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

Biological Opinion

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

Activity Considered: Biological Opinion on the proposal to issue Permit Number 15271 to Jim Harvey of Moss Landing Marine Laboratories to authorize research on blue, fin, and humpback whales off the California, Oregon, and Washington coasts in the North Pacific Ocean, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

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

Approved by: _____

Date: MAR 24 2011

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

This document represents the NMFS' biological opinion (Opinion) of the effects of the proposed research on the endangered blue, fin, and humpback whales as has been prepared in accordance with Section 7 of the ESA. This Opinion is based on our review of the Permits, Conservation, and Education Division's draft Environmental Assessment, draft permit 15271, the permit application from Jim Harvey of Moss Landing Marine Laboratories, 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, Conservation, and Education Division (Permits Division) requested consultation with the NMFS' Endangered Species Division on the proposal to issue scientific research permit authorizing studies on blue, fin, and humpback whales. Issuance of the permit constitutes a federal action, which may affect marine species listed under the ESA.

On October 10, 2009 the Permits Division received an application from Jim Harvey of Moss Landing Marine Laboratories, for a permit to "take" [1] endangered blue, fin, humpback, and gray whales for scientific research. On November 29, 2010, the Permits Division requested initiation of Section 7 consultation to issue a new permit to Jim Harvey of Moss Landing Marine Laboratories. The Endangered Species Division determined that the request for initiation was complete and formally initiated consultation with the Permits Division.

Description of the proposed action

NMFS' Office of Protected Resources – Permits, Conservation, and Education 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 15271 to Jim Harvey of Moss Landing Marine Laboratories would authorize research on cetaceans off the California, Oregon, and Washington coasts in the North Pacific Ocean.

Proposed permit 15271

The applicant proposes to conduct research on four species of cetaceans (three of which are endangered) off the California, Oregon, and Washington coasts in the North Pacific Ocean. For the proposed action, the permit would be valid for five years from the date of issuance, and would expire on the date specified in the permit. The proposed actions and "take" authorizations for the endangered species can be found in Table 1.

Proposed activities would include close vessel approach for behavioral observations, photo-id, and biopsy sample collection, and to attach tags by suction cup or by implanting barbs or the tag into the skin and blubber. No research-related mortalities would be authorized. Proposed research would take place throughout the year, but the majority of blue, fin, and humpback whale sampling would occur from July through December. Research would be conducted from vessels less than 30 ft in length.

Whales would be approached to a minimum of 30 meters for photo-identification and a minimum of 2 meters for biopsy sample collection and attachment of tags. Approach durations would vary depending on circumstances, behaviors, social dynamics, and weather and water conditions, but would generally not last more than 30 min. Whales

[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."

tagged for more than one day would be observed multiple times in the following weeks (approximately daily in the first week, weekly for the next two months) to assess the animals' condition, monitor for infection at the tag site, and determine if the tag is still attached.

Table 1. Proposed annual takes of endangered whales during vessel surveys in the Pacific Ocean off California, Oregon, and Washington states.

Species and life stage	Takes[2]	Procedures	Successful /missed tag attachments	Successful/ missed biopsy attempts
Whale, blue; Eastern North Pacific Stock Adult/ Juvenile	40	Passive acoustic recording; suction-cup tagging; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy.	30/10	50/15
	15	Passive acoustic recording; dart/barb tagging; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy.	10/5	
	15	Passive acoustic recording; implantable tagging; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy.	10/5	
	50	Tagged whales approached for follow-up photos, 20 times each. Includes passive acoustic recording; monitoring and behavioral observation; photo-id.	--	--
Whale, fin; California/ Oregon/ Washington Stock Adult/ Juvenile	15	Passive acoustic recording; suction-cup tagging; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy.	10/5	30/10
	7	Passive acoustic recording; dart/barb tagging; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy.	5/2	
	7	Passive acoustic recording; implantable tagging; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy.	5/2	
	10	Passive acoustic recording; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy	--	
	20	Tagged whales approached for follow-up photos, 20 times each. Includes passive acoustic recording; monitoring and behavioral observation; photo-id.	--	--
Whale, humpback; Eastern North Pacific Stock Adult/ Juvenile	40	Passive acoustic recording; suction-cup tagging; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy.	30/10	200/60
	15	Passive acoustic recording; dart/barb tagging; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy.	10/5	
	15	Passive acoustic recording; implantable tagging; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy.	10/5	
	150	Passive acoustic recording; monitoring and behavioral observation; photo-id; skin sample and blubber biopsy	--	
	50	Tagged whales approached for follow-up photos, 20 times each. Includes passive acoustic recording; monitoring and behavioral observation; photo-id.	--	--

[2] Takes = the **maximum** number of animals, not necessarily individuals, that could be targeted for research annually in each row of the table. If any animal is harassed more than once during research, each additional attempt (i.e., take) reduces the number of total takes remaining. E.g., if two *attempts* were required to tag an animal for which 15 annual *takes* are authorized, the researcher has used 2 takes and has 13 takes remaining.

The applicants propose to minimize disturbance to animals during close vessel approaches for all activities by:

- Approaching at minimal speeds from behind or beside the group.
- Limiting approaches to the minimum time necessary to achieve objectives.
- Approaching individuals no more than 4 times for tagging, biopsy, or photo-ID.
- Terminating activities if active avoidance is occurring.
- Using caution when approaching females with calves.

Skin and blubber samples would be collected from the mid-body of large whales, 0.5-1.0 meters from the midline, using a small stainless steel biopsy dart. In no instance would the dart extend through the blubber to the muscle layer. Crossbows, 22-caliber rifles, or compressed air rifles would be used for sample collection. Flotation material secured to the shaft of the dart would allow it to float and be retrieved after sampling. Samples would be collected during tagging approaches as close as 2 meters from the animal, or independent of tagging from 20-30 meters away.

In addition to the mitigation measures described above for close approach, mitigation measures used during biopsy sampling would include:

- Using a new sterile dart tip for each sample collected.
- When possible, identifying individuals prior to sampling to avoid duplication.

Tags would be attached to whales via suction cup or implanted into the skin and blubber of animals, depending on the research objectives. Tags would contain a variety of components to record temperature, depth, sound, acceleration, position, and video, and may be potted in syntactic foam, making them slightly buoyant in water. Tags would be attached dorsally to the mid-body so that the antenna would be exposed when the animal surfaces.

Advancements in technology have consistently led to smaller and more effective tags, and this trend is expected to continue in the future. Exact dimensions and weights would vary with the generation of tag and the specific components included (see Table 2 for examples). Tagging equipment would be updated as newer models become available.

Three types of tag attachments would be used:

(1) external tag attached via suction cup (may contain 2 cm barb inside);
(2) external tag attached via a small, embedded prong;
(3) tag implanted just below the surface.

Table 2. Approximate dimensions of tag types. Sizes are subject to variation depending on tag generation and specific research.

Tag Type	Attachment Method	Dimensions	Expected Attachment Duration
External	Suction cup; may contain 2 cm long barb inside suction cup	18 cm long 2 cm diameter	4-24 hours
External	Prong attachment; 7 cm long, 0.2 cm wide barb in blubber	15 cm long 5 cm wide	2 wks average; 5-6 wks max
Internal	Implants in skin and blubber; anchored by two 2 cm diameter “wings”; penetration < 17 cm	13 cm long 2.4 cm diameter	2 mo average; 12 mo max

Suction cup attachments

The suction cup tags would enclose the GPS receiver, time-depth-recorder (TDR), accelerometers, and occasionally a video camera. The suction cup would be of variable size and composition and could include a small (2 cm long) barb inside the cup, to prevent the suction cup from sliding. Tags would release from the animal when the natural suction of the cup diminishes, or when a magnesium cap that corrodes in salt water causes the tag to release.

These tags would be placed on whales using a pole or low-powered cross bow. Researchers would retrieve tags upon release. Tags attached with suction cups would be expected to remain attached for less than 24 hours. The animal's behavior, including breaching, rolling, or rubbing, could cause the tag to shed prematurely.

Prong attachments

The external tag with a prong attachment would be carried on the exterior of the marine mammal and would enclose a TDR, UHF/VHF transmitters, GPS, and accelerometers. These tags would attach using a small barb that inserts into the blubber layer. A spring-loaded swivel attachment on the barb combined with the hydrodynamic shape of the tag would minimize lateral motion on the animal to minimize chafing of the skin. A magnesium nut attachment at the location of the swivel would allow the entire device, except the barb, to be released at preset times. Tags attached by barb could remain attached for up to six weeks

Implantable tags

Implantable tags would be entirely internal, with the exception of the antenna, and anchored by two 2 cm diameter wings that rotate out perpendicular to the tag axis (Figure 1). The attachment wings would be activated by a pressure sensor once the tag is greater than 5 m below sea level. The wings are driven by a small internal motor and gearing system, and are designed to provide increased resistance to removal by increasing surface area. The anchoring wings would be mechanically deployed after the tag is implanted. In this manner they would not impede deployment but increase the surface area after injection into the animal, decreasing rejection or internal migration of the tag. Implantable tags would be expected to remain attached for up to twelve months.

A stop would limit penetration to 17 cm, with the posterior end of the tag 2 cm below the whale’s surface. Tags would be sterilized via an autoclave and placed in a vacuum pack until just before deployment.

All tag types would be attached using a hand-held or cantilevered pole or deployed with a crossbow or airgun. Behavioral responses of tagged individuals and of other animals in the group would be observed and recorded.

Tagged animals would be observed and photographed many times after tagging, often daily for the first week and approximately every week for the next two months. This would allow researchers to assess whether the tag is still attached, if the condition of the animal has changed, and if the site of tag attachment is infected. When possible, tags would be retrieved after they release from the animal.

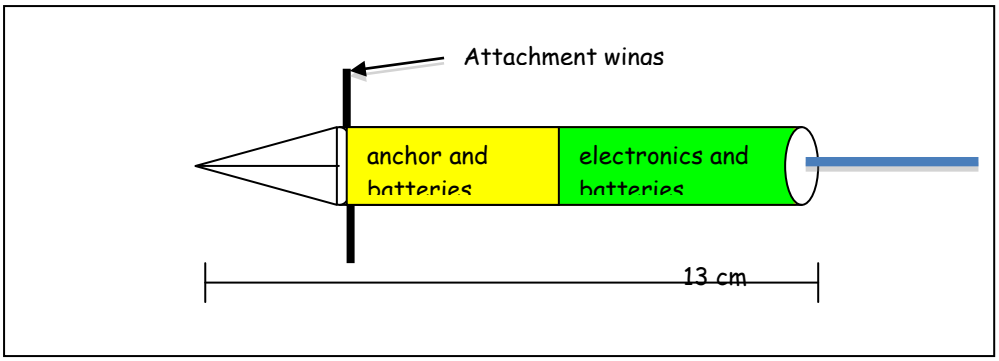

Figure 1. Diagram of implantable tag with external antenna. The perpendicular attachment wings deploy after the tag is inserted into the blubber layer.

In addition to the mitigation measures described above for close approach, mitigation measures used during tagging include:

- Sterilization of implantable tags.
- Use of a broad-spectrum antibiotic on barbs and implantable tags following sterilization.
- Minimizing size and drag and reducing motion of tags.
- Avoiding sensitive body areas (e.g., eyes, blowhole(s)).
- Assessing the effects of tag types to inform future use.

