National Marine Fisheries Service
Endangered Species Act Section 7 Consultation
Biological and Conference Opinion

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

Activity Considered: Biological and Conference Opinion on the proposal to issue Permit Number 15240 to the NMFS Pacific Islands Fisheries Science Center, to authorize research on 27 cetacean species in U.S. and international waters of the Pacific Islands Region, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

Consultation Conducted by: ESA Interagency Cooperation Division of the Office of Protected Resources, National Marine Fisheries Service

Approved by:

Date: MAY 15 2012

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

This document represents the NMFS' biological and conference opinion (Opinion) of the effects of the proposed research on 27 cetacean species (seven ESA listed) and the ESA listed species' designated critical habitat, as has been prepared in accordance with Section 7 of the ESA. This Opinion is based on our review of the Permits and Conservation Division's draft Environmental Assessment, draft permit 15240, the permit application from Frank A. Parrish, annual reports of similar past research, the most current marine mammal stock assessment reports, recovery plans for listed species, scientific and technical reports from government agencies, peer-reviewed literature, biological opinions on similar research, and other sources of information.

Consultation history

The NMFS' Permits and Conservation Division (Permits Division) requested consultation with the NMFS' Endangered Species Division on the proposal to issue scientific research permit authorizing studies on Blue, False killer (Hawaiian insular stock, proposed endangered), Fin, Humpback, North Pacific right, Sei, and Sperm whales. Issuance of the permit constitutes a federal action, which may affect marine species listed under the ESA.

On February 28, 2012, the Permits Division requested initiation of Section 7 consultation to issue a new permit to NMFS Pacific Islands Fisheries Science Center, and the ESA Interagency Cooperation Division formally initiated consultation with the Permits Division on March 1st, 2012.

Biological and Conference Opinion

Description of the proposed action

NMFS' Office of Protected Resources – Permits and Conservation Division proposes to issue a permit for scientific research pursuant to the ESA and the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 et seq., Section 104). Issuance of permit 15240 to NMFS Pacific Islands Fisheries Science Center (Responsible Party: Frank A. Parrish, Ph.D.; Principal Investigator: Erin Oleson, Ph.D.) would authorize research on 27 cetacean species (seven ESA listed) in the central and western North Pacific Ocean, focused mainly on U.S. waters off: Hawaii, Palmyra, American Samoa, Guam, CNMI, Johnston Atoll, Kingman Reef, Howland Island, Baker Island, Jarvis Island, and Wake Island, State and international waters would also be surveyed. If issued, the permit would be valid for five years. The proposed actions and "take" [1] authorizations for the species that are listed and proposed for listing can be found in Table 1.

Table 1. Proposed "takes" of listed or proposed-to-be-listed cetaceans during research activities in the central and western North Pacific Ocean. All lifestages and both sexes could be targeted.

Species	ESA Listing	Procedures	Takes per Individual	Maximum Authorized Takes*
Blue whales	Endangered	Acoustic, passive recording; Collect, sloughed skin; count/survey; behavioral observations, photo-id	4	1000
		(Aerial) Count/survey, photo-id, photogrammetry	2	250
		(Adult) Sample, skin and blubber biopsy	3	150
		(Calf)[2] Sample, skin and blubber biopsy	3	25
		(Adult) Instrument, suction-cup (e.g. VHF, TDR) Tracking (one tag per animal at one time, up to 3 per animal per year)	3	20

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[1] Under the MMPA, "take" is defined as to "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." [16 U.S.C. 1362(18)(A)] The ESA defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The term "harm" is further defined by regulations (50 CFR §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering."

[2] Calves 6 months or older.

		(Calf) Instrument, suction-cup (e.g. VHF, TDR) (one tag per animal at one time, up to 3 per animal per year)	3	5
		(Adult) Instrument dart/barb tag	3	10
		(Calf) Instrument dart/barb tag	3	5
False killer whale,	Proposed Endangered (Hawaiian Insular DPS)	Acoustic, passive recording; Collect, sloughed skin; count/survey; behavioral observations, photo-id	4	500
		(Aerial) Count/survey, photo-id, photogrammetry	2	500
		(Adult) Sample, skin and blubber biopsy	3	75
		(Calf) Sample, skin and blubber biopsy	3	25
		(Adult) Instrument, suction-cup (e.g. VHF, TDR) Tracking (one tag per animal at one time, up to 3 per animal per year)	3	15
		(Calf) Instrument, suction-cup (e.g. VHF, TDR) (one tag per animal at one time, up to 3 per animal per year)	3	5
		(Adult) Instrument dart/barb tag	3	15
		(Calf) Instrument dart/barb tag	3	5
Fin whales	Endangered	Acoustic, passive recording; Collect, sloughed skin; count/survey; behavioral observations, photo-id	4	1000
		(Aerial) Count/survey, photo-id, photogrammetry	2	500
		(Adult) Sample, skin and blubber biopsy	3	150
		(Calf) Sample, skin and blubber biopsy	3	25
		(Adult) Instrument, suction-cup (e.g. VHF, TDR) Tracking (one tag per animal at one time, up to 3 per animal per year)	3	20
		(Calf) Instrument, suction-cup (e.g. VHF, TDR) (one tag per animal at one time, up to 3 per animal per year)	3	5
		(Adult) Instrument dart/barb tag	3	10
		(Calf) Instrument dart/barb tag	3	5

Humpback whale	Endangered	Acoustic, passive recording; Collect, sloughed skin; count/survey; behavioral observations, photo-id	4	1000
		(Aerial) Count/survey, photo-id, photogrammetry	2	1000
		(Adult) Sample, skin and blubber biopsy	3	250
		(Calf) Sample, skin and blubber biopsy	3	50
		(Adult) Instrument, suction-cup (e.g. VHF, TDR) Tracking (one tag per animal at one time, up to 3 per animal per year)	3	35
		(Calf) Instrument, suction-cup (e.g. VHF, TDR) (one tag per animal at one time, up to 3 per animal per year)	3	5
		(Adult) Instrument dart/barb tag	3	20
		(Calf) Instrument dart/barb tag	3	5
North Pacific right whales	Endangered (Range-wide)	Acoustic, passive recording; Collect, sloughed skin; count/survey; behavioral observations, photo-id	4	50
		(Aerial) Count/survey, photo-id, photogrammetry	2	40
		(Adult) Sample, skin and blubber biopsy	3	25
		(Calf) Sample, skin and blubber biopsy	3	5
		(Adult) Instrument, suction-cup (e.g. VHF, TDR) Tracking (one tag per animal at one time, up to 3 per animal per year)	3	5
		(Calf) Instrument, suction-cup (e.g. VHF, TDR) (one tag per animal at one time, up to 3 per animal per year)	3	5
		(Adult) Instrument dart/barb tag	3	5
		(Calf) Instrument dart/barb tag	3	5
Sei whales	Endangered	Acoustic, passive recording; Collect, sloughed skin; count/survey; behavioral observations, photo-id	4	500
		(Aerial) Count/survey, photo-id, photogrammetry	2	500
		(Adult) Sample, skin and blubber biopsy	3	90

		(Calf) Sample, skin and blubber biopsy	3	10
		(Adult) Instrument, suction-cup (e.g. VHF, TDR) Tracking (one tag per animal at one time, up to 3 per animal per year)	3	20
		(Calf) Instrument, suction-cup (e.g. VHF, TDR) (one tag per animal at one time, up to 3 per animal per year)	3	5
		(Adult) Instrument dart/barb tag	3	10
		(Calf) Instrument dart/barb tag	3	5
Sperm whales	Endangered	Acoustic, passive recording; Collect, sloughed skin; count/survey; behavioral observations, photo-id	4	1000
		(Aerial) Count/survey, photo-id, photogrammetry	2	1000
		(Adult) Sample, skin and blubber biopsy	3	250
		(Calf) Sample, skin and blubber biopsy	3	25
		(Adult) Instrument, suction-cup (e.g. VHF, TDR) Tracking (one tag per animal at one time, up to 3 per animal per year)	3	35
		(Calf) Instrument, suction-cup (e.g. VHF, TDR) (one tag per animal at one time, up to 3 per animal per year)	3	5
		(Adult) Instrument dart/barb tag	3	20
		(Calf) Instrument dart/barb tag	3	5

* Takes = the maximum number of animals, not necessarily individuals, that may be targeted for research annually for the suite of procedures

The research activities as proposed by the applicant would include aerial surveys and close vessel approaches for: abundance and distribution surveys, behavioral observations, photo-identification, biopsy sampling, passive acoustic recordings, skin and fecal sample collection, and to attach instrumentation using suction cups or implanting darts. No research-related mortalities would be authorized.

Methods:

Proposed research would take place throughout the year, with the majority of effort likely to be around the Hawaiian Islands. Additional effort would occur near Palmyra, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands (CNMI), or in international waters throughout the Pacific Ocean.

Aerial surveys

Conventional line-transects would be flown at roughly 700 ft. altitude with an approximate airspeed of 165-175 km/hr, preferably using a twin-engine, high wing aircraft, to determine the distribution and abundance of cetacean species. Aerial surveys would occur from the coast to 200 nmi offshore. The aircraft would circle high (500-1000 ft) over animals to confirm species identification and to estimate group size. The maximum amount of time spent circling over a single group is one hour.

Vessel surveys

Data would be collected during research vessel surveys using line-transect methodology to estimate population abundance by species/stock. The following methods (including the configuration of the large vessel observation platform) are designed to match those used by the NMFS Southwest Fisheries Science Center (SWFSC) to maximize the comparability of scientific data collected by both Centers, which have overlapping responsibilities for cetacean research in the Pacific.

Although procedures may vary slightly depending on the specific objective of the survey, in general, the following protocol would be used on PIFSC research vessel surveys:

- Large research vessel (224 ft NOAA ship *Oscar Elton Sette* or similar vessel) traverses predetermined randomly-placed systematic tracklines within the study area at a constant speed (usually 10 knots).
- Marine mammal observers stationed on the flying bridge deck of the vessel search the area from directly ahead to abeam of the ship using pedestal-mounted 25X150 binoculars.
- Data on sea state, visibility, glare, observer, etc. are recorded at regular intervals for subsequent distance sampling analysis.
- Depending on the species sighted and the data collecting priorities at the time, the vessel may turn off the trackline and approach marine mammals in order to confirm species identification and to make group size estimates. Approaches of cetaceans in the large vessel are conducted at the minimum speed needed to close the distance between the ship and the group of animals, typically 10 knots or less. Approaches would usually cease when the ship is within 300 meters of the school as researchers would try to avoid disrupting the school or cause it to break into smaller groups. Approaches are from behind or from the side of animals.

Small boat research

Concurrent with visual observations from large vessels, 5-10 m rigid hull inflatable boats (RHIB) or fiberglass boats may be launched to collect biological samples (skin/blubber biopsy or sloughed skin, feces, or parts of salvaged animals found at sea) and digital photographs. Tagging activities may also be conducted from the small boats during vessel surveys. Small boat approaches would be conducted in a manner that minimizes boat noise, does not involve any sudden changes in speed or course, and approaches an animal from behind or from the side while not greatly exceeding the animal's travel speed. Time spent in the vicinity of target animals, as well as the number of attempts made, to collect photographs, biopsy samples or to deploy tags would be limited in order to minimize any incidental harassment or disturbance from the presence of the small boat or the activities themselves.

Small vessels would also be used year-round in coastal waters to conduct surveys. These visual surveys could be focused on determining species presence, collecting biopsy samples, tagging, and/or conducting photo-identification. In such cases, quantitative line transect methods may or may not be used.

Photo-identification

Photographs would be used to estimate abundance, document movements and scarring rates, and in some cases (e.g., spinner dolphins) estimate vital parameters such as survival and calving rates. Photo-identification studies are expected to be most useful for island-associated (or otherwise localized) stocks and migratory species exhibiting site fidelity. They are also used for stock identification.

Activities would primarily be conducted from small boats (5-10 m) with 120 hp to 150 hp four-stroke outboard engines either on an opportunistic basis during large vessel surveys or during small boat surveys off Hawaii, Palmyra, American Samoa, Guam, CNMI, or in international waters. Animals would be approached close enough to optimize photographic quality (i.e., well-focused images, utilizing at least one half of the slide viewing area) while approaching from behind at a consistent speed and avoiding sudden changes in speed or direction. Distances for optimal approach vary with the species being photographed. Generally, large whales would be approached within approximately 15-20 m. Smaller animals, such as delphinids, would be approached within approximately 5-10 m. Photographs of bow-riding animals would also be taken on an opportunistic basis from large or small vessels. As these animals approach the vessel on their own, researchers would maintain a consistent speed to avoid startling any animals.

Passive acoustic recordings

Various towed hydrophones arrays would be used to listen for and locate vocal cetaceans to increase encounter rate during large-scale vessel surveys. Arrays are typically towed at full ship speed (10 kts), though can remain in the water even at slower speed, down to 2 kts. All towed arrays would employ only passive listening. There are no active acoustic elements within the towed arrays. The towed array generally extends up to 300 m behind the vessel and is deployed and retrieved using a hydraulic-powered winch aboard the ship. Arrays have from 2 to 5 hydrophone elements spaced to allow localization of most cetacean vocalizations.

Mitigation measures that would be implemented during activities:

- Potential disturbance from aerial surveys is minimized by flying at a constant speed and altitude.
- Aerial photographic passes would be limited in number to reduce the potential for harassment of individual animals.

- If an animal or group reacts behaviorally to the plane, researchers would move on to a different group of animals.
- Vessels approaches would be from behind or from the side of animals.
- Small boat approaches are conducted by specific crew members with extensive experience handling small boats around cetaceans during PIFSC research surveys.
- Small boat approaches would be conducted in a manner that minimizes boat noise, does not involve any sudden changes in speed or course, and approaches an animal from behind or from the side while not greatly exceeding the animal's travel speed.
- Time spent in the vicinity of target animals would be limited in order to minimize any incidental harassment or disturbance from the presence of the small boat or the activities themselves.
- Animals exhibiting aerial behaviors or tail slaps would not be approached.
- During photo-identification research, animals would be approached from behind at a consistent speed and avoiding sudden changes in speed or direction.
- Researchers would maintain a consistent speed to avoid startling any bowriding animals.
- Photo-identification would cease when clear photos have been obtained of all individuals present, or when excessive avoidance behavior is displayed by the group.
- Females accompanied by calves may be approached for photo-identification, but efforts would cease immediately if there is any evidence that the activity may be interfering with pair bonding, nursing, reproduction, feeding or other vital functions.

Biological sample collection

Biopsy samples would be collected using either a crossbow, adjustable-pressure modified air-gun, or pole during both small boat and large vessel surveys. Animals within approximately 5 to 30 m of the bow of the vessel or small boat would be targeted (Palsbøll et al. 1991). If animals ride the bow of the large vessel, samples would be obtained using a tethered biopsy dart. The PIFSC would use one of two basic configurations:

1. Tethered line: This technique is used for bow-riding dolphins. One end of a length of line is tied to a handrail on the ship and the other end is tied to the dart. The line is just long enough to go straight down to the water surface and back up. A metal washer is tied to the lower end to keep the line somewhat taught in case of wind. Most of the time, the dolphins are hit on the back close to the dorsal fin. Typically the dart bounces up and back or away from the dolphin. Occasionally a miss occurs and the dart goes down alongside the dolphin and passes behind it; the dart is retrieved via the tether and another attempt is made. The SWFSC has biopsied thousands of dolphins from 15 or more species this way with no entanglements. Quite often sampled dolphins do not even leave the bow, or if they do, researchers often see them again a short time later.

2. Spooled line: A spool is attached to the crossbow and the other end of the line is attached to the dart. This set-up is most often used when attempting to sample large whales from a ship where dart retrieving is unfeasible. The line is light enough that it would be easily snapped by a large whale were it to become entangled, but the PIFSC has never seen an entanglement using this method.

In general, except for bowriders, the PIFSC prefers not to use tethered systems because the trajectory of a tethered dart is more easily affected by the wind but it can be useful at times.

For small cetaceans, the tissue sample is a small plug of skin and blubber, approximately 7mm in diameter and 20mm long. It is collected from the area behind the blowhole and in front of the dorsal fin. The depth of the biopsy tip is controlled by a cushioned stop (25mm in diameter) of neoprene vacuum hose encircling the biopsy head. Biological samples may be collected from small cetacean adults, juveniles and calves of one year or older. For large cetaceans, small samples (<1 gram) would be obtained from free-ranging individuals using a biopsy dart with a stainless steel tip measuring approximately 4 cm in length with an external diameter of 9mm and fitted with a 2.5 cm stop to ensure recoil and prevent deeper penetration (so that only 1.5cm of the tip is available to penetrate the animal). Between sample periods, the biopsy tips are thoroughly cleaned and sterilized with bleach. Biological samples may be collected from adults, juveniles and calves six months or older.

In addition to biopsy darts, sloughed skin and feces would be collected opportunistically using a net or sieve. Sloughed skin would also be collected when attached to a tag that has been retrieved.

Samples would initially be stored on ice, and then as soon as they are processed they would be stored in a cryovial and either stored immediately in a -80°C freezer, frozen in a cryovial with 90% ethanol in a -20°C until a -80°C freezer is available, or frozen in a cryovial which is placed in liquid nitrogen until a freezer is available or stored in DMSO. Labels with the field id would be put both on the outside of the vial and inside with the sample. The samples would then either be stored in the PIFSC genetics freezer, or sent to SWFSC for entry into their archive. If the samples are to be shipped they would be sent overnight in Styrofoam packaging with dry ice to keep the samples frozen.

Tagging

A number of tag types (e.g., VHF transmitting tags, time depth recorder (TDR) tags, acoustic recording tags, GPS-location tags, and satellite tags) would be used during both large vessel surveys and coastal small boat surveys. The two methods of attaching a tag to the animals are suction cup and darts/barbs. The choice of tag or tags would depend on the primary research question being addressed. Suction cup attached time-depth recorder tags, which generally fall off within 72 hours, would be used to study diving and foraging behavior. Satellite-linked position and TDR tags would be used to study animal movements and behavior over a longer period of time.

<u>Suction-cup tags</u>: Each tag consists of one to six suction cups, attached to a syntactic foam housing (to float the package once it falls off). Attached to the foam would be a variety of sensors that collect data such as time, depth, temperature, light levels, acoustics, GPS locations during surface events, photographs, video, and a VHF transmitter. The size and dimensions of suction-cup attached tags vary by tag type, but representative sizes are listed here:

- Most tags (containing a time-depth recorder or a Mk10a fastloc GPS unit): measure approximately 33 cm x 12 cm x 3 cm, not including the VHF antenna, and weigh 0.45 kg.
- DTAGs: approximately 6 in x 3 in x 2 in with four, one-inch diameter suction cups.

- Bioacoustic Probes and Acousondes: 1.25 in diameter x 8.7 in long, and weighs 0.30g in air. Attached with two 2.5 in diameter suction cups.
- New hydrodynamic Acousonde: 8.8 in long, weighs 0.36kg in air, and contains the flotation and VHF transmitter within the tag body. Also attached with two 2.5 in diameter suction cups.
- Crittercam: tag (not including suction cup) is approximately 25 cm long by 6 cm in diameter and weighs about 0.8 kg (see Marshall et al. 2008). The suction cups for Crittercam tags may be either 23 cm in diameter (weighing 1.1 kg) or 16 cm in diameter (weighing 0.65 kg).

