisions of section 10 of the ESA and MMPA, this concludes formal consultation on NMFS' proposal to issue Permit 15844 to the NPS. 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, NMFS Permits, Conservation and Education Division must immediately request reinitiation of section 7 consultation.

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