Permit conditions

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

- In the event of serious injury or mortality or if the permitted “take” is exceeded, researchers must suspend permitted activities and contact the Permits Division by phone within two business days, and submit a written incident report. The Permits Division may grant authorization to resume permitted activities.
- Permit holders must exercise caution when approaching animals and must retreat from animals if behaviors indicate the approach may be interfering with reproduction, feeding, or other vital functions.
- **Takes.** Any “approach” constitutes a take by harassment under the MMPA and must be counted and reported. An "approach" is defined as a continuous sequence of maneuvers (episode) involving a vessel, including drifting, directed toward a cetacean or group of cetaceans closer than 100 yards for large whales, or 50 yards for smaller cetaceans. Regardless of success, any attempt to tag or biopsy sample an animal, which includes the associated close approach, constitutes a take and must be counted and reported. No individual animal may be “taken” more than 3 times in one day.
- To minimize disturbance of the subject animals the Permit Holder must exercise caution when approaching animals and must retreat from animals if behaviors indicate the approach may be interfering with reproduction, feeding, or other vital functions.

- **Mother and calf pairs**. When females with calves are authorized to be taken, researchers must terminate efforts if there is any evidence that the activity may be interfering with pair-bonding or other vital functions; must not position the research vessel between mother and calf; must approach mothers and calves gradually to minimize or avoid any startle response; and must not approach when calf is actively nursing;.
- **Biopsy and Tagging.** All biopsy tips must be disinfected between and prior to each use. Adults and juveniles may be biopsy sampled or tagged, including females with dependent calves. Researchers must take reasonable measures to avoid repeated sampling of an individual. No more than three attempts may be made to attach a tag to or collect a biopsy sample from an individual. A tag attachment or biopsy attempt must be discontinued if an animal exhibits repetitive strong adverse reactions to the activity or the vessel. Researchers will not attempt to biopsy or tag forward of the pectoral flipper.

Approach to the assessment

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

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

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

risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population-level risks to the species those populations comprise.

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

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

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

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

To conduct these analyses, we rely on all of the evidence available to us. This evidence consists of

- monitoring reports submitted by past and present permit holders
- reports from the NMFS Science Centers
- reports prepared by natural resource agencies in States and other countries
- reports from non-governmental organizations involved in marine conservation issues
- the information provided by the NMFS Permits Division when it initiates formal consultation
- the general scientific literature

We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies.

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

Action Area

Activities would be conducted year-round in the North Pacific Ocean. Research would be conducted off the coasts of California, Oregon, and Washington, and the primary area of research would be within 15 nautical miles of the central California coast (especially from Point Reyes south through Monterey Bay and to Point Sur; see Figure 2). Proposed research would take place throughout the year, but research involving blue, fin, and humpback whales would mostly occur from July through December, and research on non-listed species (gray whales) would occur from December through July.

Figure 2: Central California coast, from Point Reyes south through Monterey Bay and to Point Sur. Source: Google Earth.

Status of listed resources

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

Pinnipeds		
Guadalupe fur seal	*Arctocephalus townsendi*	Threatened
Steller sea lion – Eastern DPS*	*Eumetopias jubatus*	Threatened
Cetaceans		
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Killer whale - Southern Resident*	*Orcinus orca*	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
Fish		
Chinook salmon ESUs*	*Oncorhynchus tshawytscha*	Threatened
		Endangered
Chum salmon ESUs*	*Oncorhynchus keta*	Threatened
Coho salmon ESUs*	*Oncorhynchus kisutch*	Threatened
		Endangered
Green sturgeon – Southern DPS*	*Acipenser medirostris*	Threatened
Sockeye salmon ESUs*	*Oncorhynchus nerka*	Threatened
		Endangered
Steelhead trout ESUs*	*Oncorhynchus mykiss*	Threatened
		Endangered
Invertebrates		
Black abalone	*Haliotis cracherodii*	Endangered
White abalone	*Haliotis sorenseni*	Endangered

* Critical habitat for this species exists within action area.

Species not considered further in this opinion

To refine the scope of this Opinion, NMFS used two criteria (risk factors) to determine whether any endangered or threatened species or critical habitat are not likely to be adversely affected by vessel traffic 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 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 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 or human disturbance. This section summarizes the results of our evaluations.

Guadalupe fur seals, Steller sea lions, Southern Resident killer whales, North Pacific right whales, sei and sperm whales, and green, hawksbill, leatherback, loggerhead, and olive ridley sea turtles may occur in the action area. However, because the proposed activities are targeted specifically to blue, fin, and humpback whales and because of the relatively small size and slow speeds of the vessels, and therefore we do not expect the proposed action to adversely affect these species. The proposed activities are entirely aquatic in nature and therefore will not affect the nesting activities of any sea turtles or any rookeries or haulouts of any pinniped species.

Critical habitat for the DPS of Southern Resident killer whales was designated on November 29, 2006 (71 FR 69054). Three specific areas were designated; (1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; (2) Puget Sound; and (3) the Strait of Juan de Fuca, which comprise approximately 2,560 square miles of marine habitat. Three essential factors exist in these areas: water quality to support growth and development; prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and passage conditions to allow for migration, resting, and foraging. Any potential effects to this critical habitat would be insignificant because the proposed activities would not cause any significant changes to water quality in designated critical habitat, would not affect prey species, and would not limit passage conditions. Therefore, the proposed activities are not expected to adversely affect the conservation value of designated critical habitat for these species.

Critical habitat was designated on August 27, 1993 for both eastern and western DPS Steller sea lions in California, Oregon, and Alaska (58 FR 45269). Steller sea lion critical habitat includes all major rookeries in California, Oregon, and Alaska and major haulouts in Alaska. Essential features of Steller sea lion critical habitat include the physical and biological habitat features that support reproduction, foraging, rest, and refuge, and include terrestrial, air and aquatic areas. Specific terrestrial areas include rookeries and haul-outs where breading, pupping, refuge and resting occurs. The principal, essential aquatic areas are the nearshore waters around rookeries and haulouts, their forage resources and habitats, and traditional rafting sites. Air zones around terrestrial and aquatic habitats are also designated as critical habitat to reduce disturbance in these

essential areas.

The proposed research would not affect population ecology or population dynamics of prey species, predators, or competitors of Steller sea lions. We do not expect that changes in prey distribution would be measurable even for the short period of time researchers may be in designated critical habitat. Additionally, we do not expect the physical, chemical, and biotic features that form and maintain the critical habitat to be changed, including the space needed for population growth, cover or shelter, sites for breeding, and habitats that are protected from disturbance. As a result, the proposed permits are not likely to result in an appreciable reduction in the conservation value of the critical habitat for Steller sea lions.

For ESA-listed black and white abalone, as well as green sturgeon (Southern DPS) and Pacific salmon ESUs that may be present in the action area, the proposed activities would target other species and would be conducted in a manner that is not expected to adversely affect these species. Critical habitat designated for ESA-listed Pacific salmon and the Southern DPS of green sturgeon occurs within the action area.

Designated critical habitat for several ESUs of steelhead and chinook, sockeye, and chum salmon includes nearshore marine waters contiguous with the shoreline from the line of extreme high water out to a depth no greater than 30 m (98 ft) relative to mean lower low water (70 FR 52630; September 2, 2005). The primary constituent elements (PCEs) for these habitat designations include nearshore marine areas free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; natural cover; and offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. Any potential effects to this critical habitat would be insignificant because the proposed activities would not cause obstruction or significantly affect predation, would not cause any significant changes to water quality in designated critical habitat, would not affect forage or the ability for critical habitat areas to support growth and maturation of listed salmon, and would not affect the natural cover in these areas. Therefore, the proposed activities are not expected to adversely affect the conservation value of designated critical habitat for these species.

Designated habitat for the Southern DPS green sturgeon generally includes coastal U.S. marine waters within 60 fathoms depth, from Monterey Bay, California, north to Cape Flattery, Washington, as well as certain rivers, bays, and estuaries (74 FR 52300; October 9, 2009). PCEs are designated for each of the three different systems that green sturgeon at specific life stages; the action area intersects the coastal marine critical habitat, for which the PCEs area migratory corridor, water quality, and food resources. Any potential effects to this critical habitat would be insignificant because the proposed activities would not disrupt the migratory behavior of the fish, would not cause any significant changes to water quality in designated critical habitat, and would not affect food availability. Therefore, the proposed activities are not expected to adversely affect the conservation value of designated critical habitat for these species.

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

Status of species considered in this opinion

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

Blue whale

Description of the species

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

Stock designations

Little is known about population and stock structure of blue whales. Studies suggest a wide range of alternative population and stock scenarios based on movement, feeding, and acoustic data. For management purposes, the International Whaling Commission (IWC) considers all Pacific blue whales as a single stock, whereas under the MMPA, the NMFS recognizes four stocks of blue whales: western North Pacific Ocean, eastern North Pacific Ocean, Northern Indian Ocean, and Southern Hemisphere.

Until recently, blue whale stock structure had not been tested using molecular or nuclear genetic analyses (Reeves *et al.* 1998). A recent study by Conway (2005) suggested that the global population could be divided into four major subdivisions, which roughly correspond to major ocean basins: eastern North and tropical Pacific Ocean, Southern Indian Ocean, Southern Ocean, and western North Atlantic Ocean. This Opinion treats blue whales as four distinct populations.

North Pacific. Blue whales occur widely throughout the North Pacific. Acoustic monitoring has recorded blue whales off Oahu and the Midway Islands, although sightings or strandings in Hawaiian waters have not been reported (Barlow *et al.* 1997; Northrop *et al.* 1971; Thompson and Friedl 1982). Nishiwaki (1966) notes blue whale occurrence among the Aleutian Islands and in the Gulf of Alaska, but no one has sighted a blue whale in Alaska for some time, despite several surveys (Stewart *et al.* 1987;

Carretta *et al.* 2005; Leatherwood *et al.* 1982; Forney and Brownell 1996). Blue whales are thought to summer in high latitudes and move into the subtropics and tropics during the winter (Yochem and Leatherwood 1985).

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

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

Southern Hemisphere. Blue whales range from the edge of the Antarctic pack ice (40°-78°S) during the austral summer north to Ecuador, Brazil, South Africa, Australia, and New Zealand during the austral winter (Shirihai 2002). The IWC has designated Southern Hemisphere stock areas for management purposes based upon feeding areas. However, the overall population structure is unknown (Sears and Larsen 2002).

Reproduction

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

Feeding

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

Status and trends

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

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

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

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

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

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

Critical habitat

NMFS has not designated critical habitat for blue whales.

Fin whale

Description of the species

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

Stock designations

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

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

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

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

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

Reproduction

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

Feeding

Fin whales in the North Atlantic eat pelagic crustaceans (mainly krill and schooling fish such as capelin, herring, and sand lance (Hjort and Ruud 1929; Ingebrigtsen 1929; Jonsgård 1966; Mitchell 1974b; Sergeant 1977; Overholtz and Nicolas 1979; Watkins *et al.* 1984; Christensen *et al.* 1992; Borobia and Béland 1995; Shirihai 2002). In the North Pacific, fin whales also prefer euphausiids and large copepods, followed by schooling fish such as herring, walleye pollock, and capelin (Nemoto 1970; Kawamura 1982a; Kawamura 1982b; Ladrón De Guevara *et al.* 2008; Paloma *et al.* 2008). Fin whales frequently forage along cold eastern boundaries of currents (Perry *et al.* 1999). Antarctic fin whales feed on krill, *Euphausia superba*, which occurs in dense near-surface schools (Nemoto 1959). However, off the coast of Chile, fin whales are known to feed on the euphausiid *E. mucronata* (Antezana 1970; Perez *et al.* 2006). Feeding may occur in waters as shallow as 10 m when prey are at the surface, but most foraging is observed in high-productivity, upwelling, or thermal front marine waters (Gaskin 1972; Sergeant 1977; Nature Conservancy Council 1979 as cited in ONR 2001).