All of the suction-cup attached tags are slightly positively buoyant so they will float when they detach from an animal.

Suction cup attached tags would be applied to an individual animal using a long pole (4-7m) to press the suction cup(s) onto the skin of the animal during a surfacing series. Many of the species which would be suction-cup tagged during this project are small odontocetes that frequently bowride, and therefore are not actively approached by the vessel. For those species which do not typically bowride, the vessel would usually approach the target individual from behind and attempt to match the animals speed, closing to the length of the pole. Tags would be attached up high on the back around the dorsal area of the animal, and no attachments would be targeted forward of the pectoral fins. The suction cup-attached tags would generally remain attached for a few hours to a few days, and simply fall off the individual when they lose suction. The tags would then float to the surface and can be recovered by using the VHF signal emitted by the tag. Occasionally, skin samples would be attached to the tag when it is retrieved. These would be collected for analysis.

<u>Dart/barb tags:</u> The Low Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) tag system would be used for satellite tagging (Andrews et al. 2008, Schorr et al. 2009). This system is currently in use by other researchers working with killer whales in Alaska and in the Antarctic, as well as beaked whales and several other species in the Bahamas. These tags have been successfully deployed by the PIFSC research team in collaboration with Cascadia Research Collective on 15 different species: bottlenose and Risso’s dolphins; killer, short-finned pilot, false killer, melon-headed, pygmy killer, Cuvier’s beaked, Blainville’s beaked, sperm, sei, fin, blue, minke, and humpback whales (under NMFS Scientific Research Permits No. 540-1811, 774-1714, 782-1719, 781-1824, and/or 731-1774).

The location-only tag body is dome-shaped in the current configuration (a Wildlife Computers Spot-5 PTT), approximately 6.3 cm in length, 3 cm in width, and 2.2 cm in height, with a 17 cm long antenna sticking out of the center of the half dome. In current configurations location-only satellite tags weigh 44-49 grams. The location-depth tag (Wildlife Computers Mk10a) is approximately 5.3 cm in length, 5.2 cm in width, and 2.4 cm in height and weighs 54-59 grams. As well as location, this tag allows for the collection of basic dive parameters including max depth and dive and surface interval and duration.

On the flat side (bottom) of the tag is the dart retention system. Currently this uses two medical-grade titanium darts, approximately 0.6 cm in diameter, with 3 to 6 backwards facing petals that act to anchor the tag. Alternative darts are under consideration and testing, including a hollow design with very small backward facing barbs. Dart length may vary by species; tags used on smaller species (e.g., bottlenose and Risso's dolphins) would have shorter dart lengths (~3.5 cm). Currently, the longest darts in use are 7 cm in length such that when the transmitter is deployed flush on the fin the backward facing petals will be located below the vertical sheath of the dorsal fin (the tissue layer with the greatest structural integrity) in order to provide the most secure anchoring.

Tags would be deployed with a pneumatic projector, a crossbow, or a pole, at distances from 2-30 m. The tag would be attached to an arrow using a holder and water-soluble tape which secures the tag to the arrow until contact with the whale is made. Upon impact with the whale, the arrow would most often immediately bounces free. In the few cases where the arrow holds on, it would generally separate from the tag upon submersion in the water. Tags are expected to stay attached for periods ranging from approximately 1-25 weeks and all release within a year. High resolution photographs would be taken of all tagged animals whenever possible for individual photo-identification (to assess population identity and for examining tag impacts), to confirm sex (e.g. with beaked whales), to document tag deployment location on the body and to document tag orientation (e.g., whether the tag is flush against the dorsal fin).

Mitigation measures that would be used activities:

- Between sampling, biopsy tips would be thoroughly cleaned and sterilized with bleach.
- If signs of harassment such as rapid changes in direction, prolonged diving and other behaviors are observed from an individual or a group, biopsy activities would be discontinued on that individual or group.
- When possible, attempts will be made to obtain photographs of tagged individuals to examine wound healing and modes of tag failures.
- Researchers would select the appropriate tag type, depending on the objectives.
- Exact dimensions and weights of tags would vary with the generation of tag and the specific components included. However, advancements in technology have consistently led to smaller and more effective tags, and this trend is expected to continue in the future. Tagging equipment would be updated as newer models become available.
- All considerations would be made to minimize tissue damage while allowing for retention durations to match battery life.
- When working with coastal populations, attempts would be made to monitor individuals' life history patterns through photo-identification.

Import/Export

The PIFSC would be authorized to import/export/re-export biological samples collected during research activities. In addition, they would be authorized to import/export/re-export parts and specimens salvaged by them and biological samples or parts and specimens collected by other researchers. Such sample material would be archived and analyzed for information such as molecular genetics, life history, stable isotopes ratios and fatty acid composition.

Approach to the Assessment

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

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

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

We measure risks to listed individuals using the 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, and 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).

The analyses used in this Opinion include several assumptions. As far as we are able to determine, field researchers cannot generally identify specific individuals in the field (Hawaiian insular false killer whales are possible exceptions) and, therefore, have no mechanism to know what previous exposure an individual has had to proposed activities or other natural or anthropogenic stressors. Based upon descriptions in past annual monitoring reports from the applicant and documentation provided by the Permits Division, we assume that proposed activities will be similar to those that the applicant has conducted in the past and the level of "effort" (magnitude of time and asset resources dedicated to the proposed action) will be roughly similar to that which has previously occurred. We assume that free-ranging cetaceans range over wide areas and although they likely occupy restricted regions for relatively brief periods (hours to days), individuals are expected to move widely and, as far as we can predict, broadly within an oceanographic region. Although we expect that variability in reporting exists within the applicant's annual reports and other specific information provided, these reports accurately document the number of "takes" that occurred under the MMPA and that additional, accessory data not rising to the level of "take" (observations of unusual or rare species) are also reported.

Action Area

The proposed activities would occur in the U.S. EEZ waters of the Pacific Ocean (primarily Hawaii, American Samoa, Johnston Atoll, Palmyra Atoll, Kingman Reef, Howland Island, Baker Island, Jarvis Island, Wake Island, Guam and the Commonwealth of the Northern Mariana Islands) Marine National Sanctuaries/Monuments are located in the Northwestern Hawaiian Islands (Papahānaumokuākea Marine National Monument), the main Hawaiian Islands (Hawaiian Islands Humpback Whale National Marine Sanctuary), American Samoa (Rose Atoll Marine National Monument and Fagatele Bay National Marine Sanctuary), the Line Islands Marine National Monument, and Marianas Trench Marine National Monument. International waters and foreign waters subject to permission of the sovereign host State. The applicant would be permitted to conduct research throughout the year.

Status of listed resources

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

Pinnipeds		
Hawaiian monk seal*	*Monachus schauinslandi*	Endangered
Cetaceans		
Blue whale	*Balaenoptera musculus*	Endangered
False Killer whale	*Pseudorca crassidens*	Proposed Endangered
Fin whale	*Balaenoptera physalus*	Endangered

Humpback whale	*Megaptera novaeangliae*	Endangered
North Pacific right whale*	*Eubalaena japonica*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Sea Turtles		
Green sea turtle – most areas	*Chelonia mydas*	Threatened
Florida and Mexico's Pacific coast breeding colonies		Endangered
Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered
Leatherback sea turtle	*Dermochelyts coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Olive ridley sea turtle – most areas	*Lepidochelys olivacea*	Threatened
Mexico's Pacific coast breeding colonies		Endangered

* denote listed species with Critical Habitat in the general area of the proposed action.

Species not considered further in this opinion

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

Hawaiian monk seals, green, hawksbill, leatherback, loggerhead, and olive ridley sea turtles may occur in the action area, but are not expected to be exposed to the proposed activities. Sea turtles have not been documented to be struck by researchers in the area and the possibility of this occurring is discountable.

In addition to these species, critical habitat that has been designated for Hawaiian monk seals also occurs in the action area. In May 1988, NMFS designated critical habitat for the Hawaiian monk seal out from shore to 20 fathoms in 10 areas of the northwestern Hawaiian Islands. Critical habitat for these species includes all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and ocean waters out to a depth of 20 fathoms around the following: Kure Atoll, Midway Islands, except Sand Island and its harbor, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, rench Frigate Shoals, Necker Island, and Nihoa Island (50 CFR §226.201).

None of the proposed research would adversely affect prey species of the Hawaiian monk seals. As a result, the proposed exercises are not likely to adversely affect the conservation value of the critical habitat that has been designated for Hawaiian monk seals.

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

Species Considered Further in this Biological Opinion

The rest of this section of our Opinion consists of narratives for each of the threatened and endangered species that occur in the action area and that may be adversely affected by the activities the NMFS Pacific Islands Fisheries Science Center proposes to conduct. In each narrative, we present a general species description and a summary of information on the distribution and population structure of each species to provide a foundation for the exposure analyses that appear later in this Opinion. Then we summarize information on the threats to the species and the species' status given those threats to provide points of reference for the determinations we make later in this Opinion. That is, we rely on a species' status and trend to determine whether or not an action's direct or indirect effects are likely to increase the species' probability of becoming extinct.

After the *Status* subsection of each narrative, we present information on the diving and social behavior of the different species because that behavior helps determine whether aerial and ship board surveys are likely to detect each species.

More detailed background information on the status of these species and critical habitat can be found in a number of published documents including status reviews, recovery plans for the blue whale (NMFS 1998b), fin whales (NMFS 2010d), fin and sei whale (NMFS 1998a), humpback whale (NMFS 1991), sperm whale (NMFS 2010e), a status report on large whales prepared by Perry et al. (1999a) and the recovery plans for the green and hawksbill sea turtles (NMFS and USFWS 1998a; NMFS and USFWS 1998c; NMFS and USFWS 1998d; NMFS and USFWS 2007). Richardson et al. (1995) and Tyack (2000) provide detailed analyses of the functional aspects of cetacean communication and their responses to active sonar. Finally, Croll et al. (1999b), NRC (2000; 2003a; 2005), and Richardson and Wursig (1995) provide information on the potential and probable effects of active sonar on the marine animals considered in this Opinion.

Blue Whale

The blue whale, *Balaenoptera musculus* (Linnæus 1758), is a cosmopolitan species of baleen whale. It is the largest animal ever known to have lived on Earth: adults in the Antarctic have reached a maximum body length of about 33 m and can weigh more than 150,000 kg. The largest blue whales reported from the North Pacific are a female that measured 26.8 m (88 ft) taken at Port Hobron in 1932 (Reeves et al. 1985) and a 27.1 m (89 ft) female taken by Japanese pelagic whaling operations in 1959 (NMFS 1998b).

As is true of other baleen whale species, female blue whales are somewhat larger than males. Blue whales are identified by the following characteristics: a long-body and comparatively slender shape; a broad, flat "rostrum" when viewed from above; a proportionately smaller dorsal fin than other baleen whales; and a mottled gray color pattern that appears light blue when seen through the water.

Distribution

Blue whales are found along the coastal shelves of North America and South America (Clarke 1980; Donovan 1984; Rice 1998). In the western North Atlantic Ocean, blue whales are found from the Arctic to at least the mid-latitude waters of the North Atlantic (CETAP 1982; Gagnon and Clark 1993; Wenzel et al. 1988; Yochem and Leatherwood 1985). Blue whales have been observed frequently off eastern Canada, particularly in waters off Newfoundland, during the winter. In the summer month, they have been observed in Davis Strait (Mansfield 1985), the Gulf of St. Lawrence (from the north shore of the St. Lawrence River estuary to the Strait of Belle Isle), and off eastern Nova Scotia (Sears 1987a). In the eastern North Atlantic Ocean, blue whales have been observed off the Azores Islands, although Reiner et al. (1996) do not consider them common in that area.

In 1992, the Navy conducted an extensive acoustic survey of the North Atlantic Ocean using the Integrated Underwater Surveillance System‘s fixed acoustic array system (Clark 1995). Concentrations of blue whale sounds were detected in the Grand Banks off Newfoundland and west of the British Isles. In the lower latitudes, one blue whale was tracked acoustically for 43 days, during which time the animal traveled 1400 nautical miles around the western North Atlantic from waters northeast of Bermuda to the southwest and west of Bermuda (Gagnon and Clark 1993).

In the North Pacific Ocean, blue whales have been recorded off the island of Oahu in the main Hawaiian Islands and off Midway Island in the western edge of the Hawaiian Archipelago (Barlow 2006; Northrop et al. 1971; Thompson and Friedl 1982), although blue whales are rarely sighted in Hawaiian waters and have not been reported to strand in the Hawaiian Islands. In the eastern tropical Pacific Ocean, the Costa Rica Dome appears to be important for blue whales based on the high density of prey (euphausiids) available in the Dome and the number of blue whales that appear to reside there (Reilly and Thayer 1990). Blue whales have been sighted in the Dome area in every season of the year, although their numbers appear to be highest from June through November. Blue whales have also been reported year-round in the northern Indian Ocean, with sightings in the Gulf of Aden, Persian Gulf, Arabian Sea, and across the Bay of Bengal to Burma and the Strait of Malacca (Mizroch et al. 1984). The migratory movements of these whales are unknown.

Blue whales in the eastern Pacific winter from California south; in the western Pacific, they winter from the Sea of Japan, the East China and Yellow Seas, and the Philippine Sea. Blue whales occur in summer foraging areas in the Chukchi Sea, the Sea of Okhotsk, around the Aleutian Islands, and the Gulf of Alaska. Nishiwaki (1966) reported that blue whales occur in the Aleutian Islands and in the Gulf of Alaska. An array of hydrophones, deployed in October 1999, detected two blue whale call types in the Gulf of Alaska (Stafford 2003). Fifteen blue whale sightings off British Columbia and in the Gulf of Alaska have been made since 1997 (Calambokidis et al. 2009). Three of these photographically verified sightings were in the northern Gulf of Alaska within 71 nm of each other and were less than 100 nm offshore (Calambokidis et al. 2009).

Population Structure

For this and all subsequent species, the term ― population refers to groups of individuals whose patterns of increase or decrease in abundance over time are determined by internal dynamics (births resulting from sexual interactions between individuals in the group and deaths of those individuals) rather than external dynamics (immigration or emigration). This definition is a reformulation of definitions articulated by Futuymda (1986) and Wells and Richmond (1995) and is more restrictive than those uses of population that refer to groups of individuals that co-occur in space and time but do not have internal dynamics that determine whether the size of the group increases or decreases over time (see review by Wells and Richmond 1995). The definition we apply is important to section 7 consultations because such concepts as population decline, population collapse, population extinction, and population recovery apply to the restrictive definition of population but do not explicitly apply to alternative definitions. As a result, we do not treat the different whale stocks recognized by the International Whaling Commission or other authorities as populations unless those distinctions were clearly based on demographic criteria. We do, however, acknowledge those stock distinctions in these narratives.

At least three subspecies of blue whales have been identified based on body size and geographic distribution (*B. musculus intermedia*, which occurs in the higher latitudes of the Southern Oceans, *B. m. musculus*, which occurs in the Northern Hemisphere, and *B. m. brevicauda* which occurs in the mid-latitude waters of the southern Indian Ocean and north of the Antarctic convergence), but this consultation will treat them as a single entity. Readers who are interested in these subspecies will find more information in Gilpatrick et al. (1997), Kato et al. (1995), Omura et al. (1970), and Ichihara (1966).

In addition to these subspecies, the International Whaling Commission‘s Scientific Committee has formally recognized one blue whale population in the North Pacific (Donovan 1991), although there is increasing evidence that there may be more than one blue whale population in the Pacific Ocean (Barlow 1995; Gilpatrick et al. 1997; Mizroch et al. 1984; Ohsumi and Masaki. 1972). For example, studies of the blue whales that winter off Baja California and in the Gulf of California suggest that these whales are morphologically distinct from blue whales of the western and central North Pacific (Gilpatrick et al. 1997), although these differences might result from differences in the productivity of their foraging areas more than genetic differences (Barlow et al. 1997; Calambokidis et al. 1990; Sears 1987b). A population of blue whales that has distinct vocalizations inhabits the northeast Pacific from the Gulf of Alaska to waters off Central America (Gregr et al. 2000; Mate et al. 1998; Stafford 2003). We assume that this population is the one affected by the activities considered in this Opinion.

Natural Threats

Natural causes of mortality in blue whales are largely unknown, but probably include predation and disease (not necessarily in their order of importance). Blue whales are known to become infected with the nematode *Carricauda boopis* (Baylis 1928), which are believed to have caused fin whales to die as a result of renal failure (Lambertsen 1986); see additional discussion under Fin whales). Killer whales and sharks are also known to attack, injure, and kill very young or sick fin and humpback whales and probably hunt blue whales as well (Perry et al. 1999a).

Anthropogenic Threats

Two human activities are known to threaten blue whales; whaling and shipping. Historically, whaling represented the greatest threat to every population of blue whales and was ultimately responsible for listing blue whales as an endangered species. As early as the mid-seventeenth century, the Japanese were capturing blue, fin, and other large whales using a fairly primitive open-water netting technique (Tonnessen and Johnsen 1982). In 1864, explosive harpoons and steam-powered catcher boats were introduced in Norway, allowing the large-scale exploitation of previously unobtainable whale species.

From 1889 to 1965, whalers killed about 5,761 blue whales in the North Pacific Ocean (Hill et al. 1999). From 1915 to 1965, the number of blue whales captured declined continuously (Mizroch et al. 1984). Evidence of a population decline was seen in the catch data from Japan. In 1912, whalers captured 236 blue whales; in 1913, 58 blue whales; in 194, 123 blue whales; from 1915 to 1965, the number of blue whales captured declined continuously (Mizroch et al. 1984). In the eastern North Pacific, whalers killed 239 blue whales off the California coast in 1926. And, in the late 1950s and early 1960s, Japanese whalers killed 70 blue whales per year off the Aleutian Islands (Mizroch et al. 1984).

Although the International Whaling Commission banned commercial whaling in the North Pacific in 1966, Soviet whaling fleets continued to hunt blue whales in the North Pacific for several years after the ban. Surveys conducted in these former-whaling areas in the 1980s and 1990s failed to find any blue whales (Forney and Brownell Jr. 1996). By 1967, Soviet scientists wrote that blue whales in the North Pacific Ocean (including the eastern Bering Sea and Prince William Sound) had been so overharvested by Soviet whaling fleets that some scientists concluded that any additional harvests were certain to cause the species to become extinct in the North Pacific (Latishev 2007). As its legacy, whaling has reduced blue whales to a fraction of their historic population size and, as a result, makes it easier for other human activities to push blue whales closer to extinction. Otherwise, whaling currently does not threaten blue whale populations.

In 1980, 1986, 1987, and 1993, ship strikes have been implicated in the deaths of blue whales off California (Barlow 1997). More recently, Berman-Kowalewski et al. (2010) reported that between 1988 and 2007, 21 blue whale deaths were reported along the California coast, typically one or two cases annually. In addition, several photo-identified blue whales from California waters were observed with large scars on their dorsal areas that may have been caused by ship strikes. Studies have shown that blue whales respond to approaching ships in a variety of ways, depending on the behavior of the animals at the time of approach, and speed and direction of the approaching vessel. While feeding, blue whales react less rapidly and with less obvious avoidance behavior than whales that are not feeding (Sears 1983). Within the St. Lawrence Estuary, blue whales are believed to be affected by large amounts of recreational and commercial vessel traffic. Blue whales in the St. Lawrence appeared more likely to react to these vessels when boats made fast, erratic approaches or sudden changes in direction or speed (Edds and Macfarlane 1987).