Status and trends

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

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

North Atlantic. Sigurjónsson (1995) estimated that between 50,000 and 100,000 fin whales once populated the North Atlantic, although he provided no data or evidence to

support that estimate. However, over 48,000 fin whales were caught between 1860- 1970 (Braham 1991). Although protected by the IWC, from 1988-1995 there have been 239 fin whales taken from the North Atlantic. Recently, Iceland resumed whaling of fin whales despite the 1985 moratorium imposed by the IWC. The western Mediterranean fin whale population is estimated at 3,583 individuals (95% CI = 2,130- 6,027; Forcada et al. 1996).

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

Critical habitat

NMFS has not designated critical habitat for fin whales.

Humpback whale

Description of the species

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

Stock designations

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

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

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

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

Reproduction

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

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

Feeding

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

Status and trends

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

North Pacific. The pre-exploitation population size of North Pacific humpback whales may have been as many as 15,000 humpback whales, and current estimates are 6,000-8,000 whales (Calambokidis *et al.* 1997; Rice 1978). From 1905 to 1965, nearly 28,000 humpback whales were taken in whaling operations, reducing the number of all North

Pacific humpback whale to roughly 1,000 (Perry *et al.* 1999). Population estimates have risen over time from 1,407-2,100 in the 1980s to 6,010 in 1997 (Baker 1985; Baker and Herman 1987; Darling and Morowitz 1986; Calambokidis *et al.* 1997). Tentative estimates of the eastern North Pacific stock suggest an increase of 6-7% annually, but fluctuations have included negative growth in the recent past (Angliss and Outlaw 2005). Based upon surveys between 2004 and 2006, Calambokidis et al. (2008) estimated that the current population of humpback whales in the North Pacific consists of about 18,300 whales, not counting calves. Almost half of these whales likely occur in wintering areas around the Hawaiian Islands.

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

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

Critical habitat

NMFS has not designated critical habitat for humpback whales.

Environmental baseline

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

A number of human activities have contributed to the current status of ESA-listed whales 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 predation, disease and parasitism, commercial and subsistence harvest,

fisheries interactions, ship strikes, contaminants, noise, U.S. Navy activities, and scientific research.

Predation

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

Based upon prevalence of tooth marks, attacks by killer whales 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).

Disease and parasitism

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

Commercial and subsistence harvest

The target large whale populations were the subject of commercial whaling to varying degrees for hundreds of years. The development of steam-powered boats in the late 19th century, coupled with the use of the forward-mounted gun-fired harpoon, made it possible to more efficiently kill and tow ashore the larger baleen whale species such as blue, fin, and minke whales. Earliest efforts to end commercial whaling included a ban by the League of Nations in the mid-1930s and the formation of the International Convention for the Regulation of Whaling in 1946. Prior to current prohibitions on whaling, such as the IWC's moratorium, most large whale species had been depleted to the extent that it was necessary to list them as endangered under the ESA.

The industry caused significant declines in several of the target species' populations. Over 28,000 humpback whales were taken by commercial whalers during the 20th century (Rice 1978). Before its protection by the IWC in 1966, whalers took approximately 9,500 blue whales throughout the North Pacific over a span of 55 years, beginning in 1910 (Ohsumi and Wada. 1972).

Fin whales continue to be hunted in subsistence fisheries off West Greenland. Between 2003 and 2007, the IWC set a catch limit of up to 19 fin whales in this subsistence fishery. In the Antarctic Ocean, fin whales are hunted by Japanese whalers who have been allowed to kill up to 10 fin whales each ear for the 2005-2006 and 2006-2007 seasons under an Antarctic Special Permit NMFS (2006).

Fisheries interactions

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

Marine mammals probably consume at least as much fish as is harvested by humans (Kenney *et al.* 1985). Therefore, competition with humans for prey is a potential concern for whales. Reductions in fish populations, whether natural or human-caused, may affect listed whale populations and their recovery.

Humpback and fin whales are known to feed on several species of fish that are harvested by humans and fishery-caused reductions in prey resources could also have an influence on these species (Waring *et al.* 2008). However, the extent of competition between humans and whales is not known.

Ship strikes

Collisions with commercial ships are an increasing threat to many large whale species, particularly as shipping lanes cross important large whale breeding and feeding habitats or migratory routes. In the Eastern Pacific, the following average observed annual mortalities due to ship strike have been reported for the period 2002-2006: 1.6 fin whales, 0.6 blue whales, and 0 humpback whales, although it is apparent that animals struck by ships are unlikely to be reported (Carretta *et al.* 2009).

Ship strike is presently a concern for blue whale recovery. Dive data support a surface-oriented behavior during nighttime that would make blue whales particularly vulnerable to ship strikes. There are concerns that, like right whales, blue whales may surface when approached by large vessels, a behavior that would increase their likelihood of being struck. Protective measures are not currently in place. It is believed that the vast majority of ship strike mortalities are never identified, and that actual mortality is higher than currently documented.

Fin whales experience significant injury and mortality from fishing gear and ship strikes (Perkins and Beamish 1979; Lien 1994; Waring *et al.* 2007; Douglas *et al.* 2008; Carretta *et al.* 2007). Management measures aimed at reducing the risk of ships hitting right whales have been put in place.

Vessel activity also has been identified as a threat. This includes physical harm or behavioral modifications as well as habitat degradation/loss from U.S. naval vessel sonar activities, ship strike, and heavy and continuous presence by whale-watching vessels.

Contaminants

The accumulation of stable pollutants is a possible human-induced source of mortality in long-lived high trophic level animals (Waring *et al.* 2004; NMFS 2005b), 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).

There is a paucity of contaminant data regarding blue whales. Available information indicates that organochlorines, including DDT, PCB, HCH, HCB, chlordane, dieldrin, methoxychlor, and mirex have been isolated from blue whale blubber and liver samples (Gauthier *et al.* 1997b; Metcalfe *et al.* 2004). DDE, DDT, and PCBs have been also identified from fin whale blubber, but levels are lower than in toothed whales due to the lower level in the food chain at which the baleen whales feed (Henry and Best 1983; Borrell and Aguilar 1987; Marsili and Focardi 1996; Borrell 1993; Aguilar and Borrell 1988). Humpback whale blubber has been shown to contain PCB and DDT (Gauthier *et al.* 1997a). 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.

Noise

Increasing oceanic noise may impair blue whale behavior. Although available data do not presently support traumatic injury from sonar, the general trend in increasing ambient low-frequency noise in the deep oceans of the world, primarily from ship engines, could impair the ability of whales to communicate or navigate through these vast expanses (Aburto *et al.* 1997; Clark 2006).

U.S. Navy activities

Southern California Range Complex

The U.S. Navy has been conducting training and other activities in their Southern California Range Complex for over 70 years. Current activities include anti-submarine warfare exercises, anti-air warfare exercises, anti-surface warfare exercises, and amphibious warfare exercises, coordinated training events and research, development and evaluation activities. The U.S. Navy estimates that it currently conducts about 8 major training exercises, seven integrated exercises, and numerous unit-level training and maintenance exercises in the Southern California Range Complex each year (U.S. Navy 2008).

Although the U.S. Navy did not estimate the number of times different listed species might be exposed to mid-frequency active sonar during these training activities, NMFS estimated about 14,000 instances in which endangered or threatened marine mammals would be exposed to Navy training activities during the cold season and another 3,600 exposure events during the warm season. The largest number of exposure events (about 70 percent or about 9,900 exposure events during the cold season and about 1,891 exposure events during the warm season) would involve blue whales, with 2,100 exposure events involving sperm whales (about 15 percent of the exposure events), and 1,900 exposure events involving fin whales (about 13.7 percent of the exposures).

Of this total number of exposure events involving mid-frequency active sonar, the U.S. Navy estimated that yearly totals for behavioral harassment events would be 480 for blue

whales, 135 for fin whales, 120 for sperm whales, and 772 for Guadalupe fur seals. Because blue whales are not likely to hear mid-frequency active sonar, it is assumed that blue whales would be more likely to be harassed by vessel traffic rather than the active sonar itself.

The U.S. Navy also estimated that three blue whales would have been behaviorally harassed each year as a result of underwater detonations associated with training activities in the Southern California Range Complex and another two blue whales would have experienced temporary losses in hearing sensitivity as a result of being exposed to those detonations. Two fin whales and an additional fin whale would also have experienced temporary losses in hearing sensitivity as a result of being exposed to these detonations. Two sperm whales would have been behaviorally harassed each year and an additional two sperm whales would have experienced temporary losses in hearing sensitivity as a result of being exposed to these detonations. Two Guadalupe fur seals would have been behaviorally harassed and an additional two seals would have experienced temporary losses in hearing sensitivity as a result of being exposed to these detonations.

Northwest Training Range

The U.S. Navy has conducted training activities in the Northwest Training Range Complex for decades and has conducted training at current intensities and frequencies for about 10 years. These activities have typically occurred in the areas that are about 12 kilometers off the coast of northern Washington. Those training activities have included tracking exercises with maritime patrol aircraft (200 events), tracking exercises with extended echo ranging (10 events), tracking exercises with surface ships (24 events per year employing AN/SQS-53c sonar for a total of 36 hours of active sonar and 36 events per year employing AN/SQS-56 sonar for a total of 54 hours of active sonar), tracking exercises with submarines (96 events with passive sonar), electronic combat exercises, mine warfare exercises (which occurred at higher frequencies than with the proposed action), naval special warfare, strike warfare, and support activities.

Thus far, the impacts of these training activities on endangered or threatened species in the action area have not been apparent. Nevertheless, on May 5, 2003, the U.S. Navy guided missile destroyer *USS Shoup* passed through the strait while operating its mid-frequency sonar during a training exercise. Members of the J pod of southern resident killer whales were in the strait at the same time and exhibited unusual behavior in response to being exposed to sonar at received levels of about 169 dB (Fromm 2004; NMFS 2005a; U.S. Navy Pacific Fleet 2004). Based on the duration and received levels, and the levels known to cause behavioral reactions in other cetaceans, NMFS concluded that J pod had been exposed to the sonar at received levels that were likely to cause behavioral disturbance, but not temporary or permanent hearing loss (NMFS 2005a). These findings were consistent with the reports generated from the eyewitness accounts of the event.

Scientific research

A total of 12 permits authorize the harassment of one or more of the listed target species in the action area during research (Table 3). Most of the permits in Table 3 authorize a

smaller study area or region within an ocean basin, reducing the chance of repeated harassment of individual whales by researchers. Most of this research does not overlap in area or timing, although some spatial overlap exists for research on species with known feeding or breeding grounds, such as humpback whales.

Table 3: Active scientific research permits and letters of confirmation authorizing research on target species in the action area.

Permit No. and Holder	Ocean Basin or Area	Expiration date	Species
369-1757-01* Mate	Pacific, Atlantic, and high seas	5/31/2011	blue, fin, humpback whale
782-1719-09* NMFS, NMML	Pacific	6/30/2011	blue, fin, humpback whale
14097 NMFS, SWFSC	Pacific	6/30/2015	blue, fin, humpback whale
731-1774-06* Baird	HI, CA to AK, high seas	8/31/2011	blue, fin, humpback whale
540-1811-03 Calambokidis	North Pacific, including CA, OR, WA	4/14/2011	blue, fin, humpback whale
781-1824-01 NMFS, NWFSC	AK to CA	4/14/2011	blue, fin, humpback whale
965-1821-01 Bain	AK to CA	4/14/2011	fin and humpback whale
1058-1733-01 Baumgartner	Pacific, Atlantic, and high seas	5/31/2012	blue, fin, humpback whale
727-1915 Scripps Institute of Oceanography	HI, CA to WA	2/1/2013	blue, fin, humpback whale
14451 Joseph Mobley	North Pacific, including CA, OR, WA	7/31/2015	blue, fin, humpback whale
13846 Jim Darling	WA	7/31/2015	humpback whale
14585 Adam Pack	North Pacific, including CA, OR, WA	7/31/2015	blue, fin, humpback whale

* indicates that there is an extension on the permit

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 endangered whales to actions that constitute “take” from tagging activities. 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 whales 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:

- boat motor noise;
- oil or fuel leakage;
- ship strike due to vessel transit;
- photo-identification;
- disturbance of non-target listed species;
- close approach by research vessels;
- entanglement or interaction with research equipment;
- skin and blubber biopsy;
- tagging with suction-cup, prong, or implantable tags (including VHF/UHF transmitters);

Based on a review of available information, the following stressors would be negligible: photo-identification; boat motor noise; oil or fuel leakage from vessels; entanglement or interaction of the targeted species with equipment; ship strikes due to vessel transit; and VHF/UHF transmitters (but not the tagging procedure, which will be assessed further in this Opinion).

Photo-identification of the listed species during vessel surveys would have no effect on listed species beyond the effect of the vessel surveys themselves, which will be considered further in this Opinion. Vessel noise would add so little noise to the overall sound field as to have a discountable change to the ambient sound environment of the region. The potential for fuel or oil leakages is extremely unlikely. Due to the small size the boats, leaks should be easily identified and contained, and the experience of the researchers in conducting vessel surveys and the availability of high-resolution bathymetric maps of the research area makes running aground unlikely. We also do not

anticipate risk of interaction or entanglement in equipment associated with the proposed activities, other than permitted actions, nor do we expect any unintentional physical contact with the species during the proposed studies, such as ship strikes, given the applicant's experience and the fact that vessels will be at sea with the primary purpose of locating these species. We expect the applicant would be able to locate, identify, and avoid these species during transit when not specifically targeting animals for research, and we do not expect vessel strike during transit.

The VHF and UHF transmitters that would be used to aid researchers in locating tags will transmit at frequencies above 30 MHz. This is well above the known hearing range for marine mammals, and NMFS considers anything over 200 KHz to have no effects (A. Scholik-Schlomer, NMFS, pers. comm. 2010), therefore VHF and UHF transmissions are not considered further.

The remainder of our analysis focuses on the following potential stressors: close approach of vessels, skin and blubber biopsy, suction-cup, prong, and implantable tagging, and disturbance.

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 permit for scientific research to Jim Harvey of Moss Landing Marine Laboratories. Table 1 identifies the numbers of different listed species that the applicant would be authorized to take annually over the lifetime of the permit (5 years). The research would be conducted off the coasts of California, Oregon, and Washington, and the primary area of research would be within 15 nautical miles of the central California coast (especially from Point Reyes south through Monterey Bay and to Point Sur).

Adults and juveniles of both sexes of cetaceans would be targeted for the suites of procedures in the proposed permit (see Table 1). The proposed permit would allow the applicant to close approach, photo-identify, biopsy, and suction-cup tag 40 blue, 15 fin, and 40 humpback whales; close approach, photo-identify, biopsy, and tag with prong attachment 15 blue, 7 fin, and 15 humpback whales; close approach, photo-identify, biopsy, and deploy implantable tags 15 blue, 7 fin, and 15 humpback whales; and close approach, photo-identify, and biopsy (with no tagging) 10 fin and 150 humpback whales. These take limits include failed attempts to tag or biopsy.

For the short-term tags (suction-cup and prong attachment) the applicant based the take numbers requested on the sample sizes sufficient to determine dive behaviors and local movements while minimizing the number of animal disturbed during the study. For the longer-term tags (implantable), the applicant expects that throughout a five-year study the requested sample sizes should be adequate to describe and quantify movements, diving, and response to anthropogenic noise for the populations of interest. Although the applicants anticipate that their annual take levels will be variable, they hope to maximize

their chances of sampling enough animals for the statistical power necessary for testing their hypotheses regarding foraging and the effects of anthropogenic noise.

Response analysis

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

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

Response to vessel surveys (including close approaches)

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

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

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

When more pronounced behavioral changes occur, the responses appear to be short-lived (Gauthier and Sears 1999; Weinrich *et al.* 1992; Clapham and Mattila 1993; Weinrich *et al.* 1991). The slow and careful approach to humpback whales is important and is supported by studies conducted by Clapham and Mattila (1993) on the reactions of humpback whales to close approaches for biopsy sampling in Caribbean breeding areas. The investigators concluded that the way a vessel approached a group of whales had a major influence on the whale's response to the approach, particularly for cow and calf pairs. Barrett-Lennard et al. (1996) also found that experienced, trained personnel approaching killer whales slowly would result in fewer whales exhibiting behavioral responses indicative of stress. Smaller pods of whales and pods with calves also seem more responsive to approaching vessels (Bauer and Herman 1986; Bauer 1986). Based on their experiments with different approach strategies, researchers concluded that experienced, trained personnel approaching humpback whales slowly would result in fewer whales exhibiting responses that might indicate stress.

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

Blue whales are thought to respond to approaching vessels in a similar manner as other baleen whales, with responses depending on whale behavior and the speed and direction of the approaching vessel (Perry *et al.* 1999).

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.

Response to skin and blubber biopsy

The likelihood of significant responses by whales to biopsy sampling is low and any responses that may occur are expected to be minor and temporary. Gauthier and Sears (1999) studied the behavioral responses of fin, blue, and humpback whales to crossbow deployed biopsy sampling activities similar to those proposed. Of these, roughly 45% of successful biopsies elicited no response. Those that did resulted in behaviors such as tail flicking and the animals submerging. Most whales returned to normal activities and exhibited normal behavior after a few minutes. Whales reacted similarly when biopsied more than once.

Weinrich (1992) noted that, although rare, biopsy attempts on humpback whales may result in vigorous responses which can lead to near physical exhaustion. Strong reactions in humpback whales occurred in only 3.3% of biopsy attempts and were always associated with unusual occurrences such as the entanglement of retrieval lines on the flukes or fins of the target animal (Weinrich *et al.* 1991). More common reactions included decreased time at the surface, a reduction in movement and an increase in tail flicks.

A study by Clapham and Mattila (1993) showed that 67% of humpback whales exhibited either no reaction or only a low-level reaction in response to biopsy procedures. Brown et al. (1994) reported that detectable reactions to biopsy sampling occurred in 41.6 % of humpback whales sampled, and that females responded more than males. No long-term effects were observed in any of these studies and no significant age or gender differences in whale responses to biopsy procedures were reported. Similar short-term responses in killer whales were observed by Barrett-Lennard et al. (1996), such as momentary shakes or accelerations, whether the procedure resulted in a hit or a miss. This study also found no indication that darted whales became more evasive of the research boat in either the long or short term. Hooker et al. (2001) found that reactions in northern bottlenose whales to biopsy darting were weak and short lived and that target animals did not avoid the research vessel following biopsy procedures and often re-approached the vessel within several minutes.

Mother/calf pairs of humpbacks appeared to be no more sensitive to biopsy activities than were other whales, although mothers tended to be more evasive of approaching boats (Weinrich *et al.* 1992; Clapham and Mattila 1993). In southern right whales, Best et al. (2005) found that cows with calves exhibited the strongest reactions (10% had no response, 26% startled, 45% responded with a fluke move; 17% responded with a fluke slap), but that calf reactions were indistinguishable from the reactions of other classes of whales when biopsied in pairs. Because of the observed reactions from mothers, as well as the possible tendency for sensitization following repeated sampling, the authors recommended that sampling of cow-calf pairs should be done with extra care.

A maximum of three attempts to obtain a single biopsy sample would be made per animal and investigators would take reasonable measures to avoid repeated sampling of any individual. Strong responses to biopsy darting in past studies usually resulted when whales became entangled in retrieval lines. Because the researchers would not use

tethered biopsy darts, these responses are expected to be unlikely. Furthermore, approaches would be aborted if animals are observed to display unusual behavior, aggravation or distress. These mitigation methods should further reduce the likelihood of any significant disturbance occurring.

There is a risk of infection and disease transfer from biopsy procedures. However, the biopsy tips are to be disinfected between and prior to each use. Therefore, the possibility of infection or disease transfer is not expected to be significant. The proposed biopsy sampling is not expected to result in any long term adverse affects to listed whales. No reduction in fitness is expected to any individual listed animal from the proposed biopsy procedures.

Response to tagging

Tagging involves physical contact with the animal, and is generally categorized as having the potential to injure. A variety of scientific instruments, such as VHF tags and satellite-linked time depth recorders can be attached to marine mammals for collection of a wide-range of data including location, dive and movement patterns, and ambient noise levels. The duration of the tag placement can be from a few hours (suction cup tags) to several weeks (prong tags) to months or a year (implantable tags), and ultimately the tag is released from the animal and retrieved by the researcher. Information is then used to infer habitat use, migratory and foraging behavior, and habitat quality, which are in turn used to make management decisions for the conservation and recovery of a species. Tags do not contain any hazardous materials.

Effects of attached devices may range from subtle, short-term behavioral responses to long-term changes that affect survival and reproduction; attached devices may cause effects not detectable in observed behaviors, such as increased energy expenditure by the tagged animal (Wilson and McMahon 2006; White and Garrot 1990). 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 (White and Garrot 1990; Walker and Boveng 1995).

Although several tagging studies have been conducted on marine mammals, 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 whale to ensure proper tag placement.

Evidence available on the short-term effects of tagging whales indicates that responses vary from little to no observable change in behavior to momentary changes such as skin twitching, startle reactions or flinching, altered swimming speed and orientation, diving, rolling, head lifts, high back arching, fluking, and tail swishing (Baird 1994; Goodyear 1981; Goodyear 1989; Goodyear 1993; Hooker *et al.* 2001; Watkins *et al.* 1984; Mate *et al.* 1998; Mate *et al.* 1997; Andrews *et al.* 2008; Mate *et al.* 2007; Watkins *et al.* 1981). Infrequently, aerial displays like breaching are also noted (Goodyear 1989); and Mate et

al. (2007) reported other infrequent behavioral responses of cetaceans as including fluke slaps and swishes, head lunges, defecation, decreased surfacing rates, disaffiliation with a group of whales, evasive swimming behavior, or cessation of singing (in the case of humpback whales).

Cetaceans frequently react when hit by tags delivered by remote devices such as tagging poles, but are also known to react when tags miss and hit the water. Behavioral responses are noted to be short-term (Mate *et al.* 2007), with the likelihood of a reaction possibly depending on an individual's behavioral state at the time of tagging (Hooker *et al.* 2001). Mate et al. (1998) concluded the responses observed were usually the same as those elicited by close vessel approaches alone.

Hanson et al. (2008) tagged four species of Hawaiian odontocetes (Blainville's and Cuvier's beaked whales, short-finned pilot whale, and false killer whale). Eight days after tagging, one short-finned pilot whale had evidence of swelling of the dermis around the base of a dart, and it and anther pilot whale had bumps on the opposite side of the dorsal fin from the darts, with clear signs of chronic inflammation at the dart site. In both cases, the tags had not been flush with skin at deployment. For the 13 tagged whales re-sighted after tagging, all the tags out-migrated through tag attachment holes, and did not migrate backwards through the fin, with no evidence of major tissue damage or disfigurement, nor the previously observed bumps. Four whales had minor depression at tag site, four had slightly raised tissue, and seven had depigmentation around the tag site. Hanson et al. (2008) suggested that tags that are not deployed to sit flush on fin surface will increase drag, which can lead to increasing load (as the tag pulls away from skin), tissue breakdown, and earlier tag loss. Chronic inflammation and the formation of granulation tissue were observed, but no indication of infection, cutaneous erythema, ulceration, discoloration, or necrosis.