Although commercial fisheries using large gill nets or other large set gears poses some entanglement risk to marine mammals, there is little direct evidence of blue whale mortality from fishing gears. Therefore it is difficult to estimate the numbers of blue whales killed or injured by gear entanglements. The offshore drift gillnet fishery is the only fishery that is likely to take blue whales from this stock, but no fishery mortalities or serious injuries have been observed. In addition, the injury or mortality of large whales due to interactions or entanglements in fisheries may go unobserved because large whales swim away with a portion of the net or gear. Fishermen have reported that large whales tend to swim through their nets without becoming entangled and cause little damage to nets (Carretta et al. 2008).

Status and Trends

Blue whales (including all subspecies) were originally listed as endangered in 1970 (35 FR 18319), and this status continues since the inception of the ESA in 1973. Blue whales are listed as endangered on the IUCN Red List of Threatened Animals (IUCN 2010). They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for blue whales. It is difficult to assess the current status of blue whales because (1) there is no general agreement on the size of the blue whale population prior to whaling and (2) estimates of the current size of the different blue whale populations vary widely. We may never know the size of the blue whale population prior to whaling, although some authors have concluded that their population numbered about 200,000 animals before whaling. Similarly, estimates of the global abundance of blue whales are uncertain. Since the cessation of whaling, the global population of blue whales has been estimated to range from 11,200 to 13,000 animals (Maser et al. 1981). These estimates, however, are more than 20 years old.

A lot of uncertainty surrounds estimates of blue whale abundance in the North Pacific Ocean. Barlow (1994) estimated the North Pacific population of blue whales at approximately 1,400 to 1,900. Barlow (1995) estimated the abundance of blue whales off California at 2,200 individuals. Wade and Gerrodette (1993) and Barlow et al. (1997) estimated there were a minimum of 3,300 blue whales in the North Pacific Ocean in the 1990s. The size of the blue whale population in the North Atlantic is also uncertain. The population has been estimated to number from a few hundred individuals (Allen 1970; Mitchell 1974) to 1,000 to 2,000 individuals (Sigurjónsson 1995). Gambell (1976) estimated there were between 1,100 and 1,500 blue whales in the North Atlantic before whaling began and Braham (1991) estimated there were between 100 and 555 blue whales in the North Atlantic during the late 1980s and early 1990s. Sears et al. (1987) identified over 300 individual blue whales in the Gulf of St. Lawrence, which provides a minimum estimate for their population in the North Atlantic.

Sigurjónsson and Gunnlaugson (1990) concluded that the blue whale population had been increasing since the late 1950s and argued that the blue whale population had increased at an annual rate of about 5 percent between 1979 and 1988, although the level of confidence we can place in these estimates is low. Estimates of the number of blue whales in the Southern Hemisphere range from 5,000 to 6,000 (Yochem and Leatherwood 1985) with an average rate of increase that has been estimated at between 4 and 5 percent per year. Butterworth et al. (1993), however, estimated the Antarctic population at 710 individuals. More recently, Stern (2001) estimated the blue whale population in the Southern Ocean at between 400 and 1,400 animals (CV 0.4). The pygmy blue whale population has been estimated at 6,000 individuals (Yochem and Leatherwood 1985).

The information available on the status and trend of blue whales do not allow us to reach any conclusions about the extinction risks facing blue whales as a species, or particular populations of blue whales. With the limited data available on blue whales, we do not know whether these whales exist at population sizes large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as small populations (that is, small populations experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their population size to become a threat in and of itself) or if blue whales are threatened more by exogenous threats such as anthropogenic activities (primarily whaling and ship strikes) or natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate).

Critical Habitat

Critical habitat has not been designated for blue whales.

False killer whale-Hawaiian insular DPS (Proposed)

Hawaiian insular false killer whales (HIFKWs) are genetically unique compared to the pelagic form in surrounding Pacific waters; at a broader level, individuals inhabiting the Central Pacific are genetically different from those in the Eastern Pacific (Chivers et al. 2010; Chivers et al. 2007). Genetic data suggest little immigration into the HIFKW population. Additional data are being collected to identify whether other false killer whale groups are part of the Hawaiian insular population.

Distribution

The range and boundaries of HIFKW s may be assessed using ship and aerial survey sightings and location data from satellite-linked telemetry tags. Satellite telemetry location data from 7 groups of individuals tagged off the islands of Hawaii and Oahu indicate that the whales move widely and quickly among the main Hawaiian Islands and use waters up to 112 km offshore over a total range of 77,600 km^2 (Baird 2009; Baird et al. 2008; Baird et al. 2005a; Baird et al. 2010; Forney et al. 2010; Oleson et al. 2010). Regular movement throughout the main Hawaiian Islands is also documented by resightings of photographically-identified individuals over several years (Baird et al., 2005; Baird, 2009; Baird et al., 2010). Movements between islands can occur over the course of a few days, and although individuals were tagged on the leeward sides of the islands, they used both windward and leeward waters, moving from the windward to leeward side and back within a day (Baird, 2009; Baird et al., 2010). Ship survey sightings with photographs of individuals also confirm that HIFKW s occur on both the windward and leeward sides of the main Hawaiian Islands (Forney et al., 2010). Some individual HIFKW s were tagged off the island of Hawaii have remained around that island for extended periods (days to weeks), but individuals from all tagged groups eventually ranged widely throughout the main Hawaiian Islands. Individuals can move between islands within a matter of days (Oleson et al. 2010). However, they do not appear to move broadly within the ocean basin, as is generally assumed for false killer whales. Part of HIFKW range overlaps with pelagic forms of false killer whales between 42 and 112 km from shore (Baird et al. 2010; Forney et al. 2010).

Population Structure

False killer whale group sizes can vary widely. Group sizes average 10-30 individuals based upon aerial and vessel surveys, but groups stranding on shore are generally much larger, frequently numbering from 100 to more than 800 individuals (Baird 2009; Baird et al. 2008; Baird et al. 2010; Ferreira 2008; Ross 1984; Wade and Gerrodette 1993). It has been proposed that groups seen during surveys are a part of larger aggregations maintaining acoustic contact

(Baird et al. 2010). Indeed, larger dispersed aggregations of false killer whales have been noted during surveys (Baird 2009; Carretta et al. 2007a; Reeves et al. 2009b; Wade and Gerrodette 1993) that can move in a coordinated fashion (Baird et al. 2008). HIFKWs form strong long-term bonds (Baird et al. 2008).

False killer whales generally reach sexual maturity at 8-11 years of age for females and 8-10 years for males (Kasuya 1986; Odell and McClune. 1999; Stacey et al. 1994). Individuals grow to 40-50% of adult body length in their first year, but males continue to grow faster and to a larger size thereafter (Kasuya 1986). This leads to a degree of sexual dimorphism, with males larger in size than females, the degree of which varies around the world; in Japan, females are about 84% the length of males (Ferreira 2008; Kitchener et al. 1990). Maximum body size appears to vary at different locations, although growth appears to end after 20-30 years of age (Ferreira 2008; Kasuya 1986). Data from Japanese drive fisheries found a nearly 2:1 sex bias towards females (Ferreira 2008).

There is debate regarding false killer whale mating systems, which may be polygamous or matrilinear (Ferreira 2008). Females ovulate at least annually, apparently at random, and calving can occur year-round (Stacey et al. 1994). Ovulation rates decrease with age to the point that females over the age of 44 years are considered reproductively senescent (Ferreira 2008; Kasuya 1986) rates for false killer whales have been estimated at 14-21% of females annually, although this has been found to vary (11.4% in Japan and 2.2% in South Africa)(Kasuya 1986; Perrin and Reilly 1984). Gestation lasts 11-16 months in captivity (Brown et al. 1966). Lactation lasts 18-24 months (Perrin and Reilly 1984). Calving intervals have been estimated at roughly 7-9 years in Japan (Ferreira 2008; Stacey et al. 1994), relatively long for cetaceans. However, this varies, with 4.5 years in South Africa (Ferreira 2008).

Maximum lifespan for false killer whales has been reported as 63 years for females and 58 for males (Kasuya 1986). Some individuals have been resighted in Hawaiian waters over a 21-year time span (Baird et al. 2008).

Status and trends

The Hawaiian insular DPS was proposed for listing as endangered on November 17, 2010 (75 FR 70169). No historical levels for population size are known. Estimates based upon assumed biological parameters have suggested possible historical levels of 769-2,461 individuals (Wearmouth and Sims, 2008). Data from 1993-1998 support a population estimate of 121 individuals, which is likely negatively biased (Mobley Jr. et al., 2000; Wearmouth and Sims, 2008). The best available estimate of population size is 123 individuals, but this estimate is somewhat dated (Baird et al., 2005). It is not known whether two groups of false killer whales who have not been seen to associate with insular false killer whales are a part of the population or part of a separate population. Current estimates of population size are 151 individuals without these groups and 170 with them (Wearmouth and Sims, 2008).

Aerial survey data suggest that the population has been in decline since at least 1989 (Reeves et al., 2009). Aerial surveys since 1989 through 2003 have encountered gradually fewer individuals (Baird, 2009; Mobley, 2004; Mobley Jr. et al., 2000). Resighting rates have also been low during this time. Findings of surveys are supported by genetic analyses, which suggest a recent population decline (Chivers et al., 2010).

Natural threats

Reduced genetic diversity may be a natural, but partially anthropogenically induced factor leading to HIFKW decline (Oleson et al. 2010). Only a single instance of depredation on false killer whales has been documented, where killer whales attacked, killed, and consumed a false killer whale calf off New Zealand (Heithaus 2001; Visser et al. 2010). Parasitic infections have risen to levels thought to contribute to the deaths of some false killer whales, but these were from stranded individuals and it is unknown whether other health issues allowed for unhealthy levels of parasitism to develop (Andrade et al. 2001; Hernandez-Garcia 2002; Odell et al. 1980; Sedlak-Weinstein 1991; Stacey et al. 1994; Zylber et al. 2002).

Anthropogenic threats

Several threats have been identified that may have or continue to lead to the decline of HIFKWs. These include competition with fisheries for prey, bioaccumulation of contaminants, live captures for aquaria, and injury from longline fisheries (Oleson et al. 2010). False killer whales in Hawaiian waters have been seen to take catches from longline and trolling lines (Nitta and Henderson 1993; Shallenberger et al. 1981). Interactions with longline and troll fishery operations appear to result in disfigurement to dorsal fins, with roughly 4% of the population showing this injury, as well as entanglement and hooking (Baird and Gorgone 2005; Forney and Kobayashi. 2007; McCracken and Forney 2010; Nitta and Henderson 1993; Shallenberger et al. 1981; Zimmerman 1983). Carretta et al. (2009) estimated that 7.4 individuals per year are killed or seriously injured during the course of fishing operations in the Hawaiian EEZ. In this area, false killer whales are the most frequently hooked or entangled cetacean species, with most interactions occurring in tuna-targeting longline operations (Forney and Kobayashi. 2007; McCracken and Forney 2010). In total, 31 observations of serious injury or mortality have been documented from 1994-2008, which has led to an estimated 13 false killer whales killed or seriously injured throughout the Hawaiian longline fishery (Forney and Kobayashi. 2007; McCracken and Forney 2010). It is noteworthy that most interactions occurred well beyond the range known for HIFKWs (0.6 HIFKWs were estimated to have been killed or serious injured from 2003-2008)(McCracken and Forney 2010). In addition, false killer whales depredate on catches from shortline fisheries at least off northern Maui, with deliberate shootings occurring in some cases (Nitta and Henderson 1993; NMFS 2009b; Schlais 1985; TEC 2009).

Overfishing of some pelagic fishes, including bigeye and yellowfin tuna, may be adversely affecting HIFKWs. Catch weights for mahimahi have also declined since 1987 (NMFS 2009d). These changes may limit the prey quantity or quality available for HIFKWs.
Bioaccumulation of particularly organic contaminants may be more of a concern for false killer whales than for many other cetaceans due to the high trophic level at which false killer whales feed. The only available study of HIFKW contaminant burden found PCBs and DDT present, with adult females carrying lower burdens than subadults or adult males (likely due to contaminants being unloaded into fetuses and milk during lactation) (Aguilar and Borrell. 1994; Krahn et al. 2009; Ylitalo et al. 2009). PCB levels were high enough that biological effects would be experienced in other mammals (Kannan et al. 2000). Persistent organic pollutant levels are similar between false killer whales sampled in Taiwan and Japan, but smaller (some much smaller) than samples from British Columbia (Chou et al. 2004; Haraguchi et al. 2006; Ylitalo et al. 2009). Although these pollutants are believed to typically be sequestered in blubber,

individuals undergoing metabolic stress mobilize fat tissue, resulting in pollutants being mobilized into other body tissues (Aguilar et al. 1999). False killer whales from Australia and Japan have been found to have relatively high body burdens of mercury, lead, and cadmium (Endo et al. 2010; Kemper et al. 1994).

Critical Habitat

Critical habitat has not been designated for Hawaiian insular false killer whales.

Fin Whale

The fin whale, *Balaenoptera physalus* (Linnæus 1758), is a well-defined, cosmopolitan species of baleen whale (Gambell 1985a). Fin whales are the second-largest whale species by length. Fin whales are long-bodied and slender, with a prominent dorsal fin set about two-thirds of the way back on the body. The streamlined appearance can change during feeding when the pleated throat and chest area becomes distended by the influx of prey and seawater, giving the animal a tadpole-like appearance. The basic body color of the fin whale is dark gray dorsally and white ventrally, but the pigmentation pattern is complex. The lower jaw is gray or black on the left side and creamy white on the right side. This asymmetrical coloration extends to the baleen plates as well, and is reversed on the tongue. Individually distinctive features of pigmentation, along with dorsal fin shapes and body scars, have been used in photo-identification studies (Agler et al. 1990). Fin whales live 70-80 years (Kjeld 1982).

Distribution

Fin whales are distributed widely in every ocean except the Arctic Ocean. In the North Atlantic Ocean, fin whales occur in summer foraging areas from the coast of North America to the Arctic, around Greenland, Iceland, northern Norway, Jan Meyers, Spitzbergen, and the Barents Sea. In the western Atlantic, they winter from the edge of sea ice south to the Gulf of Mexico and the West Indies. In the eastern Atlantic, they winter from southern Norway, the Bay of Biscay, and Spain with some whales migrating into the Mediterranean Sea (Gambell 1985a). In the Southern Hemisphere, fin whales are distributed broadly south of 50° S in the summer and migrate into the Atlantic, Indian, and Pacific Oceans in the winter, along the coast of South America (as far north as Peru and Brazil), Africa, and the islands in Oceania north of Australia and New Zealand (Gambell 1985a).

Fin whales are common off the Atlantic coast of the United States in waters immediately off the coast seaward to the continental shelf (about the 1,000-fathom contour). In this region, they tend to occur north of Cape Hatteras where they accounted for about 46 percent of the large whales observed in surveys conducted between 1978 and 1982. During the summer months, fin whales in this region tend to congregate in feeding areas between 41°20'N and 51°00'N, from shore seaward to the 1,000-fathom contour. This species preys opportunistically on both invertebrates and fish (Watkins et al. 1984). They feed by filtering large volumes of water for the associated prey.

In the North Pacific Ocean, fin whales occur in summer foraging areas in the Chukchi Sea, the Sea of Okhotsk, around the Aleutian Islands, and the Gulf of Alaska; in the eastern Pacific, they occur south to California; in the western Pacific, they occur south to Japan. Fin whales in the eastern Pacific winter from California south; in the western Pacific, they winter from the Sea of

Japan, the East China and Yellow Seas, and the Philippine Sea (Gambell 1985a). The overall distribution may be based on prey availability. Fin whales are larger and faster than humpback and right whales and are less concentrated in nearshore environments.

Population Structure

Fin whales have two recognized subspecies: *Balaoptera physalus physalus* occurs in the North Atlantic Ocean while *B. p. quoyi* (Fischer 1829) occurs in the Southern Ocean. Globally, fin whales are sub-divided into three major groups: Atlantic, Pacific, and Antarctic. Within these major areas, different organizations use different population structure.

In the North Atlantic Ocean, the International Whaling Commission recognizes seven management units or stocks of fin whales: (1) Nova Scotia, (2) Newfoundland-Labrador, (3) West Greenland, (4) East Greenland-Iceland, (5) North Norway, (6) West Norway-Faroe Islands, and (7) British Isles-Spain-Portugal. In addition, the population of fin whales that resides in the Ligurian Sea, in the northwestern Mediterranean Sea, is believed to be genetically distinct from other fin whale populations.

In the North Pacific Ocean, the International Whaling Commission recognizes two stocks: (1) East China Sea and (2) rest of the North Pacific (Donovan 1991). However, Mizroch et al. (1984) concluded that there were five possible stocks of fin whales within the North Pacific based on histological analyses and tagging experiments: (1) East and West Pacific that intermingle around the Aleutian Islands; (2) East China Sea; (3) British Columbia; (4) Southern-Central California to Gulf of Alaska; and (5) Gulf of California. Based on genetic analyses, Berube et al. (1998) concluded that fin whales in the Sea of Cortez represent an isolated population that has very little genetic exchange with other populations in the North Pacific Ocean (although the geographic distribution of this population and other populations can overlap seasonally). They also concluded that fin whales in the Gulf of St. Lawrence and Gulf of Maine are distinct from fin whales found off Spain and in the Mediterranean Sea.

Regardless of how different authors structure the fin whale population, mark-recapture studies have demonstrated that individual fin whales migrate between management units (Mitchell 1974; Sigurjonsson et al. 1989), which suggests that these management units are not geographically isolated populations. Mizroch et al. (1984) identified five fin whale feeding aggregations in the Pacific Ocean: (1) an eastern group that move along the Aleutians, (2) a western group that move along the Aleutians (Berzin and Rovnin 1966; Nasu 1974); (3) an East China Sea group; (4) a group that moves north and south along the west coast of North America between California and the Gulf of Alaska (Rice 1974); and (5) a group centered in the Sea of Cortez (Gulf of California).

Hatch (2004) reported that fin whale vocalizations among five regions of the eastern North Pacific were heterogeneous: the Gulf of Alaska, the northeast North Pacific (Washington and British Columbia), the southeast North Pacific (California and northern Baja California), the Gulf of California, and the eastern tropical Pacific.

Sighting data show no evidence of migration between the Sea of Cortez and adjacent areas in the Pacific, but seasonal changes in abundance in the Sea of Cortez suggests that these fin whales might not be isolated (Tershy et al. 1993). Nevertheless, Bérubé et al. (2002) concluded that the Sea of Cortez fin whale population is genetically distinct from the oceanic population and have lower genetic diversity, which suggests that these fin whales might represent an isolated population.

Natural Threats

Natural sources and rates of mortality are largely unknown, but Aguilar and Lockyer (1987) suggested annual natural mortality rates might range from 0.04 to 0.06 for northeast Atlantic fin whales. The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure and may be preventing some fin whale populations from recovering (Lambertsen 1983). Adult fin whales engage in flight responses (up to 40 km/h) to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Killer whale or shark attacks may also result in serious injury or death in very young and sick individuals (Perry et al. 1999a).