Behavioral responses of whales to the use of non-invasive suction cup tags are also noted by a few researchers. Goodyear (1981) attached a suction cup tag to one humpback whale and found behaviors of the tagged whale and a closely associated whale did not appear to change due to tagging. More recently, Goodyear (1989) tagged 12 humpback whales with suction cup tags and found responses to tagging were minimal with no long-term changes in behavior detected. Of the tagged whales, 69 percent showed no immediate reaction to tagging, and 31 percent exhibited a detectable reaction including quickened dive, high back arch, and tail swish. One breach was seen in over 100 tagging attempts (i.e., <1%). After all tagging attempts the author noted that pre-tagging behavior resumed within a few minutes and that some whales curiously approached the tagging vessel. Additionally, the suction cup did not appear to harm whales' skin. Baird et al. (2000) deployed 15 suction-cup tags in 31 tagging attempts. No strong reactions were observed, all reactions appeared to be short-term and whales returned to pre-tagging behavior, and no reactions from non-target whales were observed.

Long-term effects from tagging remain largely unknown. Goodyear (1989) noted that humpback whales monitored several days after being suction cup tagged did not appear to exhibit altered behavior. In addition, Mate et al. (2007) found that tagged whales re-sighted up to three years later did not appear in poor health and did not appear to behave differently than untagged whales. Hanson et al. (2008) observed a Cuvier's beaked whale

with a young calf after tag loss, suggesting that tagging does not adversely affect reproduction.

After reviewing available information on the responses of large whales to both dart and suction-cup tagging procedures, we do not expect any mortality to occur due to the tagging under permit 15271. Injury from the dart tags would be small and localized on targeted whales and is expected to heal completely and not result in any permanent scarring or other long-term physical damage. Rates of wound healing are expected to vary across regions and are not easily predicted in advance of the proposed tagging studies; however, photo monitoring would be conducted to determine healing or infection rates during the proposed study. Resighting of tagged whales is expected to occur multiple times during the year and cover a range of healing times.

Although tags have the potential to create hydrodynamic drag, which may have an effect on the tagged animal (Hooker *et al.* 2007), the proportion of the proposed tags to be used under permit 15271 relative to the size and weight of the targeted whales is such that the energetic demand on the animal would likely be insignificant. We also believe there is minimal risk of non-target whales being hit with a dart tag given the close proximity of researchers to the targeted whale, the experience of researchers in positioning the vessel around this species, and the very low likelihood that a non-target whale would surface between the vessel and the target animal during a tagging attempt. Some tags could fail soon after deployment (within 1-2 days) due to poor attachments, electronic failure due to impact, or damage to the electronics due to pressure from deep dives, resulting in an individual being retagged unintentionally in one year, but the retagging would not be expected to result in a different behavioral response.

Based on the evidence available, the experience of researchers; the proposed research protocol including the limited number of tags to be deployed, and the limited number of whales that would be re-tagged; as well as the permit conditions to be implemented with the proposed tagging studies, we expect all whales tagged under permit 15271 would exhibit either no visible reaction or short-term behavioral responses to tagging. Strong behavioral responses are not expected during the proposed tagging studies, nor are significant bleeding or infection. We assume short-lived stress responses are possible in a few individuals as are short-term interruptions in behaviors such as foraging; however, we do not expect these responses to lead to reduced opportunities for foraging or reproduction for tagged individuals. Because any responses to tagging are expected to be short-lived, and assuming an animal is no longer disturbed after it returns to its pre-tagging behavior, we do not expect a negative fitness consequence for the tagged individuals.

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 2008-2010 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 California, Oregon, and Washington address efforts to reduce marine debris; efforts to control contaminants and agricultural, stormwater, and municipal effluents; alternative energy development; oil spill prevention and response; prevention of invasive species; promotion of policies to decrease greenhouse gas emission; climate change and sea level rise; ecosystem, natural resource, and endangered species recovery and protection; and regulation of commercial and recreational use of ocean waters.

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 Jim Harvey of Moss Landing Marine Laboratories authorizing studies on blue, fin, and humpback whales off the coasts of California, Oregon, and Washington.

The *Status of listed resources* described the factors that have contributed to the reduction in population size for the three listed species considered in this Opinion. Commercial whaling is a primary reason for the reduction in population size for the three species of cetaceans. Other worldwide threats to the survival and recovery of listed whale species include ship strike, entanglement in fishing gear, toxic chemical burden and biotoxins, and ship noise.

NMFS expects that the current natural anthropogenic threats described in the *Environmental Baseline* will continue, including predation, disease and parasitism, commercial and subsistence harvest, fisheries interaction, ship strikes, contaminants, noise, U.S. Navy activities, and ongoing scientific research. Reasonably likely future actions described in the *Cumulative effects* section include state legislation addressing efforts to reduce marine debris, efforts to control contaminants and agricultural, stormwater, and municipal effluents, alternative energy development, and more.

Blue, fin, and humpback whales would be exposed to vessel surveys (including close approaches), skin and blubber biopsy, and suction-cup, prong attachment, and implantable tagging. Each year of the five-year proposed permit, up to 70 blue, 39 fin, and 220 humpback whales could be affected.

For cetaceans, we believe short-lived stress responses due to close approach, skin and blubber biopsies, and suction-cup and implantable tagging 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. Infection or disease transfer from biopsy procedures is possible, but unlikely given the practice of disinfecting biopsy tips. Injury from the dart tags would be small and localized on targeted whales and is expected to heal completely and not result in any permanent scarring or other long-term physical damage.

Resighting and photo monitoring of biopsied or tagged whales (including after tag has detached) would add to our understanding of the effects of these actions. 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 15271, as proposed, is not likely to jeopardize the continued existence of blue, fin, and humpback 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 work with the Marine Mammal Commission, International Whaling Commission, and the marine mammal research community 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 regional species coordinators, permit holders conducting research within a region, and future applicants to ensure that the results of all research programs or other studies on specific threatened or endangered species are coordinated among the different investigators.

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

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

Reinitiation notice

This concludes formal consultation on the proposal to issue scientific research permit No. 15271 to Jim Harvey of Moss Landing Marine Laboratories for studies of blue, fin, and humpback whales off the coasts of California, Oregon, and Washington. 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.

References

Aburto, A. D., J. Rountry, and J. L. Danzer. 1997. Behavioral response of blue whales to active signals. Naval Command, Control, and Ocean Surveillance Center, RDT&E Division, San Diego, CA.

Agler, B. A., R. L. Schooley, S. E. Frohock, S. K. Katona, and I. E. Seipt. 1993. Reproduction of photographically identified fin whales, *Balaenoptera physalus*, from the Gulf of Maine. Journal of Mammalogy 74(3):577-587.

Aguilar, A. and A. Borrell. 1988. Age- and sex-related changes in organochlorine compound levels in fin whales (Balaenoptera physalus) from the eastern North Atlantic. Marine Environmental Research 25:195-211.

Aguilar, A. and C. H. Lockyer. 1987. Growth, physical maturity, and mortality of fin whales (*Balaenoptera physalus*) inhabiting the temperate waters of the northeast Atlantic. Canadian Journal of Zoology 65:253-264.

Allen, K. R. 1970. A note on baleen whale stocks of the North West Atlantic. Report of the International Whaling Commission Annex I, 20:112-113.

Anderson, J. J. 2000. A vitality-based model relating stressors and environmental properties to organism survival. Ecological Monographs 70(3):445-470.

Andrews, R. D., R. L. Pitman, and L. T. Balance. 2008. Satellite tracking reveals distinct movement patterns for Type B and Type C killer whales in the southern Ross Sea, Antarctica. Polar Biology 31:1461-1468.

Angliss, R. P. and R. B. Outlaw. 2005. Alaska marine mammal stock assessments, 2005. U.S. Department of Commerce, NOAA Technical Memorandum NMFSAFSC-161, 250 p.

Antezana, T. 1970. Eufáusidos de la costa de Chile. Su rol en la Economía del mar. . Revista de Biologia Marina 14:19-27.

Au, W. W. L. and M. Green. 2000. Acoustic interaction of humpback whales and whale-watching boats. Marine Environmental Research 49:469-481.

Baird, R. W. 1994. Foraging behavior and ecology of transient killer whales (*Orcinus orca*). Ph.D. Thesis, Simon Fraser University, Burnaby, British Columbia.

Baird, R. W., A. D. Ligon, and S. K. Hooker. 2000. Sub-surface and night-time behavior of humpback whales off Maui, Hawaii: A preliminary report. Report prepared under Contract # 40ABNC050729 from the Hawaiian Islands Humpback Whale National Marine Sanctuary, Kihei, HI, to the Hawaii Wildlife Fund, Paia, HI. 19p.

Baker, C. S. 1985. The behavioral ecology and populations structure of the humpback whale (*Megaptera novaeangliae*) in the central and eastern Pacific. Unpublished Dissertation. University of Hawaii at Manoa.

Baker, C. S. and L. M. Herman. 1987. Alternative population estimates of humpback whales in Hawaiian waters. Canadian Journal of Zoology 65(11):2818-2821.

Baker, C. S. and L. M. Herman. 1989. Behavioral responses of summering humpback whales to vessel traffic: Experimental and opportunistic observations. Kewalo Basin Marine Mammal Lab, Univ HI, Honolulu. Final Report for the U.S. NPS, Anchorage, Alaska. 50p.

Baker, C. S., L. M. Herman, B. G. Bays, and G. B. Bauer. 1983. The impact of vessel traffic on the behavior of humpback whales in southeast Alaska: 1982 season. Report submitted to the National Marine Mammal Laboratory, Seattle, WA. 78pp.

Baker, C. S., A. Perry, and G. Vequist. 1988. Conservation update-- humpback whales of Glacier Bay, Alaska. Whalewatcher 22(3):13-17.

Balcomb, K. C. 1987. The whales of Hawaii, including all species of marine mammals in Hawaiian and adjacent waters.Marine Mammal Fund Publication, San Francisco, CA. 99p.

Balcomb, K. C. and G. Nichols, Jr. 1982. Humpback whale censuses in the West Indies. Report of the International Whaling Commission 32:401-406.

Baraff, L. and M. T. Weinrich. 1993. Separation of humpback whale mothers and calves on a feeding ground in early autumn. Marine Mammal Science 9(4):431-434.

Barlow, J. 1997. Preliminary estimates of cetacean abundance off California, Oregon, and Washington based on a 1996 ship survey and comparisons of passing and closing modes. Southwest Fisheries Science Center, National Marine Fisheries Service, Admin. Rept. LJ-97- 11, La Jolla, CA.

Barlow, J. 2003. Preliminary estimates of the abundance of cetaceans along the U.S. West Coast: 1991-2001. Southwest Fisheries Science Center Administrative Report LJ-03-03:Available from SWFSC, 8604 La Jolla Shores Dr., La Jolla CA 92037. 92031p.

Barlow, J. and P. J. Clapham. 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. Ecology 78(2):535-546.

Barlow, J., K. A. Forney, P. S. Hill, J. Brownell, R.L., J. V. Carretta, D. P. DeMaster, F. Julian, M. S. Lowry, T. Ragen, and R. R. Reeves. 1997. U.S. Pacific marine mammal stock assessment -1996. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-248.:Southwest Fisheries Science Center; La Jolla, California.

Barlow, J. and B. L. Taylor. 2001. Estimates of large whale abundance off California, Oregon, Washington, and Baja California based on 1993 and 1996 ship surveys. Southwest Fisheries Science Center, National Marine Fisheries Service, La Jolla, California.

Barrett-Lennard, L. G., T. G. Smith, and G. M. Ellis. 1996. A cetacean biopsy system using lightweight pneumatic darts, and its effect on the behavior of killer whales. Marine Mammal Science 12:14-27.

Bauer, G. and L. M. Herman. 1986. Effects of vessel traffic on the behavior of humpback whales in Hawaii. National Marine Fisheries Service, Honolulu, Hawaii.