Anthropogenic Threats

Fin whales have undergone significant exploitation, but are currently protected under the IWC. Fin whales are still hunted in subsistence fisheries off West Greenland. In 2004, five males and six females were killed, and two other fin whales were struck and lost. In 2003, two males and four females were landed and two others were struck and lost (IWC 2005). Between 2003 and 2007, the IWC set a catch limit of up to 19 fin whales in this subsistence fishery. However, the scientific recommendation was to limit the number killed to four individuals until accurate populations could be produced (IWC 2005). The Japanese whalers plan to kill 50 whales per year starting in the 2007-2008 season and continuing for the next 12 years (IWC 2006; Nishiwaki et al. 2006).

Fin whales experience significant injury and mortality from fishing gear and ship strikes (Carretta et al. 2007; Douglas et al. 2008; Lien 1994; Perkins and Beamish 1979; Waring et al. 2007). Between 1969 and 1990, 14 fin whales were captured in coastal fisheries off Newfoundland and Labrador; of these seven are known to have died because of capture (Lien 1994; Perkins and Beamish 1979). In 1999, one fin whale was reported killed in the Gulf of Alaska pollock trawl fishery and one was killed the same year in the offshore drift gillnet fishery (Angliss and Outlaw 2005; Carretta and Chivers. 2004). According to Waring et al. (2007), four fin whales in the western North Atlantic died or were seriously injured in fishing gear, while another five were killed or injured as a result of ship strikes between January 2000 and December 2004.

Jensen and Silber (2004) review of the NMFS‘ ship strike database revealed fin whales as the most frequently confirmed victims of ship strikes (26 percent of the recorded ship strikes [n = 75/292 records]), with most collisions occurring off the east coast, followed by the west coast of the U.S. and Alaska/Hawai′i. Between 1999-2005, there were 15 reports of fin whales strikes by vessels along the U.S. and Canadian Atlantic coasts (Cole et al. 2005; Nelson et al. 2007). Of these, 13 were confirmed, resulting in the deaths of 11 individuals. Five of seven fin whales stranded along Washington State and Oregon showed evidence of ship strike with incidence increasing since 2002 (Douglas et al. 2008). Similarly, 2.4 percent of living fin whales from the Mediterranean show ship strike injury and 16 percent of stranded individuals were killed by vessel collision (Panigada et al. 2006). There are also numerous reports of ship strikes off the Atlantic coasts of France and England (Jensen and Silber 2004).

Management measures aimed at reducing the risk of ships hitting right whales should also reduce the risk of collisions with fin whales. 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 predicted to be capable of reducing ship strike mortality by 27 percent in the Bay of Fundy region.

The organochlorines DDE, DDT, and PCBs have been identified from fin whale blubber, but levels are lower than in toothed whales due to the lower level in the food chain that fin whales feed at (Aguilar and Borrell 1988; Borrell 1993; Borrell and Aguilar 1987; Henry and Best 1983; Marsili and Focardi 1996). Females contained lower burdens than males, likely due to mobilization of contaminants during pregnancy and lactation (Aguilar and Borrell 1988; Gauthier et al. 1997). Contaminant levels increase steadily with age until sexual maturity, at which time levels begin to drop in females and continue to increase in males (Aguilar and Borrell 1988).

Climate change also presents a potential threat to fin whales, particularly in the Mediterranean Sea, where fin whales appear to rely exclusively upon northern krill as a prey source. These krill occupy the southern extent of their range and increases in water temperature could result in their decline and that of fin whales in the Mediterranean Sea (Gambaiani et al. 2009).

Status and Trends

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

The status and trend of fin whale populations is largely unknown. Over 26,000 fin whales were harvested between 1914-1975 (Braham 1991 as cited in Perry et al. 1999a). NMFS estimates roughly 3,000 individuals occur off California, Oregon, and Washington based on ship surveys in summer/autumn of 1996, 2001, and 2005, of which estimates of 283 and 380 have been made for Oregon and Washington alone (Barlow 2003; Barlow and Taylor 2001; Forney 2007). Barlow (2003) noted densities of up to 0.0012 individuals/km2 off Oregon and Washington and up to 0.004 individuals/km2 off California.

Fin whales were extensively hunted in coastal waters of Alaska as they congregated at feeding areas in the spring and summer (Mizroch et al. 2009). There has been little effort in the Gulf of Alaska since the cessation of whaling activities to assess abundance of large whale stocks. Fin whale calls have been recorded year-round in the Gulf of Alaska, but are most prevalent from August-February (Moore et al. 1998; Moore et al. 2006).

Regardless of which of these estimates, if any, have the closest correspondence to the actual size and trend of the fin whale population, all of these estimates suggest that the global population of fin whales consists of tens of thousands of individuals and that the North Atlantic population consists of at least 2,000 individuals. Based on ecological theory and demographic patterns derived from several hundred imperiled species and populations, fin whales appear to exist at population sizes that are large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as small populations (that is, small populations experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their population size to become a threat in and of itself). As a result, we assume that fin whales are likely to be threatened more by exogenous threats such as anthropogenic activities (primarily whaling, entanglement, and ship strikes) or natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) than endogenous threats caused by the small size of their population.

Nevertheless, based on the evidence available, the number of fin whales that are recorded to have been killed or injured in the past 20 years by human activities or natural phenomena, does not appear to be increasing the extinction probability of fin whales, although it may slow the rate at which they recover from population declines that were caused by commercial whaling.

Critical Habitat

Critical habitat has not been designated for fin whales.

Humpback Whale

Humpback whales (*Megaptera novaeangliae*) are distinguished from other whales in the same Family (Balaenopteridae) by extraordinarily long flippers (up to 5 m or about 1/3 total body length), a more robust body, fewer throat grooves (14-35), more variable dorsal fin, and utilization of very long (up to 30 min.), complex, repetitive vocalizations (songs) (Payne and McVay 1971) during courtship. Their grayish-black baleen plates, approximately 270-440 on each side of the jaw, are intermediate in length (6570 cm) to those of other baleen whales. Humpbacks in different geographical areas vary somewhat in body length, but maximum recorded size is 18m (Winn and Reichley 1985).

The whales are generally dark on the back, but the flippers, sides and ventral surface of the body and flukes may have substantial areas of natural white pigmentation plus acquired scars (white or black). Researchers distinguish individual humpbacks by the apparently unique black and white patterns on the underside of the flukes as well as other individually variable features (Glockner and Venus 1983; Katona and Whitehead 1981; Kaufman and Osmond 1987).

Distribution

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). In both regions, humpback whales tend to occupy shallow, coastal waters. However, migrations are undertaken through deep, pelagic waters (Winn and Reichley 1985).

In the North Pacific Ocean, the summer range of humpback whales includes 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 (Tomilin 1967, Nemoto 1957, Johnson and Wolman 1984 as cited in NMFS 1991). These whales migrate to Hawai'i, southern Japan, the Mariana Islands (Fulling et al. 2011), and Mexico during the winter. Most contemporary reports of humpback whales in the Marianas place them there from February and March (Fulling et al. 2011; SRS-Parsons 2007).

Population Structure

Descriptions of the population structure of humpback whales differ depending on whether an author focuses on where humpback whales winter or where they feed. During winter months in northern or southern hemispheres, adult humpback whales migrate to specific areas in warmer, tropical waters to reproduce and give birth to calves. During summer months, humpback whales migrate to specific areas in northern temperate or sub-arctic waters to forage. In summer months, humpback whales from different reproductive areas will congregate to feed; in the winter months, whales will migrate from different foraging areas to a single wintering area. In either case, humpback whales appear to form open populations; that is, populations that are connected through the movement of individual animals.

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). However, 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 Hawaiʹi, 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 Hawaiʹi 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.

Between 2004 and 2006, an international group of whale researchers coordinated their surveys to conduct a comprehensive assessment of the population structure, levels of abundance, and status of humpback whales in the North Pacific (Calambokidis et al. 2008). That effort identified a total of 7,971 unique individuals from photographs taken during close approaches.

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 Hawaiʹi and Mexico (with further mixing on feeding areas in Alaska) and suggested that humpback whales that winter in Hawai′i 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, at Guam, Rota, and Saipan from January-March (Darling and Cerchio 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 2008; Calambokidis 1997; Calambokidis et al. 2001).

Separate feeding groups of humpback whales are thought to inhabit western U.S. and Canadian waters, with the boundary between them located roughly at the U.S./Canadian border. The southern feeding ground ranges between 32°-48°N, with limited interchange with areas north of Washington State (Calambokidis et al. 2004; Calambokidis et al. 1996). Humpback whales feed along the coasts of Oregon and Washington from May-November, with peak numbers reported May-September, when they are the most commonly reported large cetacean in the region (Calambokidis and Chandler. 2000; Calambokidis et al. 2004; Dohl 1983; Green et al. 1992). Off Washington State, humpback whales concentrate between Juan de Fuca Canyon and the outer edge of the shelf break in a region called the Prairie, near Barkley and Nitnat canyons, in the Blanco upwelling zone, and near Swiftsure Bank (Calambokidis et al. 2004). Humpback whales also tend to congregate near Heceta Bank off the coast of Oregon (Green et al. 1992). Additional data suggest that further subdivisions in feeding groups may exist, with up to six feeding groups present between Kamchatka and southern California (Witteveen et al., 2009).

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).

Parasites and biotoxins from red-tide blooms are other potential causes of mortality (Perry et al. 1999a). 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

Three human activities are known to threaten humpback whales: whaling, commercial fishing, and shipping. Historically, whaling represented the greatest threat to every population of whales and was ultimately responsible for listing several species as endangered.

Humpback whales are also killed or injured during interactions with commercial fishing gear. Like fin whales, humpback whales have been entangled by fishing gear off Newfoundland and Labrador, Canada. 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. NMFS estimates that between 2002 and 2006, there were incidental serious injuries to 0.2 humpback whales annually in the Bering Sea/Aleutian Islands sablefish longline fishery. This estimation is not considered reliable. Observers have not been assigned to a number of fisheries known to interact with the Central and Western North Pacific stocks of humpback whale. In addition, the Canadian observation program is also limited and uncertain (Angliss and Allen 2009).

More humpback whales are killed in collisions with ships than any other whale species except fin whales (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). Of 123 humpback whales that stranded along the Atlantic coast of the U.S. between 1975 and 1996, 10 (8.1 percent) 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 percent.

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 (Metcalfe 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.

Status and Trends

Humpback whales were originally listed as endangered in 1970 (35 FR 18319), and this status remains under the ESA.

In the 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. 2009; 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. 1999a). Population estimates have risen over time from 1,407-2,100 in the 1980s to 6,010 in 1997 (Baker 1985; Baker and Herman. 1987; Calambokidis et al. 1997; Darling and Morowitz 1986). Based on surveys between 2004 and 2006, Calambokidis et al. (2008) estimated that the number of humpback whales in the North Pacific consisted of about 18,300 whales, not counting calves. 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 18,300 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 percent annually, but fluctuations have included negative growth in the recent past (Angliss and Outlaw 2005).

Critical Habitat

Critical habitat has not been designated for humpback whales.

North Pacific Right Whale

Right whales are large baleen whales. Adults are generally between 45 and 55 feet (13.7-16.7 m) in length and can weigh up to 70 tons (140,000 lbs; 63,502 kg). Females are larger than males. Calves are 13-15 feet (3.9-4.6 m) in length at birth. Distinguishing features for right whales include a stocky body, generally black coloration (although some individuals have white patches on their undersides), lack of a dorsal fin, a large head (about 1/4 of the body length), strongly bowed margin of the lower lip, and callosities (raised patches of roughened skin) on the head region. Two rows of long (up to eight feet in length) dark baleen plates hang from the upper jaw, with about 225 plates on each side. The tail is broad, deeply notched, and all black with a smooth trailing edge. Females give birth to their first calf at an average age of 9-10 years. Gestation lasts approximately 1 year. Calves are usually weaned toward the end of their first year. It is believed that right whales live at least 50 years, but there are few data on the longevity of right whales. There are indications that closely related species may live over 100 years.

Distribution

Historically, right whales occurred across the entire North Pacific Ocean from the western coast of North America to the Russian Far East (Scarff 1986; Brownell et al. 2001, Clapham et al. 2004, Shelden et al. 2005), and occurred in waters off Guam and the Mariana Islands (Clapham et al. 2004; Scarff 1986). Sightings in the twentieth century were from as far south as central Baja California, Mexico and the Yellow Sea, and as far north as the Bering Sea and the Okhotsk Sea (Goddard and Rugh 1998; Brownell et al. 2001). A recent comprehensive summary of all 20th century records of right whales in this ocean reported a total of 1,965 sightings, 741 catches and 13 strandings or entanglements (Brownell et al. 2001). Details for each sighting are provided for both the western (Brownell et al. 2001) and eastern (Brownell et al. 2001) populations. Clapham et al. (2004) plotted these data by month and discussed apparent seasonal movements (see below). Shelden et al. (2005) also plotted 20th century records and attempted to characterize the habitats used by this species. Despite many years of systematic aerial and ship-based surveys for marine mammals off the western coast of the U.S., only seven documented sightings of right whales were made from 1990 through 2000 (Waite et al. 2003).

In the last two decades, right whale sightings have been so rare in the eastern and central North Pacific that single sightings have often resulted in scientific publications (e.g., Rowntree et al.. 1980; Herman et al. 1980; Carretta et al. 1994; Rowlett et al. 1994; Goddard and Rugh 1998; Gendron et al. 1999; Salden and Mickelsen 1999, Waite et al. 2003). It is evident that there are markedly fewer sightings since 1964, which is now known to be due to large illegal Soviet catches of this species in the early 1960s (Doroshenko 2000). The current paucity of sightings of right whales in the eastern North Pacific is apparent despite high levels of survey effort in the region, notably from Japanese sighting surveys (Miyashita and Kato 1998). Recent summer sightings of right whales in the eastern Bering Sea (Goddard and Rugh 1998; Tynan 1998, 1999; Moore et al. 2000; LeDuc et al. 2001; Tynan et al. 2001, Wade et al. 2006) represent the first reliable observations of associated groups in the eastern North Pacific since the 1960s.

Sightings of right whales have been made with greater regularity in the western North Pacific, notably in the Okhotsk Sea, Kuril Islands and adjacent areas (Brownell et al. 2001)(see section 4.2.2). It is clear that abundance here is significantly larger than in the eastern North Pacific although there is no agreement on current abundance. In the western North Pacific Ocean, feeding areas occur in the Okhotsk Sea and adjacent waters along the coasts of Kamchatka and the Kuril Islands (IWC 2001a). Historical concentrations of sightings in the Bering Sea together with some recent sightings indicate that this region, together with the Gulf of Alaska, was an important summer habitat for eastern North Pacific right whales (Scarff 1986; Goddard and Rugh 1998; Brownell et al. 2001, Clapham et al. 2004, Shelden et al. 2005).

Little is known regarding the migratory behavior of either the western or eastern North Pacific whales. Historical sighting and catch records provide the only information on possible migration patterns for North Pacific right whales (Omura 1958; Omura et al. 1969; Scarff 1986). During summer, whales were found in the Gulf of Alaska, along both coasts of the Kamchatka Peninsula, the Kuril Islands, the Aleutian Islands, the southeastern Bering Sea and in the Okhotsk Sea. Fall and spring distribution was the most widely dispersed, with whales occurring in mid-ocean waters and extending from the Sea of Japan to the eastern Bering Sea. In winter, right whales were found in the Ryukyu Islands (south of Kyushu, Japan), the Bonin Islands, the Yellow Sea and the Sea of Japan. The current distribution patterns and migration routes of these whales are not known.

Right whales are frequently found in coastal or shelf waters. Such sightings, however, may be partially a function of survey effort, and thus may not reflect current or historical distribution. Sighting records also indicate that right whales occur far offshore, and movements over abyssal depths are known (Scarff 1986; Mate et al. 1997). Clapham et al. (2004) plotted 20th century records together with data summarized from 19th century whaling catches. These plots show that right whales had an extensive offshore distribution in the 19th century, and were common in areas where few or no right whales occur today. Seasonal movements of right whales were apparent in the data, and were characterized by a general northward migration in spring from lower latitudes and major concentrations above 40^{o} N in summer. Sightings diminished and occurred further south in autumn, and very few animals were recorded anywhere in winter.

Whalers never reported winter calving areas in the North Pacific and where calving occurs remains unknown (Scarff 1986, Clapham et al. 2004). Overall, these analyses confirmed that the size and range of the right whale population is now considerably diminished in the North Pacific relative to the situation during the peak period of whaling for this species in the 19th century.

Tynan et al. (2001) suggested that right whales had changed their distribution in the last 50 years. These researchers reached this conclusion based on the frequency of recent sightings in one area of the southeastern Bering Sea (known as the "Box"). Contrary to the assertion in their paper, the major whaling period for this species was not the 1940s to 1960s, but from 1835 to the 1850s, and the reduction in both numbers and range is evident in sightings and catch data (Clapham et al. 2004, Shelden et al. 2005). The population underwent slow recovery in the 20thcentury, but was decimated again by the illegal Soviet whaling noted above. By focusing on only the recent hunting history, Tynan et al. (2001) mistakenly concluded that a habitat shift has occurred when in reality the whales they found on their surveys were in a small (but historically well-documented) portion of their former range. Furthermore, Tynan et al.'s survey coverage was not adequate to document any absence of whales from other historic habitats. This was further reinforced by the discovery in the summer of 2004 of some 24 right whales (the largest concentration observed in the eastern North Pacific in decades) outside the "Box" (Wade et al. 2006) and again in October 2005 when about 12 right whales were observed just north of Unimak Pass (NMML unpublished data). North Pacific right whales inhabit the Pacific Ocean, particularly between 20° and 60° latitude. A survey of historic whaling records indicates that right whales ranged across the entire North Pacific, north of 35°N and occasionally as far south as 20°N (Rosenbaum et al. 2000; Angliss and Outlaw 2006). Before commercial whalers heavily exploited right whales in the North Pacific, concentrations were found in the Gulf of Alaska, eastern Aleutian Islands, south central Bering Sea, Sea of Okhotsk, and Sea of Japan.

Population Trends

There are no reliable estimates of current abundance or trends for right whales in the North Pacific. However, the pre-exploitation size of this stock exceeded 11,000 animals.

In general, there are no data on trends in abundance for either the eastern or western population. For the western North Pacific, sighting survey estimates for the summer feeding ground indicate an abundance of around 900 in the Sea of Okhotsk. It is clear that this population is significantly larger than that in the eastern North Pacific. Over the past forty years, most sightings in the eastern North Pacific have been of single whales. However, during the last few years, small groups of right whales have been sighted. This is encouraging but there has been only one confirmed sighting of calves in the 20th century. Further, the North Pacific animals are known to have been subjected to large illegal Soviet catches in the early 1960s.

No reliable estimates of current abundance or trends for right whales in the North Pacific exist (Angliss and Outlaw, 2006). Sightings in Hawaiian waters are rare. A sighting near Maui in 1996 (Salden and Mickelsen 1999) was the first since 1979 (Herman et al. 1980, Rowntree et al. 1980). The minimum estimate of abundance of North Pacific right whales is 17 based on photo-identification of uniquely identifiable individuals. An estimate of abundance is not yet available (Allen and Angliss 2011) nor is any information regarding population trends.

Very little is known about right whales in the eastern North Pacific, which were severely depleted by commercial whaling in the 1800s (Brownell et al. 2001). In the last several decades there have been markedly fewer sightings due to the drastic reduction in number, caused by illegal Soviet whaling in the 1960s (Doroshenko 2000).

Anthropogenic Threats

In the North Pacific, ship strikes and entanglements may pose a threat to right whales. The role vessel interactions play in the mortality of North Pacific right whales is not known. In the North Atlantic, ship collisions and fishing gear entanglements are the most common direct known causes of mortality in North Atlantic right whales (Kraus 1990; Knowlton and Kraus 2001; Gillespie and Leaper 2001), but little is known of the nature or extent of this problem in the North Pacific. The area where right whales have been seen in recent surveys is not in a major vessel traffic lane. However, the proximity of the other known right whale habitats to shipping lanes (e.g. Unimak Pass) suggests that collisions with vessels may represent a threat to North Pacific right whales. Because of the rarity of right whales, the impact to the species from even low levels of interaction could be significant. Life history characteristics such as low reproductive rates, delayed sexual maturity, and reliance on high juvenile survivorship make long-lived species such as whales particularly vulnerable to demographic risks posed by anthropogenic related mortalities. Until recently, it was thought that the right whale had been extirpated from the eastern North Pacific Ocean. Recent sightings suggest that the abundance in the eastern North Pacific is indeed very small, perhaps in the tens of animals.

The life history characteristics and habitat requirements of this species make it extremely vulnerable to environmental variation and demographic stochasticity at such low numbers. Right whale life history characteristics make them very slow to adapt to rapid changes in their habitat (see Reynolds et al. 2002). They are also feeding specialists that require exceptionally high densities of their prey (see Baumgartner and Mate 2003, Baumgartner et al. 2003). Zooplankton abundance and density in the Bering Sea has been shown to be highly variable, affected by climate, weather, and ocean processes and in particular ice extent (Napp and Hunt 2001, Baier and Napp 2003).

Status and Trends

In 2008, NMFS listed the endangered ***northern right whale*** (*Eubalaena spp.*) as two separate, endangered species, North Pacific right whale (*E. japonica*) and North Atlantic right whale (*E. glacialis*) (73 FR 12024).

Recently released information (Yablokov 1994; Doroshenko 2000; Brownell et al. 2001) indicates that Soviet whalers caught 372 right whales in the Bering Sea, Aleutian Islands and Gulf of Alaska, mostly over a three-year period in the 1960s. The continued illegal exploitation of North Pacific right whales further reduced abundance in the eastern North Pacific. Despite high levels of survey effort in the region, most notably from Japanese sighting surveys (Miyashita and Kato 1998) right whale sightings in the eastern North Pacific have been rare and geographically scattered (Perry et al, 1999). Recent sightings of right whales in the eastern Bering Sea during the summer (Goddard and Rugh 1998; Tynan 1998, 1999; Moore et al. 2000; LeDuc et al. 2001; Tynan et al 2001; Wade et al. 2006) represent the first reliable observations of aggregations of right whales in the eastern North Pacific since the 1960s. Although a few calves have recently been documented in the eastern North Pacific (Goddard and Rugh 1998; LeDuc 2004; Wade et al. 2006), these were the first such sightings in over a century (Brownell et al. 2001).

From sighting data collected during minke whale surveys, Miyashita and Kato (1998) an abundance estimate of 900 right whales for the western North Pacific. These surveys covered only a small portion (50-56°N, 143°E, Kamchatka Peninsula) of the historic range in the western North Pacific. The associated confidence limits of these estimates were large (404 to 2,108) and it is likely that this number will be revised. Given this, and levels of recent sightings in the western North Pacific (Brownell et al. 2001), it is clear that abundance is significantly larger than that in the eastern North Pacific. Calves have been observed with some regularity in the western North Pacific (Miyashita and Kato 1998, Brownell et al. 2001), which appears large enough to sustain reproduction.

Critical Habitat

In April 2008, because the North Pacific right whale was listed as a separate, endangered species (the "northern right whale"), and because this was a newly listed entity, NMFS was required to designate critical habitat for the "North Pacific right whale." The same two areas, within the Gulf of Alaska and within the Bering Sea, that were previously designated as critical habitat in 2006 (71 FR 38277) for the northern right whale are now designated as critical habitat for the North Pacific right whale (73 FR 19000).

Sei Whale

Sei whales (pronounced "say" or "sigh"; *Balaenoptera borealis*) are members of the baleen whale family and are considered one of the "great whales" or rorquals. Two subspecies of sei whales are recognized, *B. b. borealis* in the Northern Hemisphere and *B. b. schlegellii* in the Southern Hemisphere.

These large animals can reach lengths of about 40-60 ft (12-18 m) and weigh 100,000 lbs (45,000 kg). Females may be slightly longer than males. Sei whales have a long, sleek body that is dark bluish-gray to black in color and pale underneath. The body is often covered in ovalshaped scars (probably caused from cookie-cutter shark and lamprey bites) and sometimes has subtle "mottling". This species has an erect "falcate", "dorsal" fin located far down (about twothirds) the animals back. They often look similar in appearance to Bryde's whales, but can be distinguished by the presence of a single ridge located on the animal's "rostrum". Bryde's whales, unlike other rorquals, have three distinct prominent longitudinal ridges on their rostrum. Sei whales have 219-410 baleen plates that are dark in color with gray/white fine inner fringes in their enormous mouths. They also have 30-65 relatively short ventral pleats that extend from below the mouth to the naval area. The number of throat grooves and baleen plates may differ depending on geographic population.

The Sei is regarded as the fastest swimmer among the great whales, reaching bursts of speed in excess of 20 knots. When a sei whale begins a dive it usually submerges by sinking quietly below the surface, often remaining only a few meters deep, leaving a series of swirls or tracks as it move its flukes. When at the water's surface, sei whales can be sighted by a columnar or bushy blow that is about 10-13 ft (3-4 m) in height. The dorsal fin usually appears at the same time as the blowhole, when the animal surfaces to breathe. This species usually does not arch its back or raise its flukes when diving.

Sei whales become sexually mature at 6-12 years of age when they reach about 45 ft (13 m) in length, and generally mate and give birth during the winter in lower latitudes. Females breed every 2-3 years, with a gestation period of 11-13 months. Females give birth to a single calf that is about 15 ft (4.6 m) long and weighs about 1,500 lbs (680 kg). Calves are usually nursed for 6-9 months before being weaned on the preferred feeding grounds. Sei whales have an estimated lifespan of 50-70 years.

Distribution

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

In the western Atlantic Ocean, sei whales occur from Nova Scotia and Labrador in the summer months and migrate south to Florida, the Gulf of Mexico, and the northern Caribbean (Gambell 1985b). In the eastern Atlantic Ocean, sei whales occur in the Norwegian Sea (as far north as Finnmark in northeastern Norway), occasionally occurring as far north as Spitsbergen Island, and migrate south to Spain, Portugal, and northwest Africa (Gambell 1985b).

In the North Pacific Ocean, sei whales occur from the Bering Sea south to California (on the east) and the coasts of Japan and Korea (on the west). During the winter, sei whales are found from 20°-23°N (Gambell 1985b; Masaki 1977).

Sei whales occur throughout the Southern Ocean during the summer months, although they do not migrate as far south to feed as blue or fin whales. During the austral winter, sei whales occur off Brazil and the western and eastern coasts of Southern Africa and Australia.

Population Structure

The population structure of sei whales is not well defined, but presumed to be discrete by ocean basin (north and south), except for sei whales in the Southern Ocean, which may form a ubiquitous population or several discrete ones.

<u>North Pacific</u>. Some mark-recapture, catch distribution, and morphological research indicate more than one population may exist – one between 155°-175° W, and another east of 155° W (Masaki 1976; Masaki 1977). During marine mammal and sea turtles surveys conducted in the Mariana Islands from January through April 2007, sei whales were observed in the offshore areas of Guam and the Mariana Islands south to nearly 10° N (SRS-Parsons 2007). During these surveys, sei whales were most commonly observed in waters between 3,164 and 9,322 m (10,381

– 30,583 ft) in depth; all of these sightings were south of Saipan (about 15°N). Sei whales have been reported primarily south of the Aleutian Islands, in Shelikof Strait and waters surrounding Kodiak Island, in the Gulf of Alaska, and inside waters of southeast Alaska and south to California to the east and Japan and Korea to the west (Leatherwood et al. 1982; Nasu 1974). Sightings have also occurred in Hawaiian waters (Smultea et al. 2010). Sei whales have been occasionally reported from the Bering Sea and in low numbers on the central Bering Sea shelf (Hill and DeMaster 1998). Whaling data suggest that sei whales do not venture north of about 55°N (Gregr et al. 2000). Masaki (1977) reported sei whales concentrating in the northern and western Bering Sea from July-September, although other researchers question these observations because no other surveys have reported sei whales in the northern and western Bering Sea. Horwood (1987) evaluated Japanese sighting data and concluded that sei whales rarely occur in the Bering Sea. Horwood (1987) reported that 75-85 percent of the North Pacific population resides east of 180°. During winter, sei whales are primarily found from 20°-23° N (Gambell 1985b; Masaki 1977). Considering the many British Columbia whaling catches in the early to mid 1900s, sei whales have clearly utilized this area in the past (Gregr et al. 2000; Pike and Macaskie 1969).

Sei whales appear to prefer to forage in regions of steep bathymetric relief, such as continental shelf breaks, canyons, or basins situated between banks and ledges (Best and Lockyer. 2002; Gregr and Trites. 2001; Kenney and Winn. 1987), where local hydrographic features appear to help concentrate zooplankton, especially copepods. In their foraging areas, sei whales appear to associate with oceanic frontal systems (Horwood 1987). In the north Pacific, sei whales are found feeding particularly along the cold eastern currents (Perry et al. 1999a).

Natural Threats

The foraging areas of right and sei whales in the western North Atlantic Ocean overlap and both whales feed preferentially on copepods (Mitchell 1975).

Andrews (1916) suggested that killer whales attacked sei whales less frequently than fin and blue whales in the same areas. Sei whales engage in a flight responses to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Endoparasitic helminths (worms) are commonly found in sei whales and can result in pathogenic effects when infestations occur in the liver and kidneys (Rice 1977).

Anthropogenic Threats

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

Sei whales, because of their offshore distribution and relative scarcity in U.S. Atlantic and Pacific waters, probably have a lower incidence of entrapment and entanglement than fin whales. Data on entanglement and entrapment in non-U.S. waters are not reported systematically. Heyning and Lewis (1990) made a crude estimate of about 73 rorquals killed/year in the southern California offshore drift gillnet fishery during the 1980s. Some of these may have been fin whales instead of sei whales. Some balaenopterids, particularly fin whales, may also be taken in the drift gillnet fisheries for sharks and swordfish along the Pacific coast of Baja California, Mexico (Barlow et al. 1997). Heyning and Lewis (1990) suggested that most whales killed by offshore fishing gear do not drift far enough to strand on beaches or to be detected floating in the nearshore corridor where most whale-watching and other types of boat traffic occur. Thus, the small amount of documentation may not mean that entanglement in fishing gear is an insignificant cause of mortality. Observer coverage in the Pacific offshore fisheries has been too low for any confident assessment of species-specific entanglement rates (Barlow et al. 1997). The offshore drift gillnet fishery is the only fishery that is likely to take sei whales from this stock, but no fishery mortalities or serious injuries to sei whales have been observed. Sei whales, like other large whales, may break through or carry away fishing gear. Whales carrying gear may die later, become debilitated or seriously injured, or have normal functions impaired, but with no evidence recorded.

Sei whales are occasionally killed in collisions with vessels. Of three sei whales that stranded along the U.S. Atlantic coast between 1975 and 1996, two showed evidence of collisions (Laist et al. 2001). Between 1999 and 2005, there were three reports of sei whales being struck by vessels along the U.S. Atlantic coast and Canada‘s Maritime Provinces (Cole et al. 2005; Nelson et al. 2007). Two of these ship strikes were reported as having resulted in death. One sei whale was killed in a collision with a vessel off the coast of Washington in 2003 (Waring et al. 2009). New rules for seasonal (June through December) slowing of vessel traffic in the Bay of Fundy to 10 knots and changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are predicted to reduce sei whale ship strike mortality by 17 percent.

Sei whales are known to accumulate DDT, DDE, and PCBs (Borrell 1993; Borrell and Aguilar 1987; Henry and Best 1983). Males carry larger burdens than females, as gestation and lactation transfer these toxins from mother to offspring.

Status and Trends

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

Ohsumi and Fukuda (1975) estimated that sei whales in the North Pacific numbered about 49,000 whales in 1963, had been reduced to 37,000-38,000 whales by 1967, and reduced again to 20,600-23,700 whales by 1973. From 1910-1975, approximately 74,215 sei whales were caught in the entire North Pacific Ocean (Horwood 1987; Perry et al. 1999a). From the early 1900s, Japanese whaling operations consisted of a large proportion of sei whales: 300-600 sei whales were killed per year from 1911-1955. The sei whale catch peaked in 1959, when 1,340 sei whales were killed. In 1971, after a decade of high sei whale catch numbers, sei whales were scarce in Japanese waters. Japanese and Soviet catches of sei whales in the North Pacific and Bering Sea increased from 260 whales in 1962 to over 4,500 in 1968-1969, after which the sei whale population declined rapidly (Mizroch et al. 1984). When commercial whaling for sei whales ended in 1974, the population in the North Pacific had been reduced to 7,260-12,620 animals (Tillman 1977). There have been no direct estimates of sei whale populations for the eastern Pacific Ocean (or the entire Pacific). Between 1991 and 2001, during aerial surveys, there were two confirmed sightings of sei whales along the U.S. Pacific coast.

Sei whales are known to occur in the Gulf of Alaska and as far north as the Bering Sea in the north Pacific. However, their distribution is poorly understood. The only stock estimate for U.S. waters is for the eastern north Pacific stock offshore California, Oregon and Washington (Carretta et al. 2009); abundance in Alaskan waters is unknown and they have not been sighted during recent surveys (Rone et al. 2010; Waite et al. 2003).

Critical Habitat

Critical habitat has not been designated for sei whales.

Sperm Whale

Sperm whales (*Physeter macrocephalus*) are the largest of the odontocetes (toothed whales) and the most sexually dimorphic cetaceans, with males considerably larger than females. Adult females may grow to lengths of 36 ft (11 m) and weigh 15 tons (13,607 kg). Adult males, however, reach about 52 ft (16 m) and may weigh as much as 45 tons (40,823 kg).

The sperm whale is distinguished by its extremely large head, which takes up to 25 to 35 percent of its total body length. It is the only living cetacean that has a single blowhole asymmetrically situated on the left side of the head near the tip. Sperm whales have the largest brain of any animal (on average 17 pounds (7.8 kg) in mature males), however, compared to their large body size, the brain is not exceptional in size.

There are between 20-26 large conical teeth in each side of the lower jaw. The teeth in the upper jaw rarely erupt and are often considered to be vestigial. It appears that teeth may not be necessary for feeding, since they do not break through the gums until puberty, if at all, and healthy sperm whales have been caught that have no teeth.

Sperm whales are mostly dark gray, but oftentimes the interior of the mouth is bright white, and some whales have white patches on the belly. Their flippers are paddle-shaped and small compared to the size of the body, and their flukes are very triangular in shape. They have small dorsal fins that are low, thick, and usually rounded.

Distribution

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

Population Structure

There is no clear understanding of the global population structure of sperm whales (Dufault et al. 1999). Recent ocean-wide genetic studies indicate low, but statistically significant, genetic diversity and no clear geographic structure, but strong differentiation between social groups

(Lyrholm and Gyllensten 1998; Lyrholm et al. 1996; Lyrholm et al. 1999). The IWC currently recognizes four sperm whale stocks: North Atlantic, North Pacific, northern Indian Ocean, and Southern Hemisphere (Dufault et al. 1999; Reeves and Whitehead 1997). The NMFS recognizes six stocks under the MMPA- three in the Atlantic/Gulf of Mexico and three in the Pacific (Alaska, California-Oregon-Washington, and Hawai′i; (Perry et al. 1999b; Waring et al. 2004). Genetic studies indicate that movements of both sexes through expanses of ocean basins are common, and that males, but not females, often breed in different ocean basins than the ones in which they were born (Whitehead 2003). Sperm whale populations appear to be structured socially, at the level of the clan, rather than geographically (Whitehead 2003; Whitehead 2008). During marine mammal and sea turtles surveys conducted in the Mariana Islands from January through April 2007 (Fulling et al. 2011; SRS-Parsons 2007), sperm whales were encountered (visually or acoustically) more frequently than any other cetacean; they were detected acoustically three times more than they were observed.(Croll et al. 1999b).

Sperm whales are found throughout the North Pacific and are distributed broadly in tropical and temperate waters to the Bering Sea as far north as Cape Navarin in summer, and occur south of 40o N in winter (Gosho et al. 1984; Miyashita et al. 1995 as cited in Carretta et al. 2005; Rice 1974). Sperm whales are found year-round in Californian and Hawaiian waters (Barlow 1995; Dohl 1983; Forney et al. 1995; Shallenberger 1981). They are seen in every season except winter (December-February) in Washington and Oregon (Green et al. 1992). Summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993). Summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993).

Natural Threats

Sperm whales are known to be occasionally predated upon by killer whales (Jefferson et al. 1991; Pitman et al. 2001) by pilot whales (Arnbom et al. 1987; Palacios and Mate. 1996; Rice 1989; Weller et al. 1996; Whitehead et al. 1997) and large sharks (Best et al. 1984) and harassed by pilot whales (Arnbom et al. 1987; Palacios and Mate. 1996; Rice 1989; Weller et al. 1996; Whitehead et al. 1997). Strandings are also relatively common events, with one to dozens of individuals generally beaching themselves and dying during any single event. Although several hypotheses, such as navigation errors, illness, and anthropogenic stressors, have been proposed (Goold et al. 2002; Wright 2005), direct widespread causes remain unclear. Calcivirus and papillomavirus are known pathogens of this species (Lambertsen et al. 1987; Smith and Latham 1978).

Anthropogenic Threats

Sperm whales historically faced severe depletion from commercial whaling operations. From 1800 to 1900, the IWC estimated that nearly 250,000 sperm whales were killed by whalers, with another 700,000 from 1910 to 1982 (IWC Statistics 1959-1983). However, other estimates have included 436,000 individuals killed between 1800-1987 (Carretta et al. 2005). However, all of these estimates are likely underestimates due to illegal killings and inaccurate reporting by Soviet whaling fleets between 1947 and 1973. In the Southern Hemisphere, these whalers killed an estimated 100,000 whales that they did not report to the IWC (Yablokov et al. 1998), with smaller harvests in the Northern Hemisphere, primarily the North Pacific, that extirpated sperm whales from large areas (Yablokov 2000). Additionally, Soviet whalers disproportionately killed adult females in any reproductive condition (pregnant or lactating) as well as immature sperm whales of either gender.