Bauer, G. B. 1986. The behavior of humpback whales in Hawaii and modification of behavior induced by human interventions. Ph.D. dissertation:University of Hawaii, Honolulu.

Beale, C. M. and P. Monaghan. 2004. Human disturbance: people as predation-free predators? Journal of Applied Ecology 41:335-343.

Best, P. B., D. Reeb, M. B. Rew, P. Palsboll, J., C. Schaeff, and A. Brandao. 2005. Biopsying Southern right whales: Their reactions and effects on reproduction. Journal of Wildlife Managment 69(3):1171-1189.

Borobia, M. P. J. G. Y. S. J. N. G. and P. Béland. 1995. Blubber fatty acids of finback, and humpback whales from the Gulf of St. Lawrence. Marine Biology 122:341-353.

Borrell, A. 1993. PCB and DDTs in Blubber of Cetaceans from the Northeastern North Atlantic. Marine Pollution Bulletin 26(3):146.

Borrell, A. and A. Aguilar. 1987. Variations in DDE percentage correlated with total DDT burden in the blubber of fin and sei whales. Marine Pollution Bulletin 18:70-74.

Boyd, I. L., C. Lockyer, and H. D. Marsh. 1999. Reproduction in marine mammals. J. E. Reynolds III, and S. A. Rommel, editors. Biology of Marine Mammals. Smithsonian Institution Press, Washington, D.C.

Braham, H. W. 1991. Endangered Whales: A Status Update. A report on the 5-year status of stocks review under the 1978 amendments to the U.S. Endangered Species Act.:National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service. Seattle, Washington. 56p.

Branch, T. A., K. M. Stafford, D. M. Palacios, C. Allison, J. L. Bannister, C. L. K. Burton, E. Cabrera, C. A. Carlson, B. G. Vernazzani, P. C. Gill, R. Hucke-Gaete, K. C. S. Jenner, M.-N. M. Jenner, K. Matsuoka, Y. A. Mikhalev, T. Miyashita, M. G. Morrice, S. Nishiwaki, V. J. Sturrock, D. Tormosov, R. C. Anderson, A. N. Baker, P. B. Best, P. Borsa, J. R. L. Brownell, S. Childerhouse, K. P. Findlay, T. Gerrodette, A. D. Ilangakoon, M. Joergensen, B. Kahn, D. K. Ljungblad, B. Maughan, R. D. McCauley, S. McKay, T. F. Norris, Oman Whale and Dolphin Research Group, S. Rankin, F. Samaran, D. Thiele, K. V. Waerbeek, and R. M. Warneke. 2007. Past and present distribution, densities and movements of blue whales *Balaenoptera musculus* in the Southern Hemisphere and northern Indian Ocean. Mammal Review 37(2):116-175.

Brandon, R. 1978. Adaptation and evolutionary theory. Studies in the History and Philosophy of Science 9:181-206.

Brown, M. R., P. J. Corkeron, P. T. Hale, K. W. Schultz and M. M. Bryden. 1994. Behavioral responses of east Australian humpback whales (Megaptera novaeangliae) to biopsy sampling. Marine Mammal Science 10(4):391-400.

Burtenshaw, J. C., E. M. Oleson, J. A. Hildebrand, M. A. McDonald, R. K. Andrew, B. M. Howe, and J. A. Mercer. 2004. Acoustic and satellite remote sensing of blue whale seasonality and habitat in the Northeast Pacific. Deep-Sea Research II 51:967-986.

Calambokidis, J. and J. Barlow. 2004. Abundance of blue and humpback whales in the eastern North Pacific estimated by capture-recapture and line-transect methods. Marine Mammal Science 20(1):63-85.

Calambokidis, J., E. A. Falcone, T. J. Quinn II, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. G. LeDuc, D. K. Mattila, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbân, R. D. W. Weller, B. H. Witteveen, M. Yamaguchi, A. Bendlin, D. Camacho, K. R. Flynn, A. Havron, J. Huggins, and N. Maloney. 2008. SPLASH: Structure of populations, levels of abundance, and status of humpback whales in the North Pacific. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Seattle, Washington.

Calambokidis, J., G. H. Steiger, J. C. Cubbage, K. C. Balcomb, C. Ewald, S. Kruse, R. Wells, and R. Sears. 1990. Sightings and movements of blue whales off central California 1986-88 from photo-identification of individuals. Report of the International Whaling Commission (Special Issue 12):343-348.

Calambokidis, J., G. H. Steiger, J. M. Straley, T. Quinn, L. M. Herman, S. Cerchio, D. R. Salden, M. Yamaguchi, F. Sato, J. R. Urban, J. Jacobson, O. von Zeigesar, K. C. Balcomb, C. M. Gabriele, M. E. Dahlheim, N. Higashi, S. Uchida, J. K. B. Ford, Y. Miyamura, P. Ladrón de Guevara, S. A. Mizroch, L. Schlender, and K. Rasmussen. 1997. Abundance and population structure of humpback whales in the North Pacific basin. Final Report under contract No. 5ABNF500113. NMFS Southwest Fisheries Science Center; La Jolla, California.

Carretta, J. V., K. A. Forney, M. Lowry, J. Barlow, J. Baker, D. Johnston, B. Handson, M. M. Muto, D. Lynch, and L. Carswell. 2009. U.S. Pacific marine mammal stock assessments: 2008. NOAA-TM-NMFS-SWFSC-434.

Carretta, J. V., K. A. Forney, M. M. Muto, J. Barlow, J. Baker, B. Hanson, and M. S. Lowry. 2005. U.S. Pacific Marine Mammal Stock Assessments: 2004. U.S. Department of Commerce, NOAA-TM-NMFS-SWFSC-375, 322p.

Carretta, J. V., K. A. Forney, M. M. Muto, J. Barlow, J. Baker, B. Hanson, and M. S. Lowry. 2006. U.S. Pacific Marine Mammal Stock Assessments: 2005. U.S. Department of Commerce NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-388. 325p.

Carretta, J. V., K. A. Forney, M. M. Muto, J. Barlow, J. Baker, B. Hanson, and M. S. Lowry. 2007. U.S. Pacific marine mammal stock assessments: 2006. U.S. Dept. of Commerce, NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-398, 313 pp. National Marine Fisheries Service.

Cherfas, J. 1989. The hunting of the whale. Viking Penguin Inc., N.Y., 248p.

Christensen, I., T. Haug, and N. Øien. 1992. A review of feeding, and reproduction in large baleen whales (Mysticeti) and sperm whales Physeter macrocephalus in Norwegian and adjacent waters. Fauna Norvegica Series A 13:39-48.

Clapham, P. J. 1994. Maturational changes in patterns of association among male and female humpback whales. Journal of Zoology 71:440-443.

Clapham, P. J. 1996. The social and reproductive biology of humpback whales: an ecological perspective. Mammal Review 26:27-49.

Clapham, P. J., L. S. Baraff, C. A. Carlson, M. A. Christian, D. K. Mattila, C. A. Mayo, M. A. Murphy, and S. Pittman. 1993. Seasonal occurrence and annual return of humpback whales, Megaptera novaeangliae, in the southern Gulf of Maine. Canadian Journal of Zoology 71(2):440-443.

Clapham, P. J. and D. K. Mattila. 1993. Reactions of humpback whales to skin biopsy sampling on a West Indies breeding ground. Marine Mammal Science 9(4):382-391.

Clapham, P. J. and C. A. Mayo. 1987. Reproduction and recruitment of individually identified humpback whales, *Megaptera novaeangliae*, observed in Massachusetts Bay, 1979-1985. Canadian Journal of Zoology 65:2853-2863.

Clapham, P. J. and C. A. Mayo. 1990. Reproduction of humpback whales (*Megaptera novaeangliae*) observed in the Gulf of Maine. Report of the International Whaling Commission Special Issue 12:171-175.

Clapham, P. J., S. B. Young, and R. L. Brownell Jr. 1999. Baleen whales: conservation issues and the status of the most endangered populations. Mammal Review 29(1):35-60.

Clark, C. 2006. Acoustic communication in the great whales: The medium and the message. Presentation at the 86th Annual Conference of the American Society of Mammalogists.

Clark, C. W. 1995. Matters arising out of the discussion of blue whales. Annex M1. Application of U.S. Navy underwater hydrophone arrays for scientific research on whales. Report of the International Whaling Commission, Annex M 45:210-212.

Clarke, C. W. and R. A. Charif. 1998. Acoustic monitoring of large whales to the west of Britain and Ireland using bottom mounted hydrophone arrays, October 1996-September 1997. JNCC Report No. 281.

Conway, C. A. 2005. Global population structure of blue whales, *Balaenoptera musculus* spp., based on nuclear genetic variation. University of California, Davis.

Corkeron, P., P. Ensor, and K. Matsuoka. 1999. Observations of blue whales feeding in Antarctic waters. Polar Biology 22:213-215.

COSEWIC. 2002. COSEWIC assessment and update status report on the blue whale *Balaenoptera musculus* (Atlantic population, Pacific population) in Canada. COSEWIC, Committee on the Status of Endangered Wildlife in Canada, Ottawa, Canada.

COSEWIC. 2005. COSEWIC assessment and update status report on the fin whale *Balaenoptera physalus* (Pacific population, Atlantic population) in Canada. COSEWIC, Committee on the Status of Endangered Wildlife in Canada, Ottawa, Canada.

Darling, J. D. and H. Morowitz. 1986. Census of Hawaiian humpback whales (*Megaptera novaeangliae*) by individual identification. Canadian Journal of Zoology 64(1):105-111.

Dietrich, K. S., V. R. Cornish, K. S. Rivera, and T. A. Conant. 2007. Best practices for the collection of longline data to facilitate research and analysis to reduce bycatch of protected species. NOAA Technical Memorandum NMFS-OPR-35. 101p. Report of a workshop held at the International Fisheries Observer Conference Sydney, Australia, November 8,.

Dohl, T. P., R. C. Guess, M. L. Duman, and R. C. Helm. 1983. Cetaceans of central and northern California, 1980-83: Status, abundance, and distribution. Final Report to the Minerals Management Service, Contract No. 14-12-0001-29090.

Douglas, A. B., J. Calambokidis, S. Raverty, S. J. Jeffries, D. M. Lambourn, and S. A. Norman. 2008. Incidence of ship strikes of large whales in Washington State. Journal of the Marine Biological Association of the United Kingdom.

Ford, J. K. B. and R. R. Reeves. 2008. Fight or flight: antipredator strategies of baleen whales. Mammal Review 38(1):50-86.

Forney, K. A. 2007. Preliminary estimates of cetacean abundance along the U.S. west coast and within four National Marine Sanctuaries during 2005. NOAA Technical Memorandum NMFS-SWFSC-406. U.S. Department of Commerce.

Forney, K. A., J. Barlow, and J. V. Carretta. 1995. The abundance of cetaceans in California waters. Part II: Aerial surveys in winter and spring of 1991 and 1992. Fishery Bulletin 93:15-26.

Forney, K. A. and R. L. Brownell, Jr. 1996. Preliminary report of the 1994 Aleutian Island marine mammal survey. South West Fisheries Science Center, Paper SC/48/011, La Jolla, CA.

Frid, A. 2003. Dall's sheep responses to overflights by helicopter and fixed-wing aircraft. Biological Conservation 110:387-399.
Frid, A. and L. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6:11.
Fromm, D. 2004. Acoustic modeling results of the Haro Strait For 5 May 2003. Naval Research Laboratory Report, Office of Naval Research, 30 January 2004.
Gabriele, C. M., J. M. Straley, and J. L. Neilson. 2007. Age at first calving of female humpback whales in southeastern Alaska. Marine Mammal Science 23(1):226-239.
Gagnon, C. J. and C. W. Clark. 1993. The use of U.S. Navy IUSS passive sonar to monitor the movement of blue whales.Abstracts of the 10th Biennial Conference on the Biology of Marine Mammals, Galveston, TX. November 1993.
Gambell, R. 1976. World whale stocks. Mammal Review 6(1):41-53.
Gambell, R. 1985. Fin whale *Balaenoptera physalus* (Linnaeus, 1758). Pages 171-192 *in* S. H. Ridgway, and R. Harrison, editors. Handbook of marine mammals, Volume 3: The sirenians and baleen whales. Academic Press, London, UK.
Gaskin, D. E. 1972. Whales, dolphins, and seals; with special reference to the New Zealand region.Heinemann, London. 200 pp.
Gauthier, J. and R. Sears. 1999. Behavioral response of four species of balaenopterid whales to biopsy sampling. Marine Mammal Science 15(1):85-101.
Gauthier, J. M., C. D. Metcalfe, and R. Sears. 1997a. Chlorinated organic contaminants in blubber biopsies from Northwestern Atlantic Balaenopterid whales summering in the Gulf of St Lawrence. Marine Environmental Research 44(2):201-223.
Gauthier, J. M., C. D. Metcalfe, and R. Sears. 1997b. Validation of the blubber biopsy technique for monitoring of organochlorine contaminants in Balaenopterid whales. Marine Environmental Research 43(3):157-179.
Gendron, D. and J. Urban. 1993. Evidence of feeding by humpback whales (Megaptera novaeangliae) in the Baja California breeding ground, Mexico. Marine Mammal Science 9:76-81.
Gill, J. A., K. Norris, and W. J. Sutherland. 2001. Why behavioural responses may not reflect the population consequences of human disturbance. Biological Conservation 97:265-268.
Glockner-Ferrari, D. A. and M. J. Ferrari. 1985. Individual identification, behavior, reproduction, and distribution of humpback whales, Megaptera novaeangliae, in Hawaii. U.S. Marine Mammal Commission, Washington, D.C.; National Technical Information Service, Springfield, Virginia: 36p.
Goodyear, J. 1981. “Remora” tag effects the first tracking of an Atlantic humpback. P.46 In: Abstracts of the 4th Biennial Conference on the Biology of Marine Mammals, San Francisco, CA.
Goodyear, J. D. 1989. Night behavior and ecology of humpback whales (*Megaptera novaeangliae*) in the western North Atlantic. M.Sc. Thesis San Jose State University, San Jose, CA. 70p.
Goodyear, J. D. 1993. A sonic/radio tag for monitoring dive depths and underwater movements of whales. Journal of WIldlife Management 57:503-513.
Green, G. A., J. J. Brueggerman, R. A. Grotefendt, C. E. Bowlby, M. L. Bonnell, and K. C. Balcomb III. 1992. Cetacean distribution and abundance off Oregon and

Washington, 1989-1990. Oregon and Washington Marine Mammal and Seabird Surveys. Minerals Management Service Contract Report 14-12-0001-30426.
Hain, J. H. W., G. R. Carter, S. D. Kraus, C. A. Mayo, and H. E. Winn. 1982. Feeding behavior of the humpback whale, *Megaptera novaeangliae,* in the western North Atlantic. Fishery Bulletin 80(2):259-268.
Hain, J. H. W., S. L. Ellis, R. D. Kenney, P. J. Clapham, B. K. Gray, M. T. Weinrich, and I. G. Babb. 1995. Apparent bottom feeding by humpback whales on Stellwagen Bank. Marine Mammal Science 11(4):464-479.
Hain, J. H. W., M. J. Ratnaswamy, R. D. Kenney, and H. E. Winn. 1992. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. Report of the International Whaling Commission 42:653-669.
Hall, J. D. 1982. Prince William Sound, Alaska: Humpback whale population and vessel traffic study. Final Report, Contract No. 81-ABG-00265. NMFS, Juneau Management Office, Juneau, Alaska. 14p.
Hanson, M. B., R. Andrews, D., G. S. Schorr, R. W. Baird, D. Webster, L., and D. J. McSweeney. 2008. Re-sightings, healing, and attachment performance of remotely-deployed dorsal fin-mounted tags on Hawaiian odontocetes. Document PSRG-2008-10 submitted to the Pacific Scientific Review Group, Kihei, HI, November 2008.
Henry, J. and P. B. Best. 1983. Organochlorine residues in whales landed at Durban, South Africa. Marine Pollution Bulletin 14(6):223-227.
Hill, P. S. and D. P. DeMaster. 1998. Alaska marine mammal stock assessments, 1998.
Hjort, J. and J. T. Ruud. 1929. Whaling and fishing in the North Atlantic. Permanent International pour l'Exploration de la Mer. Rapports et Proces-Verbaux des Reunions 56:1-123.
Hooker, S. K., R. W. Baird, S. Al-Omari, S. Gowans, and H. Whitehead. 2001. Behavioral reactions of northern bottlenose whales (*Hyperoodon ampullatus*) to biopsy darting and tag attachment procedures. Fishery Bulletin 99(2):303-308.
Hooker, S. K., M. Biuw, B. J. McConnell, P. J. O. Miller, and C. E. Sparling. 2007. Bio-logging science: Logging and relaying physical and biological data using animal-attached tags. Deep-Sea Research II 54(3-4):177-182.
Hucke-Gaete, R., L. Osman, C. Moreno, K. P. Findlay, and D. Ljungblad. 2004. Discovery of a blue whale feeding and nursing ground in southern Chile. Proceedings of the Royal Society of London Series B-Biological Sciences 271(Suppl.):S170-S173.
Ingebrigtsen, A. 1929. Whales caught in the North Atlantic and other seas. Conseil Permanent International pour l'Exploration de la Mer. Rapports et Proces-Verbaux des Reunions 56:123–135.
IWC. 1990. Report of the Scientific Committee. Report of the International Whaling Commission 40:39-179.
IWC. 2007. Whale Population Estimates. International Whaling Commission. Accessed 02/07/2007 online at: http://www.iwcoffice.org/conservation/estimate.htm.
Jahoda, M., C. L. Lafortuna, N. Biassoni, C. Almirante, A. Azzellino, S. Panigada, M. Zanardelli, and G. N. Di Sciara. 2003. Mediterranean fin whale's (*Balaenoptera physalus*) response to small vessels and biopsy sampling assessed through passive tracking and timing of respiration. Marine Mammal Science 19(1):96-110.

Johnson, J. H. and A. A. Wolman. 1984. The humpback whale, *Megaptera novaeangliae.* Marine Fisheries Review 46(4):30-37.

Jonsgård, A. 1966. Biology of the North Atlantic fin whale *Balaenoptera physalus* (L.): Taxonomy, distribution, migration, and food. Hvalrdets Skrifter 49:1-62.

Jurasz, C. M. and V. Jurasz. 1979. Feeding modes of the humpback whale, Megaptera novaeangliae, in southeast Alaska. Scientific Reports of the Whales Research Institute, Tokyo 31:69-83.

Katona, S. K. and J. A. Beard. 1990. Population size, migrations and feeding aggregations of the humpback whale (*Megaptera novaeangliae*) in the western North Atlantic Ocean. Report of the International Whaling Commission (Special Issue 12):295-306.

Kawamura, A. 1980. A review of food of balaenopterid whales. Scientific Reports of the Whales Research Institute 32:155-197.

Kawamura, A. 1982a. Food habits and prey distributions of three rorqual species in the North Pacific Ocean. Scientific Reports of the Whales Research Institute, Tokyo 34:59-91.

Kawamura, A. 1982b. A review of food of balaenopterid whales. Scientific Report to the Whales Research Institute 32:155–197.

Kenney, R. D., M. A. M. Hyman, and H. E. Winn. 1985. Calculation of standing stocks and energetic requirements of the cetaceans of the northeast United States Outer Continental Shelf. NOAA Technical Memorandum NMFS-F/NEC-41. 99pp.

Kjeld, M., Ö. Ólafsson, G. A. Víkingsson, and J. Sigurjónsson. 2006. Sex hormones and reproductive status of the North Atlantic fin whale (*Balaenoptera physalus*) during the feeding season. Aquatic Mammals 32(1):75-84.

Ladrón De Guevara, P. P., B. E. Lavaniegos, and G. Heckel. 2008. Fin whales (Balaenoptera physalus) foraging on daytime surface swarms of the euphausiid Nyctiphanes simplex in Ballenas Channel, Gulf of California, Mexico. Journal of Mammalogy 89(32):559-566.

Lambertsen, R. H. 1986. Disease of the common fin whale (*Balaenoptera physalus*): Crassicaudiosis of the urinary system. Journal of Mammalogy 67(2):353-366.

Lambertsen, R. H. 1992. Crassicaudosis: a parasitic disease threatening the health and population recovery of large baleen whales. Rev. Sci. Technol., Off. Int. Epizoot. 11(4):1131-1141.

Leatherwood, S., R. R. Reeves, W. F. Perrin, and W. E. Evans. 1982. Whales, dolphins, and porpoises of the eastern North Pacific and adjacent Arctic waters: a guide to their identification.U.S. Department of Commerce, NOAA Technical Report NMFS Circular 444. 245p.

Lien, J. 1994. Entrapments of large cetaceans in passive inshore fishing gear in Newfoundland and Labrador (1979-1990). Reports of the International Whaling Commission Special Issue 15:149-157.

Lima, S. L. 1998. Stress and decision making under the risk of predation. . Advances in the Study of Behavior 27:215-290.

Lockyer, C. 1972. The age at sexual maturity of the southern fin whale (Balaenoptera physalus) using annual layer counts in the ear plug. J. Cons. Int. Explor. Mer 34(2):276-294.

Lusseau, D. 2004. The hidden cost of tourism: detecting long-term effects of tourism using behavioral information. Ecology and Society 9(1):2.

Marsili, L. and S. Focardi. 1996. Organochlorine levels in subcutaneous blubber biopsies of fin whales (Balaenoptera physalus) and striped dolphins (Stenella coeruleoalba) from the Mediterranean Sea. Environmental Pollution 91(1):1-9.

Maser, C., B. R. Mate, J. F. Franklin, and C. T. Dyrness. 1981. Natural History of Oregon Coast Mammals.U.S. Department of Agriculture, Forest Service, General Technical Report PNW-133. 524p.

Mate, B., R. Mesecar, and B. Lagerquist. 2007. The evolution of satellite-monitored radio tags for large whales: One laboratory's experience. Deep Sea Research II 54:224-247.

Mate, B. R., R. Gisiner, and J. Mobley. 1998. Local and migratory movements of Hawaiian humpback whales tracked by satellite telemetry. Canadian Journal of Zoology 76:863-868.

Mate, B. R., B. A. Lagerquist, and J. Calambokidis. 1999. Movements of North Pacific blue whales during the feeding season off southern California and their southern fall migration. Marine Mammal Science 15(4):1246-1257.

Mate, B. R., S. L. Nieukirk, and S. D. Kraus. 1997. Satellite-monitored movements of the northern right whale. Journal of WIldlife Management 61(4):1393-1405.

Metcalfe, C., B. Koenig, T. Metcalfe, G. Paterson, and R. Sears. 2004. Intra- and inter-species differences in persistent organic contaminants in the blubber of blue whales and humpback whales from the Gulf of St. Lawrence, Canada. Marine Environmental Research 57:245–260.

Mikhalev, Y. A. 1997. Humpback whales *Megaptera novaeangliae* in the Arabian Sea. Marine Ecology Progress Series 149:13-21.

Mills, S. K. and J. H. Beatty. 1979. The propensity interpretation of fitness. Philosophy of Science 46:263-286.