Following a moratorium on whaling by the IWC, significant whaling pressures on sperm whales were eliminated. However, sperm whales are known to have become entangled in commercial fishing gear and 17 individuals are known to have been struck by vessels (Jensen and Silber 2004). Whale-watching vessels are known to influence sperm whale behavior (Richter et al. 2006).

In U.S. waters in the Pacific, sperm whales have been incidentally taken only in drift gillnet operations, which killed or seriously injured an average of nine sperm whales per year from 1991-1995 (Barlow et al. 1997).

Interactions between sperm whales and longline fisheries in the Gulf of Alaska have been reported since 1995 and are increasing in frequency (Hill and DeMaster 1998; Hill et al. 1999; Rice 1989). Between 2002 and 2006, there were three observed serious injuries (considered mortalities) to sperm whales in the Gulf of Alaska from the sablefish longline fishery (Angliss and Outlaw 2008). Sperm whales have also been observed in Gulf of Alaska feeding off longline gear (for sablefish and halibut) at 38 of the surveyed stations (Angliss and Outlaw 2008). Recent findings suggest sperm whales in Alaska may have learned that fishing vessel propeller cavitations (as gear is retrieved) are an indicator that longline gear with fish is present as a predation opportunity (Thode et al. 2007).

Contaminants have been identified in sperm whales, but vary widely in concentration based upon life history and geographic location, with northern hemisphere individuals generally carrying higher burdens (Evans et al. 2004). Contaminants include dieldrin, chlordane, DDT, DDE, PCBs, HCB and HCHs in a variety of body tissues (Aguilar 1983; Evans et al. 2004), as well as several heavy metals (Law et al. 1996). However, unlike other marine mammals, females appear to bioaccumulate toxins at greater levels than males, which may be related to possible dietary differences between females who remain at relatively low latitudes compared to more migratory males (Aguilar 1983; Wise et al. 2009). Chromium levels from sperm whales skin samples worldwide have varied from undetectable to 122.6 μg Cr/g tissue, with the mean (8.8 μg Cr/g tissue) resembling levels found in human lung tissue with chromium-induced cancer (Wise et al. 2009). Older or larger individuals did not appear to accumulate chromium at higher levels.

Status and Trends

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

There are approximately 76,803 sperm whales in the eastern tropical Pacific, eastern North Pacific, Hawai′i, and western North Pacific (Whitehead 2002a). Minimum estimates in the eastern North Pacific are 1,719 individuals and 5,531 in the Hawaiian Islands (Carretta et al. 2007). The tropical Pacific is home to approximately 26,053 sperm whales and the western North Pacific has approximately 29,674 (Whitehead 2002a). There was a dramatic decline in the number of females around the Galapagos Islands during 1985-1999 versus 1978-1992 levels, likely due to migration to nearshore waters of South and Central America (Whitehead and Mesnick 2003).

Hill and DeMaster (1999) concluded that about 258,000 sperm whales were harvested in the North Pacific between 1947-1987. Although the IWC protected sperm whales from commercial harvest in 1981, Japanese whalers continued to hunt sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). In 2000, the Japanese Whaling Association announced plans to kill 10 sperm whales in the Pacific Ocean for research. Although consequences of these deaths are unclear, the paucity of population data, uncertainly regarding recovery from whaling, and reestablishment of active programs for whale harvesting pose risks for the recovery and survival of this species. Sperm whales are also hunted for subsistence purposes by whalers from Lamalera, Indonesia, where a traditional whaling industry has been reported to kill up to 56 sperm whales per year.

Critical Habitat

Critical habitat has not been designated for sperm 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 listed species of whales in the action area. The *Environmental baseline* focuses primarily on past and present impacts to these species.

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

The following discussion summarizes the natural and human phenomena in the action area that may affect the likelihood these species will survive and recover in the wild. These include directed harvest, fisheries interactions, ship strikes, noise, predation, disease and parasitism, contaminants, and scientific research.

Climate change

In general, based on forecasts made by the Intergovernmental Panel on Climate Change (IPCC), climate change is projected to have substantial effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the near future (IPCC 2000; IPCC 2001a; IPCC 2001b; IPCC 2002). From 1906 to 2006, global surface temperatures have risen 0.74º C and continue to rise at an accelerating pace; 11 or the 12 warmest years on record since 1850 have occurred since 1995 and the past decade has been the warmest in instrumental history (Arndt et al. 2010; Poloczanska et al. 2009). Furthermore, the Northern Hemisphere (where a greater proportion of ESA-listed species occur) is warming faster than the Southern Hemisphere, although land temperatures are rising more rapidly than over the oceans (Poloczanska et al. 2009). Climate change will result in increases in atmospheric temperatures, changes in sea surface temperatures, patterns of precipitation, and sea level. Sea levels have risen an average of 1.7 mm/year over the 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 longterm wind patterns over the Pacific Ocean (Poloczanska et al. 2009).

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

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

Species that are shorter-lived, have larger body sizes, or are generalist in nature are liable to be better able to adapt to climate change over the long term versus those that are longer-lived, smaller-sized, or rely upon specialized habitats (Brashares 2003; Cardillo 2003; Cardillo et al. 2005; Isaac 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 2008e).

Habitat degradation

A number of factors may be directly or indirectly affecting listed marine 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 noises that could affect ambient noise arise from the following general types of activities in and near the sea, any combination of which can contribute to the total noise at any one place and time. These noises include transportation and shipping traffic, dredging, construction activities; oil, gas, and mineral exploration in offshore areas; geophysical (seismic) surveys; sonars; explosions; and ocean research activities (Richardson et al., 1995).

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; McDonald et al. 2006; (Jasny et al., 2005; NRC, 1994, 2000, 2003, 2005; Richardson et al., 1995). Much of this increase is due to increased shipping as ships become more numerous and of larger tonnage (NRC, 2003). 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).

Commercial fishing vessels, cruise ships, transport boats, airplanes, helicopters and recreational boats all contribute sound into the ocean (NRC, 2003). The military uses sound to test the construction of new vessels, as well as for naval operations. In some areas where oil and gas production takes place, noise originates from the drilling and production platforms, tankers, vessel and aircraft support, seismic surveys, and the explosive removal of platforms (NRC, 2003).

Many researchers have described behavioral responses of marine mammals to the sounds produced by helicopters and fixed-wing aircraft, boats and ships, as well as dredging, construction, geological explorations, etc. (Richardson et al., 1995). Most observations have been limited to short-term behavioral responses, which included cessation of feeding, resting, or social interactions. Several studies have demonstrated short-term effects of disturbance on humpback whale behavior (Baker et al., 1983; Bauer and Herman, 1986; Hall, 1982; Krieger and Wing, 1984) but the long-term effects, if any, are unclear or not detectable. Carretta et al. (2001) and Jasny et al. (2005) identified the increasing levels of anthropogenic noise as a habitat concern for whales because of its potential effect on their ability to communicate.

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

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. (2010) 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).

In-water construction activities (e.g., pile driving associated with shoreline projects) in both inland waters as well as coastal waters in the action area can produce sound levels sufficient to disturb marine mammals under some conditions. Pressure levels from 190-220 dB re 1 μPa were reported for piles of different sizes in a number of studies (NMFS 2006b). The majority of the sound energy associated with pile driving is in the low frequency range (<1,000 Hz) (Illingworth and Rodkin Inc. 2001; Illingworth and Rodkin Inc. 2004; Reyff 2003). Dredging operations also have the potential to emit sounds at levels that could disturb marine mammals. Depending on the type of dredge, peak sound pressure levels from 100 to 140 dB re 1 μPa were reported in one study (Clarke et al. 2003). As with pile driving, most of the sound energy associated with dredging is in the low-frequency range, <1000 Hz (Clarke et al. 2003).

Several measures have been adopted to reduce the sound pressure levels associated with in-water construction activities or prevent exposure of marine mammals to sound. For example, a six inch block of wood placed between the pile and the impact hammer used in combination with a bubble curtain can reduce sound pressure levels by about 20 dB (NMFS 2008e). Alternatively, pile driving with vibratory hammers produces peak pressures that are about 17 dB lower than those generated by impact hammers (Nedwell and Edwards 2002). Other measures used in the action area to reduce the risk of disturbance from these activities include avoidance of in-water construction activities during times of year when marine mammals or listed salmon may be present; monitoring for marine mammals during construction activities; and maintenance of a buffer zone around the project area, within which sound-producing activities would be halted when marine mammals enter the zone (NMFS 2008e).

Marine features in the central and northeastern Pacific are also subject to degradation. The continental shelf off Oregon and Washington is cut by numerous submarine canyons, which tend to trap sediments and pollutants associated with discharges stemming from coastal development (Airamé et al. 2003). Seamounts are hotspots for marine biodiversity, particularly for large pelagic species (Morato et al. 2010). These areas are sensitive to fishery impacts due to the high level of endemism characteristic of this habitat. Species that inhabit seamounts tend to be long-lived and do not move widely between seamounts, meaning that their recovery can be very slow (Johnston and Santillo 2004; Richer de Forges et al. 2000). As several listed species appear to be drawn to seamounts, apparently due to prey availability there, the deterioration of the habitat could have significant effects on listed species.

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.

Ingestion of marine debris can have fatal consequences even for large whales. In 1989, a stranded sperm whale along the Mediterranean was found to have died from ingesting plastic that blocked its' digestive tract (Viale et al. 1992). A sperm whale examined in Iceland had a lethal disease thought to have been caused by the complete obstruction of the gut with plastic marine debris (Lambertsen 1990). The stomach contents of two sperm whales that stranded separately in California included extensive amounts of discarded fishing netting (NMFS 2009). A fifth individual from the Pacific was found to contain nylon netting in its stomach when it washed ashore in 2004 (NMFS 2009). Further incidents may occur but remain undocumented when carcasses do not strand. North Pacific sperm whales may be exposed to high levels of marine debris due to trash accumulation in the North Pacific Gyre, which is estimated to contain 90.7 million metric tons of marine debris (Marks and Howden 2008).

Directed harvest

U.S. Commercial harvest of large whale species no longer occurs, and the IWC has moratoriums in place to protect species from commercial whaling internationally. Nonetheless, historical whaling significantly reduced large whale abundance, and the effects of these reductions likely still persist.

Although the IWC protected sperm whales from commercial harvest in 1981, Japanese whalers continued to hunt sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). In 2000, the Japanese Whaling Association announced plans to kill 10 sperm whales in the Pacific Ocean for research. Although consequences of these deaths are unclear, the paucity of population data, uncertainly regarding recovery from whaling, and re-establishment of active programs for whale harvesting pose risks for the recovery and survival of this species. Sperm whales are also hunted for subsistence purposes by whalers from Lamalera, Indonesia, where a traditional whaling industry has been reported to take up to 56 sperm whales per year. Japan also kills up to 101 sei whales annually (IWC 2008).

Fisheries interactions

Entrapment and entanglement in fishing gear is a significant problem for several marine mammal species, and is a frequently documented source of human-caused mortality in large whale species (see Dietrich et al., 2007). 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 rorquals 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 population 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. From 2003 to 2007, there were 86 reports of human-related mortalities or injuries for the central North Pacific stock of humpbacks. Of these, 54 incidents involved commercial fishing gear, and 23 of those incidents involved serious injuries or mortalities. This estimate is considered a minimum because not all entangled animals strand and not all stranded animals are found, reported, or cause of death determined (Allen and Angliss, 2010).

Sperm whales are known to have been incidentally taken in drift gillnet operations, which killed or seriously injured an average of nine sperm whales annually from 1991-1995 (Barlow et al. 1997). Sperm whales have been bycaught in pelagic drift gillnets along the U.S. east coast and in artisanal gillnets targeting sharks and large pelagic fishes off the Pacific coasts of northwestern South America, Central America, and Mexico (Gerrodette and Palacios 1996; Waring et al. 1997). An individual was caught and released from gillnetting, although injured, on Georges Bank during 1990. A second individual was freed, but injured, from gillnetting on George's Bank in 1995. In 1994, a sperm whale was disentangled from gillnet along the coast of Maine.

Interactions between longline fisheries and sperm whales have been common over the past decade (Rice 1989; Hill and DeMaster 1999). Between 1994 and 2002, one sperm whale was observed entangled within the Hawaiian Islands EEZ in the Hawaii-based longline fishery and was able to free itself without injury (Forney 2004). In August 1993, a dead sperm whale, with longline gear wound tightly around the jaw, was found floating ~32 km off Maine.

False killer whales in Hawaiian waters have been seen to take catches from longline and trolling lines (Nitta and Henderson, 1993; Shallenberger et al., 1981). Interactions with longline and troll fishery operations appear to result in disfigurement to dorsal fins, with roughly 4% of the population showing this injury, as well as entanglement and hooking (Baird and Gorgone, 2005; Forney and Kobayashi., 2007; McCracken and Forney, 2010; Nitta and Henderson, 1993; Shallenberger et al., 1981; Zimmerman, 1983). Carretta et al. (2009) estimated that 7.4 individuals per year are killed or seriously injured during the course of fishing operations in the Hawaiian EEZ. In this area, false killer whales are the most frequently hooked or entangled cetacean species, with most interactions occurring in tuna-targeting longline operations (Forney and Kobayashi., 2007; McCracken and Forney, 2010). In total, 31 observations of serious injury or mortality have been documented from 1994-2008, which has led to an estimated 13 false killer whales killed or seriously injured throughout the Hawaiian longline fishery (Forney and Kobayashi., 2007; McCracken and Forney, 2010), although most interactions occurred well beyond the range known for the Hawaiian insular DPS (McCracken and Forney, 2010). In addition, false killer whales depredate on catches from shortline fisheries at least off northern Maui, with deliberate shootings occurring in some cases (Nitta and Henderson, 1993; NMFS, 2009; Schlais, 1985; TEC, 2009). Overfishing of some pelagic fishes, including bigeye and yellowfin tuna, may be adversely affecting Hawaiian insular false killer whales.

Ship strikes

Collisions with commercial and military ships are an increasing threat to many large whale species, particularly as shipping lanes and naval operations cross important large whale breeding and feeding habitats or migratory routes. Ship-strike is a significant concern for the recovery of baleen whales in the region. We believe the vast majority of ship-strike mortalities go unnoticed, and that actual mortality is higher than currently documented. More humpback whales are killed in collisions with ships than any other whale species except fin whales (Jensen and Silber 2003). In the central North Pacific, there have been several mortalities or serious injuries of humpbacks due to ship strike reported for the period 2003 to 2007 (Allen and Angliss, 2010). 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). Despite these reports, the magnitude of the risks commercial ship traffic poses to large whales in the proposed action areas has been difficult to quantify or estimate. We struggle to estimate the number of whales that are killed or seriously injured in ship strikes within the U.S. Exclusive Economic Zone and have virtually no information on interactions between ships and commercial vessels outside of U.S. waters. With the information available, we know those interactions occur but we cannot estimate their significance to whale species.

Ship strike is also a concern for balaenopterids. In the California/Mexico stock of blue whales, annual incidental mortality due to ship strikes averaged one whale every 5 years, but we cannot determine if this reflects the actual number of blue whales struck and killed by ships (i.e., individuals not observed when struck and those who do not strand; Barlow et al. (1997)). The vast majority of ship strike mortalities are never identified, and that actual mortality is higher than currently documented. Jensen and Silber's (2004) review of the NMFS' ship strike database revealed fin whales as the most frequently confirmed victims of ship strikes (26% of the recorded ship strikes [n = 75/292 records]), with most collisions occurring off the east coast, followed by the west coast of the U.S. and Alaska/Hawaii. Five of seven fin whales stranded along Washington State and Oregon showed evidence of ship strike with incidence increasing since 2002 (Douglas et al. 2008). From 1994-1998, two fin whales were presumed killed by ship strikes. More recently, in 2002, three fin whales were struck and killed by vessels in the eastern North Pacific (Jensen and Silber 2003). Ship strikes also present an emerging threat to sei and blue whales; in 2003, a sei whale was reported struck by a vessel , subsequently died, and stranded near Port Angeles, Washington (NMFS, unpublished data) , and a blue whale was struck and killed off the coast of California in 2002 (Jensen and Silber 2003).

There have not been any recent documented ship strikes involving sperm whales in the eastern North Pacific, although there are a few records of ship strikes in the 1990s. Two whales described as "possibly sperm whales" are known to have died in U.S. Pacific waters in 1990 after being struck by vessels (Barlow et al. 1997). There is an anecdotal record from 1997 of a fishing vessel that struck a sperm whale in southern Prince William Sound in Alaska, although the whale did not appear to be injured (Laist et al. 2001). More recently in the Pacific, two sperm whales were struck by a ship in 2005, but it is not known if these ship strikes resulted in injury or mortality (NMFS 2009b). The lack of recent evidence should not lead to the assumption that no mortality or injury from collisions with vessels occurs as carcasses that do not drift ashore may go unreported, and those that do strand may show no obvious signs of having been struck by a ship (NMFS 2009b). Worldwide, sperm whales are known to have been struck 17 times out of a total record of 292 strikes of all large whales, 13 of which resulted in mortality (Jensen and Silber 2003; Laist et al. 2001). Given the current number of reported cases of injury and mortality, it does not appear that ship strikes are a significant threat to sperm whales (Whitehead 2003).

Despite report of strikes, the magnitude of the risks ship traffic poses to large whales is difficult to quantify or estimate. We struggle to estimate the number of whales that are killed or seriously injured in ship strikes within the territorial seas and the Exclusive Economic Zone of the continental United States and have virtually no information on interactions between ships and commercial vessels in the western North Pacific Ocean. With the information available, we assume that interactions occur but we cannot estimate the number of interactions or their significance to the endangered whales of the western North Pacific Ocean.

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. 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).

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 2006b). Responses appear to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity (Au and Green. 2000; Corkeron 1995; Erbe 2002; Magalhaes et al. 2002; Richter et al. 2003; Scheidat et al. 2004; Watkins 1986; Williams et al. 2002b; Williams et al. 2002d). Foote et al. (2004) reported that southern resident killer whale call duration in the presence of whale watching boats increased by 10-15% between 1989-1992 and 2001-2003 and suggested this indicated compensation for a noisier environment. Disturbance by whale watch vessels has also been noted to cause newborn calves to separate briefly from their mothers' sides, which leads to greater energy expenditures by the calves (NMFS 2006b). 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 2006b). It is difficult to precisely quantify or estimate the magnitude of the risks posed to marine mammals in general and southern resident killer whales specifically (who possibly have the greatest exposure to whale watching activities of any listed marine mammal) by whale watching and recreational vessels (NMFS 2008e).

Naval activities

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. The action area overlaps several naval training ranges or facilities listed below. Listed individuals travel widely in the North Pacific and could be exposed to naval activities in several ranges.

- Marianas Island Range Complex, where humpback and sei whales may or likely breed and give birth,
- The Okinawa and Japan Range Complexes,
- The Southern California Range Complex, where blue whales forage,

- The Northwest Training Range Complex, where humpback whales forage and southern resident killer whales reside,
- The Gulf of Alaska Operating Area, where several listed whale species are known to forage and
- The Hawaiian Islands Operating Area, where humpback whales regularly breed and give birth.

Naval activities to which individuals could be exposed include, among others, vessel and aircraft transects, munitions' detonation, 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 µParms 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 A r ea. However, no mid-frequency sonar or explosives were used during this exercise and evidence linking the exercise to mortalities is circumstantial at best.

Disease and parasitism

Urinary tract diseases and kidney failure caused by nematode *Crassicauda boopis* could affect humpback whale populations (Lambertsen, 1986; Lambertsen, 1992), and several other species of large whale are known to carry similar parasites (Rice, 1977). Parasites and biotoxins from red-tide blooms are other potential causes of mortality of humpback whales (Perry et al., 1999).

Contaminants

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

Humpback whale blubber has been shown to contain PCB and DDT (Gauthier et al., 1997). Contaminant levels are relatively high in humpback whales, 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. Biopsies from Hawaiian insular false killer whales have also had high levels of PCBs and DDTs (Ylitalo et al., 2009).

Scientific research

A total of 23 permits authorize the harassment of one or more of the target species in the action area during research (Table 2). Permits in Table 2 are identified by ocean basin or area, but most permits authorize a smaller study area or region within an ocean basin, reducing the chance of repeated harassment of individual whales by researchers.

Table 2 – Active Scientific Research Permits and Letters of Confirmation authorizing the harassment of humpback whales and Hawaiian false killer whales in the action area of this Opinion.

Permit No.	**Permit Holder**	**Expiration date**	**Ocean Basin or Area**	**Harassment**
*587-1767-01^*	*Salden*	*9/30/2011**	*HI, AK*	*Level B only*
727-1915	Scripps	02/01/2013	HI	Level A & B
731-1774-06	Baird	8/31/2011*	HI, CA to AK, high seas	Level A & B
1058-1733-01	Baumgartner	5/31/2012	Pacific and Atlantic Oceans and high seas	Level A & B
1120-1898	Eye of the Whale	7/31/2012	AK	Level B only
1127-1921^	Hawaii Marine Mammal Consortium	6/30/2013	HI	Level A & B
10018-01^	Cartwright	6/30/2013	HI	Level B
13427^	Pacific Whale Foundation	06/15/2013	HI	Level B
13846	Darling	7/31/2015	HI, WA, AK	Level A & B
14097	NMFS, SWFSC	6/30/2015	Pacific Ocean / international and U.S. territorial waters of the Pacific and Southern Oceans	Level A & B
14118	WHOI	4/30/2017	North Pacific Ocean	Level A & B
14122	Straley	7/31/2015	AK	Level A & B
14245^	NMFS NMML	05/01/2016	AK, WA, OR, CA, HI, and Atlantic Ocean	Level A & B
14296	Witteveen	7/31/2015	AK	Level A & B
14353^	Zoidis	7/31/2015	HI	Level A & B
14451^	Mobley	7/31/2015	Pacific and Atlantic Ocean	Level B
14534	NOAA Science and Technology	7/31/2015	Eastern Pacific Ocean, CA	Level A & B
14585^	Pack	7/31/2015	Western North Pacific Ocean, CA to AK, HI	Level A & B

Table 2 – Active Scientific Research Permits and Letters of Confirmation authorizing the harassment of humpback whales and Hawaiian false killer whales in the action area of this Opinion.

Permit No.	Permit Holder	Expiration date	Ocean Basin or Area	Harassment
14599	Sharpe	7/31/2015	AK	Level A & B
14610	AK Dept of Fish and Game	5/31/2015	AK	Level A & B
14682^	Au	11/15/2015	HI	Level A & B
15330	Cascadia Research	08/01/2016	Pacific Ocean (AK, WA, OR, CA, HI)	Level A & B
15806^	U.S. Navy	09/30/2011	HI	LOA

* indicates that there is a one-year extension on the permit
^ indicates that the permit includes Hawaiian false killer whales. Current permits do not distinguish between Hawaiian stock and Hawaiian Insular stock; if the Hawaiian insular stock is designated, these permits will updated to account for the different levels of protection.
Italicized row indicates the permit that would be replaced by the permit issued in this action

Effects of the proposed actions

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

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

Potential stressors

The assessment for this consultation identified several possible stressors associated with the proposed permitted activities. These include aerial and vessel surveys, close approaches by research vessels, small boat research, skin and fecal sampling, and dart and suction cup tagging.

Exposure analysis

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

The Permits Division proposes to issue a five-year permit for scientific research to Frank Parrish. The activities would be conducted year-round in the central and western North Pacific Ocean, focused mainly on U.S. waters off: Hawaii, Palmyra, American Samoa, Guam, CNMI, Johnston Atoll, Kingman Reef, Howland Island, Baker Island, Jarvis Island, and Wake Island, with state and international waters also surveyed.

Table 1 identifies the numbers ESA listed whales that Dr. Parrish would be authorized to approach, photograph or video from ships, passively record acoustics, collect sloughed skin, biopsy sample, and dart and suction cup tagging annually under the five-year permit. A total of 250 blue, 125 Hawaiian insular false killer, 250 fin, 250 humback, 13 Northern Pacific right, 125 sei, and 250 sperm whales would be permitted to be exposed to the suite of procedures covered under the proposed permit annually.

Response analysis

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

Evidence indicates that wild animals respond to human disturbance in the same way they respond to predators (Beale and Monaghan, 2004; Frid, 2003; Frid and Dill, 2002; Gill et al., 2001; Lima, 1998; Romero, 2004). These responses may manifest themselves as stress responses, interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill, 2002; Romero, 2004; Sapolsky et al., 2000; Walker et al., 2005).

Aerial surveys

Few published data are available to evaluate the responses of listed marine mammals to aircraft overflights. Malme et al. (1983a) made an opportunistic evaluation on a bowhead whale group.

In this event, a circling single-engine aircraft descended from roughly 400 m (above the normal altitude generally used in proposed aerial surveys) to 60 m (well below the minimum altitude proposed for permitted aerial surveys). Once the aircraft descended and approached the whales at its closest point, the group discontinued its behavior and split into two groups. The groups rejoined and continued their prior behavior immediately after the departure of the aircraft. Richardson et al. (1985) found bowheads to respond frequently to Islander survey aircraft approaches below 305 m, infrequently at 457 m, and not at all at 610 m; responses were normally hasty dives and sometimes gradual departure from the area. Blow interval may also decrease upon aircraft descent. He also cites Marquette et al. (1982) as bowheads rarely reacting in a negative manner to aircraft flying as low as 75 m. Richardson et al. (1985) further cites Ljungblad et al. (1980) and Ljungblad (1981) as bowhead responses being variable by date and whale activity, with mating whales being less responsive than when they were not. Payne et al. (1983) found southern right whales to rarely react strongly to survey aircraft flying at 65-130 m. Richter et al. (2006) found sperm whales (specifically transient sperm whales) to briefly increase their time at the surface and take 20 seconds longer during their dives to start “clicking” (presumably related to prey detection), although they determined that their findings were not biologically meaningful. They did note that habituation to both vessel and aerial approaches likely occurred in “resident” individuals. Luksenburg and Parsons (2009) found that across cetacean species, most respond (when they respond) by diving. Smaller groups respond strongly less often than do larger ones; individuals in shallow water respond more frequently than those in deep water, as do mothers with calves versus other group types, when individuals were initially resting or milling, and when aircraft fly at lower altitude. Sperm whales responded in 28% (7 of 25) cases to survey aircraft (mostly by diving) and false killer whales responded in <29% of overflights (Smultea et al. 2008). Overflight and circling at 235-335 m above a sperm whale group by a Skymaster survey aircraft elicited appears to have elicited a group defensive formation from a sperm whale pod.

Data from the NMML, which has conducted extensive aerial survey effort in the North Pacific has not documented responses of several cetacean species seen during surveys, including fin, sei, humpback, and North Pacific right whales. Based upon the lack of response in the NMML’s extensive surveys, we do not expect any individual sperm, blue, fin, sei, humpback, and North Pacific right whale to respond to survey planes. However, it is possible that a few individuals of these species may respond to overflights with startle responses, rapid dives, or changes in direction. We expect the same response type and frequency for blue and sperm whales, with sperm whales also possibly delaying click production during dives or forming a group defensive posture. We do not anticipate any individual of these species will be re-exposed due to the wide-ranging nature of these taxa.

We also expect a few individual Hawaiian insular false killer whales may respond to aircraft overflights with startle responses, rapid dives, or changes in direction. Due to the more restricted ranges of these species, re-exposure may occur; however, assuming individuals experience re-exposure, we expect the same responses will not necessarily occur with every re-exposure and will vary by individual and context. Some would likely be the same and some more or less pronounced.

Close approaches by research vessels

For all research activities, the presence of vessels has the potential to induce behavioral and physiological changes in individuals being targeted, although the animals' reactions are generally short term and low impact. 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) and the degree to which they have become accustomed to vessel traffic (Lusseau, 2004; Richter et al., 2006); reactions may also vary by species or individuals within a species (Gauthier and Sears, 1999). Overall, reactions range from little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation; diving; time spent submerged; foraging; and respiratory patterns. Responses may also include aerial displays like tail flicks and lobtailing and may possibly influence distribution (Baker et al., 1983; Bauer and Herman, 1986; Clapham et al., 1993; Jahoda et al., 2003; Watkins et al., 1981). In addition, Baker et al. (1988) reported that changes in whale behavior corresponded to vessel speed, size, and distance from the whale, as well as the number of vessels operating in the proximity. Based on experiments conducted by Clapham and Mattila (1993), experienced, trained personnel approaching whales slowly would result in fewer whales exhibiting responses that might indicate stress. Jahoda et al. (2003) found effects of more than a few minutes, with fin whales failing to return to baseline behaviors after one hour of observation in some cases, in spite of the fact that Gauthier and Sears (1999) found fin whales to be less responsive than humpbacks.

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

Humpback whales have been the best-studied whale species in regards to responses to close approaches by vessels. Numerous studies have documented varied responses of humpback whales to vessel approaches, ranging from no response to approach to evasion (Goodyear 1993a; Salden 1993). In response to vessel approach, Felix (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. 1983b; Baker et al. 1982; Dunlop et al. 2010; 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; 1983b), 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 as a result. Norris (1994) documented changes in humpback song structure in response to passing vessels, with unit and phrase durations reduced versus control periods.

Bauer and Herman (1986) studied the potential consequences of vessel disturbance on humpback whales wintering off Hawaii. They as well as Scheidat et al. (2004) 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 1981). The more active the group, the more easily it was disturbed; however, Cantor et al. (2010) found structuring in the response rate of various individuals in mating groups, with male response becoming progressively less frequent with 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.

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

Several studies have suggested that stress can adversely impact female reproduction through alterations in the estrus cycle (Herrenkohl and Politch 1978; Moberg 1991; Mourlon et al. 2011). 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 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. 2010). Parks et al. (2010) and Anonymous (2010) found that North Atlantic right whales temporarily modify the amplitude of their calls, making them louder with increased background noise (including noise from vessel traffic), as well as shifting call frequency over longer time frames. 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 (Mazzuca 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.

We would expect most listed whales exposed to close vessel approaches under the proposed permit to exhibit either no visible reaction or short-term low-level to moderate behavioral responses. Available evidence, including approaches of individuals of other species in a variety of locations, leads us to conclude there should be no strong behavioral responses to close approaches. Based upon the available literature and anticipated levels of future exposure, one to a few dozen blue, fin, sei, and North Pacific right whales may also respond with low-to moderate-level behavioral responses described above for baleen whales. We expect that some, but not all, individuals may respond to re-exposures.

Researchers surveying and tagging false killer whales, including the Hawaiian insular stock, often report whales bow-riding with research vessels (Baird et al., 2008a; Castro, 2004). Articles discussing surveys of false killer whales did not note any agonistic or adverse reactions to approaches by boats (Baird et al., 2008a; Baird et al., 2008b). Additionally, false killer whales are known to purposely approach fishing vessels to depredate on catch (Baird, 2009). We believe that Hawaiian insular false killer whales will have similar or less stress related to close approaches by research vessels, compared to humpback whales.

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

Sloughed skin and feces collection

The collection of sloughed skin and feces would not involve contact with the whale and would not be invasive. Collections could potentially be done in the vicinity of a whale, but we would not expect this to have any impact beyond the effect of the close approaches to whales assessed earlier.

Tagging

Partially and fully implantable/dart/dash tags

Although external transmitting devices have been used by many researchers, few studies examine the possible effects of these devices (Culik et al. 1994; Hawkins 2004; Murray and Fuller 2000; White and Garrot 1990; Wilson and McMahon 2006). For example, Murray and Fuller (2000) surveyed a sample of articles in which vertebrates had been marked, covering nine journals that publish studies on a broad range of taxonomic groups, and found that in most instances (90 percent of 238 articles surveyed), the articles did not address potential effects of marking, or at least did not report that such effects had been considered. However, the attachment of a device has the potential to generate physiological and behavioral effects, depending on factors such as device weight, shape, and attachment location (Hawkins 2004; White and Garrot 1990). Effects of attached devices may range from subtle, short-term behavioral responses to long-term changes that affect survival and reproduction; attached devices may also cause effects not detectable in observed behaviors, such as increased energy expenditure by the tagged animal (White and Garrot 1990; Wilson and McMahon 2006). Walker and Boveng (1995) concluded the effects of devices on animal behavior are expected to be greatest when the device-to-body size ratio is large. Although the weight and size of the device may be of less concern for larger animals such as cetaceans, there is still the potential for significant effects; for example, behavioral effects that may cause reduced biological performance, particularly during critical periods such as lactation (Walker and Boveng 1995; White and Garrot 1990).

Once target individuals are approached, researchers propose to place devices in whales to track movements and dive data. This involves implanting tags into target individuals, a process that has been shown to not only result in behavioral responses, but has the potential to induce physiological and pathological changes. Implantable tags can cause behavioral responses similar to close approach as well as wounds, bruising, swelling, hydrodynamic drag, and in at least one case, lead to death. Some species are more behaviorally responsive than others, as shown in Table 23. Humpback whales tend to be one of the least responsive baleen whales to the tagging process. Although less data are available for bowheads, their closely related kin, the southern and North Atlantic right whales, tend to be amongst the most responsive species to tagging. Available data regarding the effects of tagging is almost exclusively focused on short-term effects, as few studies have attempted to follow up on tagged individuals weeks, months, or years after tagging. However, some opportunistic resightings have been documented; results are presented when available.

Physiological risks to whales from tagging include swelling, inflammation, or infection of the tag site. Although concerns about the potential to strike an animal in sensitive areas, such as the eyes or blowhole, have been raised in previous studies (Whitehead et al. 1990), methods adopted by the researchers here would prevent such occurrences. To minimize localized infection risks, the parts of the tags that would be inserted into whales would be constructed of medical grade stainless steel, titanium, or other biologically inert materials, and thoroughly disinfected before attachment. Most infections in wildlife resulting from invasive tagging stem from the skin (Hawkins 2004; Mate et al. 2007c). Invasive components are generally designed to minimize the potential for skin intrusion into the wound at time of tagging (Mate et al. 2007c). Although a wide variety of implantable tags have been used over the past several decades, review of available data support tags to generally produce a similar, small variety of wound patterns in North Atlantic right and humpback whales: white scar, white scar and divot, a divot and cyamids (whale lice), localized swelling, and regional swelling (up to 90 cm across and persisting for years), although roughly one in eight individuals showed no wound pattern (Kraus et al. 2000; Mate et al. 2007c; Weller 2008). Follow-up monitoring shows local and regional swelling frequently occurs around the tag site following implantation in humpback and North Atlantic right whales (Mate et al. 2007c). Southern right whales appeared to generally lack swelling around implantable tags, but divots were frequently seen after tag rejection on individuals resighted after greater than one year post tagging (Best and Mate. 2007). Tags appear to be shed by 27-36 months post tagging, although some may protrude (begin to be ejected) after 75 days (Best and Mate. 2007). Divots are theorized to stem from fat cell rupture upon tag entry (Mate et al. 2007c). The physiological consequences of such responses remain unstudied, but a general response of glucocorticoid secretion and lymphocyte suppression is known to occur in whales entangled in fishing gear (Cole et al. 2006). Although gear entanglement has been shown to be potentially very debilitating or lethal to a whale, we expect the same response to be present, but at a lower level.

Expert reviewers in a workshop summarized by Kraus et al. (2000) were not concerned with the consequences of divots, cyamids, or scars. However, swelling was believed to be due either to hematoma, abscess, or an active inflammatory response to a foreign body or agent (such as bacteria), rupture through the subdermal sheath, foreign body granuloma, or benign tumor.

Several reviewers had serious concerns for the potential of tags penetrating into the muscle layer, potentially introducing serious infections into muscle and expanding the infection due to shear forces at the muscle-blubber interface (Kraus et al. 2000; Quinn et al. 2000; Weller 2008). The extensive resighting history of North Atlantic right whales permits some analysis of tagging effects and, ultimately, survival rates of tagged versus untagged individuals is not discernibly different (Mate et al. 2007c). Resightings from other species, although not as extensive, has also failed to support long-term effects at the individual level (Best and Mate. 2007; Mate et al. 2007c). The only close study of a wound after tagging was based upon a gray whale that stranded dead 18 days post tagging; although the animals was decomposed, investigators found no evidence of infection at the tag site or other findings that suggested the tag/tagging process resulted in the animal's death (Weller 2008).

Keeping implanted tags stable promotes healing, as new epithelial cells and scar tissue form around the foreign body to wall it off (Mate et al. 2007c). Researchers expect that the presence of recurved barbs on the cylinder housing should enable the tag to remain embedded for longer periods of time and be more stable in the body. However, over time, the tag would be rejected by the body and migrate out of the blubber due to possible infection, reaction to a foreign body, an irritation from motion due to body flexing, as well as mechanical stress from hydrodynamic drag on the external components of the tag (Watkins et al. 1981). The applicants state that tag rejection can take as little as a couple of weeks to over one year; this is supported by Watkins et al. (1981), Best and Mate (2007), and Mate et al. (2007c).

Apart from pathological effects, tagged marine mammals can also experience physiological effects, particularly from impaired hydrodynamics. Tags should be designed to minimize the drag experienced by the individual carrying the tag (Hawkins 2004; Hooker et al. 2007). For example, Walker and Boveng (1995) found that average foraging-trip and nursing-visit durations were significantly greater for seals carrying time-depth recorders and radio transmitters than for seals carrying radio transmitters only. A spotted dolphin fitted with a bulky satellite transmitter was recaptured eight days after tagging in poor body condition, presumably due to the large drag effects it created (Scott et al. 1990). However, the tag designs under the proposed action minimizes drag, so as to increase attachment duration. Under the proposed actions, a variety of tags could be used; some have minimal drag potential (fully implantable, dart, and dash) because of their small external profile, while partially implantable tags likely experience greater overall drag because of their higher profile, but otherwise are designed for minimal drag. Hawaiian insular false killer whales have the smallest profile of all target species and would be expected to experience the greatest impact from any increase in drag. However, tag profile would be no more than 1% of the target individual's frontal cross sectional area and no more than 0.1% of its body weight. Drag would be considered minute when compared to the size of most target species, even as calves; the additional energy expenditure, even when considered over the course of a year, would be small in comparison to the drag created by such large animals in a highly viscous medium. This is supported by data from Best and Mate (2007), who found that six out of seven female southern right whales birthed in their routine intervals (similar to the rate of detection of untagged individuals; (Best et al. 2005).

Blue whales. Blue whales tagged with implantable tags have immediately resumed lunge feeding following tagging in a large number of cases (Mate et al. 2007c).

Fin whales. Watkins (1981) tagged several fin whales with relatively large radio transmitters and did not observe responses by targeted individuals to the actual tagging, although response to changes in vessel throttling or tags splashing on the water during misses were documented. It is noteworthy that closely related Bryde's whales have been documented to respond to both missed and successful tagging events with rapid acceleration and/or multiple breaching in two individuals; one returned to baseline behavior within 2-5 minutes, while the other individual took 2.5 hours to normalize (Watkins et al. 1979).

Humpback whales. Short-term, behavioral effects are also documented for humpback whales. General whale responses include no response at all, skin twitching, startle reactions or flinching, altered swimming speed and orientation, diving, rolling, head lifts, high back arching, fluking, and tail swishing (Goodyear 1981; Goodyear 1993b; Hooker et al. 2001; Mate et al. 1997b; Watkins 1981c; Watkins et al. 1984b). Mate et al. (1998) found humpback whales to not respond to satellite tagging at all. Humpback whales responded to shallow implantable tags by turning away from the tagging vessel and undertaking short dives; and increasing their swimming speed (Goodyear 1993b). Watkins (1981b) found humpback whales in the North Atlantic to respond to tagging with startle reactions, increased swimming speed, or with no reaction at all; all responding individuals returned to baseline behavior within 15 minutes. A humpback whale was found to resume singing within 13 minutes of tagging in another case (Mate et al. 2007c). "Strong" reactions were found in only 3.3-5.6% of humpbacks tagged (Weinrich et al. 1991; Weinrich et al. 1992). Humpback reactions can also occur to misses, possibly as a result of splashes in the water (Brown et al. 1994; Watkins 1981c). Baseline behavior appears to resume within minutes. Responses to tagging may be difficult to discern from responses to close approaches. In two studies of humpback whales off Hawaii and Alaska, no additional responses were found to approach and tagging versus approach alone (Mate et al. 1991; Watkins 1981c). Ultimately, humpback whale survival does not appear altered by invasive tagging; seven individuals tagged in Alaska 20-30 years ago have been reidentified in recent years also in Alaska (Mizroch et al. 2008).

Sperm whales. Responses to implantable tagging appear to vary within the species. Watkins et al. (1999) found sperm whales to not respond to tagging, including time spent at the surface, although Watkins et al. (1993a) found a startle reaction in one individual. Tagging of seven out of ten sperm whales within a single group and within a 90 minute timeframe did not cause the group to disperse, although responses to tagging occur more in this species than any other large whale (Mate et al. 2007c). These researchers have resighted 15 of 57 tagged sperm whales, finding persistent localized swelling many months after tagging. Sperm whales tagged while resting on the surface between foraging dives appear to respond by engaging in a foraging dive earlier than they otherwise would (Johnson and Tyack 2003). This dive may not last as long as it otherwise would, but conspecifics may follow the target individual in its early dive. Missed tagging attempts have resulted in a startle response (rapid acceleration and defecation), although tagging hits did not appear to elicit responses (Watkins and Tyack 1991).

Hawaiian insular false killer whales. Data from false killer whales is generally lacking, but unpublished data from Dr. Robin Baird are available to assess impacts of dart tagging. Dr. Baird has found that between 2006 and 2009, false killer whales in Hawaiian waters do not respond to dart tagging attempts in 9% of cases and respond by accelerated dives, tail flicks, and or increased swimming speed in 91% of 23 cases. These responses appear to be short-term, although follow-up monitoring is limited to observations of scarring and some tissue inflammation.

Studies of other toothed whales are also available to assess responses. Tagging has been conducted on a variety of marine mammal species, including pilot whales (Mate 1989), blue whales (2003; Calambokidis et al. 2001b; 2007; Lagerquist et al. 2000; Mate et al. 2007b), beluga whales (Martin and Smith 1992), northern bottlenose whales (Hooker et al. 2001), Hector's dolphins (Stone et al. 1994), bottlenose dolphins (Schneider et al. 1998), Dall's porpoises (Baird and Hanson 1996), harbor porpoises (Eskesen et al. 2009), and narwhals (Martin et al. 1994). Although several tagging studies have been conducted, few have systematically investigated or recorded the effects on cetaceans from tagging, and available investigations into instrument effects on marine species are often limited to visual assessments of behavior (Walker and Boveng 1995). In addition, reactions to tagging are difficult to differentiate from reactions to close vessel approaches, because in all cases it is necessary to closely approach the individual to ensure proper tag placement.

Suction-cup tagging

Baleen whales. Although suction cup tagging is not as invasive as implantable tagging, whales have also demonstrated behavioral reactions to tag attachment. Goodyear (1989c) observed a quickened dive, high back arch, tail swish (31%) or no reaction (69%) to suction cup attachment, although one breach was observed in roughly 100 taggings. Baird et al. (2000) also found responses less frequently than responses in humpbacks (17% of 31 attachments), although competitive groups were easier to approach than singletons. Regardless, pre-tagging behavior was observed again in all cases within minutes. No damage to skin was found (Goodyear 1989a). Baumgartner and Mate (2003) reported that strong reactions of North Atlantic right whales to suction-cup tagging were uncommon, and that 71% of the 42 whales closely approached for suction-cup tagging showed no observable reaction. Of the remaining whales, reactions included lifting of the head or flukes, rolling, back-arching, or performing head lunges. No differences in dive patterns were found after two dives post-tagging. Suction cup tagging of bowhead whales has met with poor attachment success due to the animal's rough skin and evasive behavior (Baumgartner and Hammar., 2010).

Whether any long-term effects resulting from tagging remain largely unknown and available information is limited. Goodyear (1989b) noted that humpbacks monitored several days after being suction-cup tagged did not appear to exhibit altered behavior.

Although reported data are relatively paucious on baleen whale responses to suction cup tagging, discussions with experts having years of experience in the field provide additional insight into likely response. Overall, suction cup tagging produces similar responses as biopsy or more invasive tagging, with low-level, ephemeral responses or no response observed in most cases.

Hawaiian insular false killer whales. As with implantable tagging, few data are available on false killer whales, but suction cup tagging has been attempted on other small odontocetes. Roberts et al. (1999) found a false killer whale to respond to a suction cup tagging attempt with a fast dive, but did not subsequently avoid the research vessel. A conspecific subsequently pulled the tag off after one hour. This study also documented spotted and spinner dolphins to respond to tagging with tail flicks or fast dives, but most animals returned to the research vessel to bowride. Hanson and Baird (1998) found bowriding Dall's porpoises to react in 11 of 13 successful tagging events, but in none of the two misses. Responses included tail slaps, flinches, and/or swimming rapidly away. However, in seven of 11 responses, individuals returned to bowriding and telemetry data suggest individuals returned to baseline behavior within eight minutes. Northern bottlenose whales generally do not respond to missed tagging attempts and usually respond to hits by low to moderate-level reactions, but returned to baseline behavior within minutes (Hooker et al. 2001). Bottlenose dolphins appear to respond very strongly to suction cup tagging, engaging in immediate and continuous leaping and increases in swimming speed in nearly all cases (Schneider et al. 1998). Stone et al. (1994) found a single successful tagging event on a Hector's dolphin caused the individual to cease bowriding and depart the area, but return to bowride within five minutes.

Data from monitoring reports are not entirely clear as to the number and type of responses target individuals show to tagging activities, nor the type of tagging conducted. Due to this lack of detail, we could not identify the number of individuals tagged using invasive means versus suction-cup tagging over the past several years of monitoring reports. However, review of the literature and discussion with experts supports responses and response rates by target species to be generally similar to these forms of tagging. Response data provided by Mate et al. (2007a) for blue, fin, humpback, right (used North Atlantic as a surrogate for whale response due to lack of species-specific response data), and sperm whales appears to be the best source to appraise the rate of response by these species to invasive tagging and is used here to estimate the number of responses; additional information summarized above helps us determine the type of response likely to occur under the proposed permit. Based upon these response rates and the expected level of tagging, we do not expect sei whales to respond, but one blue, three fin, four humpback (Pacific), one North Pacific right, and ten sperm whales are expected to respond to invasive and suction cup tagging activities with low- to moderate-level behavioral responses described above. One or a few blue whales may also respond in a similar manner over the life of the proposed permit. As it is possible that an individual could be exposed to tagging more than once per year, the same individual could respond multiple times. In addition, most if not all Hawaiian insular false killer whales are expected to respond to tagging (again, multiple individual responses are possible).

Most responses would consist of low-level, transitory behavioral responses, such as startle, flinching, defecation, fluke beat(s), premature or accelerated dive, movement away from the research vessel, increased swimming speed, rolling, head lifts, and/or back arching. Some individuals may exhibit more prolonged or extreme responses, rising to a moderate level. We do not anticipate any strong behavioral responses to tagging. We expect all individuals receiving implantable tags to experience a physiological response to the foreign body, including swelling or inflammation. We do not anticipate any individual will incur an infection from tag application, although data are spartan and additional study is needed to better inform this possibility.

Our use of behavior as an indicator of a whale's response to tagging may or may not accurately reflect the whale's experience, and we cannot definitively know whether such behavioral responses have long-term consequences. Responses to human disturbances, such as tagging, may manifest as stress responses, interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combination of these responses. Weinrich et al.(1992) associated "moderate" responses with alarm reactions and "strong" behavioral reactions with stress responses. Wild harbor porpoises restrained and tagged did not show consistent elevations in cortisol nor did heart rate change in ways consistent with a stress reaction (Eskesen et al. 2009); these actions are much more invasive that those proposed. Moderate responses might also be associated with a stress response, given that certain behavioral responses may have metabolic consequences. As a result, the proposed tagging could be stressful for a small portion of the whales; however, the significance of this stress response and its consequences, if any, on the fitness of individual whales are not definitively known. However, the limited information available from Erickson (1978) indicates that for a more invasive radio package attachment on the dorsal fin, the blood parameters of killer whales showed no significant change. Recognizing the evidence indicating that behavioral responses would be short-lived, the tagging activities could produce short-lived stress responses in some individuals.

Biopsy

Biopsy sampling has the potential to disrupt behavior and breach an individual's integument. Physiological, pathological, and behavioral responses are possible. We reviewed the literature assessing the impacts of biopsy sampling to various cetacean species. 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 invertebral 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 2012).

Balaenopterids. Although suction cup tagging has become a common field method for studying baleen whales, few data exist regarding response of balaenopterid whales to suction cup tagging. Gauthier and Sears (1999). Blue whale responses responded by submerging, accelerating, and/or diving (Gauthier and Sears 1999). Fin whales either do not respond at all, or exhibit low- to moderate-level behavioral responses (Marsili and Focardi 1996). Inadvertent repeated biopsy within a week did not appear to cause a difference in reaction in three blue whales and five fin whales (Gauthier and Sears 1999). Group size does not appear to impact the likelihood or severity of response (Gauthier and Sears 1999). Female fin whales appear to respond to biopsy more often than males (66% versus 44%) and more strongly. Individuals generally return to baseline behavior within a few minutes (Gauthier and Sears 1999). A biopsy miss that hit the water near a target fin whale apparently caused the fin whale to dive (Gauthier and Sears 1999).

Humpback whale. Many researchers claim that biopsy darts or sampling does not result in significant short-term or long-term behavioral disturbance to humpback whales. However, humpback whales do appear to be more reactive to biopsies than other baleen whale species. 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. (1992) 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. 1992). 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 nonlactating 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. (1992) 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).

Right whales. The relatively high level of behavioral responsiveness observed in bowheads also appears to be present in right whale species. North Atlantic right whales showed immediate, minor behavioral response to biopsy darting 19% of the time in 241 attempts and no reaction in 81% of hits and misses (Brown et al. 1991). Reactions include twitches, increased swimming speed and dives, back arches and dives, tail flicks, lobtails, and turning away from the tagging vessel (Brown et al. 1991). More than 50% of individuals had a hard tail flick; an unusual behavior for this species. Dives also became longer relative to surface times. However, return to baseline behavior generally occurred rapidly (Brown et al. 1991). It should be noted, though, that one individual lobtailed for 40 minutes after a missed biopsy attempt where monofilament line attached to the arrow trailed after the animal (Brown et al. 1991). Reeb and Best (2006) also documented generally no or low- to moderate-level responses of right whales to pole biopsy techniques. Demographic differences in responses have been identified in southern right whales, with greater response in singletons versus groups and cow/calf pairs responding more strongly than other groups (Best et al. 2005). Overall, changes in reproductive output by female right whales was not found, although the power to detect differences was low (Best et al. 2005).

Sperm whales. We identified only one study that has reported on the response of sperm whales to biopsy attempts. Whitehead et al. (1990) reported responses from sperm whales off Nova Scotia as well as the Azores, finding that every biopsy hit and roughly half of the misses caused a startle response. Startling was associated with flexing the body, raising the back, and/or increasing swimming speed. Other responses occasionally observed included short dives of up to five minutes and defecation. In all cases, individuals were observed to return to baseline behavior within minutes. Discussions with experienced field biologists suggest these trends are generally accurate, although no response may also occur to biopsy hits (Greg Schorr, Cascadia Research, pers. comm.).

Hawaiian insular false killer whales. Few data are available from false killer whales. However, from other odontocete species are available. A total of 28 responses (23 low-level, five moderate) out of 49 biopsy events were measured for northern bottlenose whales, with logging individuals responding more strongly than milling or traveling individuals (Hooker et al. 2001). Responses occurred to both hits and misses, although hits elicited much more frequent responses. Most responses were startles. Weller et al. (1997) found that all eight bottlenose dolphins biopsy sampled exhibited startle responses in his study, including tail flicks, increased swimming speed, and leaving the area. Misses did not produce a response. Follow-up veterinary and pathological examination found wounds to be uninfected and healing well, with skin covering the wound 15-42 days post-biopsy. Biopsies of roughly 100 bottlenose dolphins and four humpbacked dolphins generally resulted in startle responses as well (Weller et al. 1997). Long-term effects have not been found to result from biopsy attempts (Weller et al. 1997). Killer whales have been observed to shake or accelerate upon biopsy, but no other effects were observed (Barrett-Lennard et al. 1996). Resting and socializing groups of spinner, pantropical spotted, melon-headed, and Indo-Pacific bottlenose dolphins apparently respond more strongly than do milling or traveling groups (Kiszka et al. 2010). Responses were similar for both hits and misses. Overall, 94% of responses were twitch and/or dive, while 2% of responses included tail slap, leaping, multiple breaches, and/or escape. Group behavior changed in 54% of biopsy attempts, with group dive being the most common response. However, group escape or increased swimming speed occurred in 4% of biopsy attempts. Group size did not bear of the likelihood or strength of response. Gorgone et al. (2008) found that 22% of conspecifics reacted in a manner similar or identical to target individuals.

As with tagging activities, annual reports are unclear as to the number and types of responses target individuals exhibited upon biopsy. Therefore, we relied upon available literature and expert opinion to determine the number and types of responses under the proposed activities. Gauthier and Sears (1999) provide the only quantitative data available for balaenopterid response, as does Whitehead et al. (1990) for sperm whales. 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. Data from Rossi (2009) are used to calculate bowhead response rate and Brown et al. (1991) was used for right whales. Overall, we do not expect sei whales to respond to biopsy, but 33 fin, 38 humpback, five North pacific right, and 45 sperm whales are likely to respond behaviorally to biopsy activities as described above (mild- to moderate-behavioral responses). We also expect that one or a few blue whales may respond with low- to moderate-level behavioral responses over the life of the proposed permit. Based upon data from a variety of odontocete species, we expect most if not all Hawaiian insular false killer whales to respond to biopsy attempts. We could not assess the impacts of biopsy and tagging independently from one another for populations or species which we provisionally accepted proposed levels of tagging and biopsy (humpback whales in the Atlantic, southern resident killer whales, and Hawaiian insular false killer whales). However, as response rates and response types for these activities are generally similar and if biopsy and tagging were to occur to the same individual, the response to both activities by an individual would likely be the same as to one of the activities alone. 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, breeding, 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 considered by this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Sources queried include state legislature websites and Nexis. We reviewed bills passed from 2009-2011 and pending bills under consideration were included as further evidence that actions “are reasonably certain to occur.”

State regulation is critical for future anthropogenic impacts in a region. Legislation from Hawaii and many of the Pacific Islands address maintaining healthy marine ecosystems with regulated development of industry, regulation of commercial and recreational use of ocean waters, controlling contaminants in agricultural, stormwater, and municipal effluents, resisting invasive species occurrence, and promotion of policies to decrease greenhouse gas emission and pollution, including alternative energy development.

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 the effects

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

The NMFS Permits Division proposes to issue a scientific research permit to Frank Parrish authorizing research on Blue, Fin, Humpback, North Pacific right, Sei, and Sperm whales and on Hawaiian insular false killer whales, occurring in U.S. and international waters of the Pacific Islands Region..

The *Status of listed resources* described the factors that have contributed to the reduction in population size for the species considered in this Opinion. Threats to the survival and recovery of Blue, Fin, Humpback, North Pacific right, Sei, and Sperm whales and on Hawaiian insular false killer whales include directed harvest, fisheries interactions, ship strikes, noise, predation, disease and parasitism, contaminants, and scientific research. NMFS expects that the current natural and anthropogenic threats described in the *Environmental Baseline* will continue. Reasonably likely future actions described in the *Cumulative effects* section that could affect the species considered in this opinion include state legislation aimed at maintaining healthy marine ecosystems with regulated development of industry and regulation of commercial and recreational use of ocean waters, and others.

Under the proposed permit, listed whales would be exposed to close approaches by research vessels, aerial surveys, photo-identification from ships, passive acoustic recording, biopsy sampling, suction cup and dart tagging and collection of sloughed skin. For each year of the five-year proposed permit, we estimate that up to 250 of each blue, fin, humpback, sei, sperm whales and 13 North Pacific right, and 125 Hawaiian insular false killer whales could be exposed.

We believe short-lived stress responses due to close approach by research vessels are possible for a few individuals, as are short-term interruptions in behaviors such as foraging; however, we do not expect these responses to lead to reduced opportunities for foraging or reproduction for targeted individuals. Collection of sloughed skin and feces, even if done in the vicinity of a whale, would not have an effect beyond that of the close approach.

Overall, no individual whale is expected to experience a fitness reduction, and therefore no fitness consequence would be experienced at a population or species level.

Conclusion

After reviewing the current *Status of listed resources*; the *Environmental baseline* for the *Action area*; the anticipated effects of the proposed activities; and the *Cumulative effects*, it is NMFS' Opinion that the activities authorized by the proposed issuance of scientific research permit 15240, as proposed, is not likely to jeopardize the continued existence of endangered Blue, Fin, Humpback, North Pacific right, Sei, Sperm whales and proposed Hawaiian insular false killer whales .

Incidental take statement

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

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

Conservation recommendations

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

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

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

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

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

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

Reinitiation notice

This concludes formal consultation on the proposal to issue scientific research permit No. 15240 to Frank Parrish authorizing research on endangered Blue, Fin, Humpback, North Pacific right, Sei, and Sperm whales and on Hawaiian insular false killer whales, which are proposed for listing as endangered, occurring in U.S. and international waters of the Pacific Islands Region. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, the NMFS Permits Division must immediately request reinitiation of Section 7 consultation.

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