Mitchell, E. 1974a. Canada progress report on whale research, May 1972–May 1973. Report of the International Whaling Commission 24(196-213).

Mitchell, E. 1974b. Present status of northwest Atlantic fin and other whale stocks. In: W.E. Schevill (Ed.) The Whale Problem: A Status Report. Harvard University Press, Cambridge, MA. Pp.108-169.

Mizroch, S. A., D. W. Rice, and J. M. Breiwick. 1984. The sei whale, Balaenoptera borealis. Marine Fisheries Review 46(4):25-29.

Mizroch, S. A., D. W. Rice, D. Zwiefelhofer, J. Waite, and W. L. Perryman. 1999. Distribution and movements of fin whales (Balaenoptera physalus) in the Pacific Ocean. Thirteenth Biennial Conference on the Biology of Marine Mammals, Wailea, Hawaii.

Moore, S. E., J. M. Waite, L. L. Mazzuca, and R. C. Hobbs. 2000. Mysticete whale abundance and observations of prey associations on the central Bering Sea shelf. Journal of Cetacean Research and Management 2(3):227-234.

Nasu, K. 1974. Movement of baleen whales in relation to hydrographic conditions in the northern part of the North Pacific Ocean and the Bering Sea. In: Oceanography of the Bering Sea with Emphasis on Renewable Resources:Hood, D.W. and E.J. Kelley (eds). International Symposium for Bering Sea Study, Hakodate, Japan, 31 January - 34 February 1972. p1345-1361.

Nemoto, T. 1957. Foods of baleen whales in the northern Pacific. . Scientific Reports of the Whales Research Institute, Tokyo 12:33-89.
Nemoto, T. 1959. Food of the baleen whales with reference to whales movements. Scientific Reports to the Whales Research Institute 14:149-290.
Nemoto, T. 1970. Feeding pattern of baleen whales in the oceans. *In:* Steele, J.H. (ed.), Marine Food Chains. University of California Press, Berkeley, California. p.241-252
Nishiwaki, M. 1966. Distribution and migration of the larger cetaceans in the North Pacific as shown by Japanese whaling results. Pages 171-191 *in* K. S. Norris, editor. Whales, dolphins, and porpoises. University of California Press, Berkeley, California.
NMFS. 1987. Marine Mammal Protection Act of 1972 - Annual Report 1986/87. National Marine Fisheries Service.
NMFS. 1998. Recovery plan for the blue whale (*Balaenoptera musculus*). Prepared by Reeves, R.L., P.J. Clapham, R.L. Brownell, Jr., and G.K. Silber for the National Marine Fisheries Service, Silver Spring, Maryland.
NMFS. 2005a. Assessment of acoustic exposures on marine mammals in conjunction with USS Shoup active sonar transmissions in the Eastern Strait of Juan de Fuca and Haro Strait, Washington, 5 May 2003. National Marine Fisheries Service, Office Of Protected Resources.
NMFS. 2005b. Draft environmental impact statement for amending the Atlantic Large Whale Take Reduction Plan: Broad-based gear modifications. Draft EIS prepared by Industrial Economics, Incorporated, and NOAA's National Marine Fisheries Service.
NMFS. 2006. Draft recovery plan for the fin whale (Balaenoptera physalus). National Marine Fisheries Service, Silver Spring, Maryland.
Northrop, J. W., C. Cummings, and M. F. Morrison. 1971. Underwater 20-Hz signals recorded near Midway Island. Journal of the Acoustical Society of America 49:1909-1910.
Northrop, J. W., C. Cummings, and P. O. Thompson. 1968. 20-Hz signals observed in the central Pacific. Journal of the Acoustical Society of America 43:383-384.
O'Hara, T. M. and C. Rice. 1996. Polychlorinated biphenyls. Pp.71-86 In: Noninfectious Diseases of Wildlife, 2nd edition, A. Fairbrother, L.Locke, and G. Hoff (eds.). Iowa State University Press, Ames, Iowa.
Ohsumi, S. and S. Wada. 1972. Stock assessment of blue whales in the North Pacific. Working Paper for the 24th Meeting of the International Whaling Commission. 20 pp.
ONR. 2001. Final Environmental Impact Statement for the North Pacific Acoustic Laboratory.Prepared by the Office of Naval Research, Arlington, Virginia.
Overholtz, W. J. and J. R. Nicolas. 1979. Apparent feeding by the fin whale, *Balaenoptera physalus*, and humpback whale, *Megaptera novaeangliae*, on the American sand lance, Ammodytes americanus, in the northwest Atlantic. Fishery Bulletin 77(1):285-287.
Paloma, L. D. G., B. E. Lavaniegos, and G. Heckel. 2008. Fin whales (Balaenoptera physalus) foraging on daytime surface swarms of the euphausiid Nyctiphanes

simplex in Ballenas Channel, Gulf of California, Mexico. Journal of Mammalogy 89(32):559-566.
Perez, M. J., F. Thomas, F. Uribe, M. Sepulveda, M. Flores, and R. Moraga. 2006. Fin whales (Balaenoptera physalus) feeding on Euphausia mucronata in nearshore waters off north-central Chile. Aquatic Mammals 32(1):109-113.
Perkins, J. and D. Beamish. 1979. Net entanglements of baleen whales in the inshore fishery of Newfoundland. Journal of the Fisheries Research Board of Canada 36:521-528.
Perry, S. L., D. P. DeMaster, and G. K. Silber. 1999. The Great Whales: History and Status of Six Species Listed as Endangered Under the U.S. Endangered Species Act of 1973. Marine Fisheries Review 61(1):1-74.
Rasmussen, K., D. M. Palacios, J. Calambokidis, M. T. Saborío, L. D. Rosa, E. R. Secchi, G. H. Steiger, J. M. Allen, and G. S. Stone. 2007. Southern Hemisphere humpback whales wintering off Central America: insights from water temperature into the longest mammalian migration. Biology Letters 3:302-305.
Reeves, R. R., P. J. Clapham, R. L. B. Jr., and G. K. Silber. 1998. Recovery plan for the blue whale (Balaenoptera musculus). Office of Protected Resources, Silver Spring, MD.
Reeves, R. R., B. D. Smith, E. A. Crespo, and G. c. Notarbartolo di Sciara. 2003. Dolphins, Whales and Porpoises: 2002–2010 Conservation Action Plan for the World's Cetaceans. IUCN/SSC Cetacean Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. ix + 139p.
Reeves, R. R., T. D. Smith, E. A. Josephson, P. J. Clapham, and G. Woolmer. 2004. Historical observations of humpback and blue whales in the North Atlantic Ocean: Clues to migratory routes and possibly additional feeding grounds. Marine Mammal Science 20(4):774-786.
Reilly, S. B. and V. G. Thayer. 1990. Blue whale (*Balaenoptera musculus*) distribution in the Eastern Tropical Pacific. Marine Mammal Science 6(4):265-277.
Reiner, F., J. M. Gonçalves, and R. S. Santos. 1993. Two new records of Ziphiidae (Cetacea) for the Azores with an updated checklist of cetacean species. Arquipélago (Life and Marine Sciences) 11A:113-118.
Rice, D. W. 1977. Synopsis of biological data on the sei whale and Bryde's whale in the eastern North Pacific. Report of the International Whaling Commission (Special Issue 1):92-97.
Rice, D. W. 1978. The humpback whale in the North Pacific: distribution, exploitation, and numbers. In K. S. Norris and R. R. Reeves (Editors), Report on a Workshop on Problems Related to Humpback Whales (*Megaptera novaeangliae*) in Hawaii. Contr. Rep. to U.S. Mar. Mammal Comm., NTIS PB-280-794.pp. 29–44.
Rice, D. W. 1998. Marine Mammals of the World. Systematics and Distribution.Special Publication Number 4. The Society for Marine Mammalogy, Lawrence, Kansas.
Richter, C., S. Dawson, and E. Slooten. 2006. Impacts of commercial whale watching on male sperm whales at Kaikoura, New Zealand. Marine Mammal Science 22(1):46-63.
Romero, L. M. 2004. Physiological stress in ecology: lessons from biomedical research. Trends in Ecology and Evolution 19(5):249-255.

Sapolsky, R. M., L. M. Romero, and A. U. Munck. 2000. How do glucocorticoids influence stress responses? Integrating permissive, suppressive, stimulatory, and preparative actions. Endocrine Reviews 21(1):55-89.

Scheidat, M., C. Castro, J. Gonzalez, and R. Williams. 2004. Behavioural responses of humpback whales (*Megaptera novaeangliae*) to whalewatching boats near Isla de la Plata, Machalilla National Park, Ecuador. Journal of Cetacean Research and Management 6(1):63-68.

Sears, R. and F. Larsen. 2002. Long range movements of a blue whale (Balaenoptera musculus) between the Gulf of St. Lawrence and West Greenland. Marine Mammal Science 18(1):281-285.

Sears, R., J. M. Williamson, F. W. Wenzel, M. Bérubé, D. Gendron, and P. Jones. 1990. Photographic identification of the blue whale (Balaenoptera musculus) in the Gulf of St. Lawrence, Canada. Reports of the International Whaling Commission Special Issue 12:335-342.

Sergeant, D. E. 1977. Stocks of fin whales *Balaenoptera physalus* L. in the North Atlantic Ocean. Report of the International Whaling Commission 27:460-473.

Shallenberger, E. W. 1981. The status of Hawaiian cetaceans. Final report to U.S. Marine Mammal Commission. MMC-77/23.

Shirihai, H. 2002. A complete guide to Antarctic wildlife. Alula Press, Degerby, Finland.

Sigurjónsson, J. 1995. On the life history and autoecology of North Atlantic rorquals. Whales, Seals, Fish, and Man:Blix, A.S., L. Walloe, and O. Ulltang (Eds.), Proceedings of the International Symposium on the Biology of Marine Mammals in the North East Atlantic. Tromso, Norway, 29 November - 21 December 1994. Elsevier. pp.1425-1441.

Sigurjónsson, J. and T. Gunnlaugsson. 1990. Recent trends in abundance of blue (*Balaenoptera musculus*) and humpback whales (*Megaptera novaeangliae*) off West and Southwest Iceland, with a note on occurrence of other cetacean species. Report of the International Whaling Commission 40:537-551.

Smith, T. D., J. Allen, P. J. Clapham, P. S. Hammond, S. Katona, F. Larsen, J. Lien, D. Mattila, and P. J. Palsbøll. 1999. An ocean-basin-wide mark-recapture study of the North Atlantic humpback whale (*Megaptera novaeangliae*). Marine Mammal Science 15(1):1-32.

Stearns, S. C. 1992. The evolution of life histories.Oxford University Press, 249p.

Steiger, G. H., J. Calambokidis, J. M. Straley, L. M. Herman, S. Cerchio, D. R. Salden, J. U.-. R., J. K. Jacobsen, O. v. Ziegesar, K. C. Balcomb, C. M. Gabriele, M. E. Dahlheim, S. Uchida, J. K. B. Ford, P. L. d. G.-. P., M. Yamaguchi, and J. Barlow. . 2008. Geographic variation in killer whale attacks on humpback whales in the North Pacific: Implications for predation pressure. Endangered Species Research 4:247-256.

Stevick, P., J. Allen, P. J. Clapham, N. Friday, S. K. Katona, F. Larsen, J. Lien, D. K. Mattila, P. J. Palsbøll, J. Sigujónsson, T. D. Smith, N. Øien, and P. S. Hammond. 2003. North Atlantic humpback whale abundance and rate of increase four decades after protection from whaling. Marine Ecology Progress Series 258:263-273.

Stewart, B. S., S. A. Karl, P. K. Yochem, S. Leatherwood, and J. L. Laake. 1987. Aerial surveys for cetaceans in the former Akutan, Alaska, whaling grounds. Arctic 40(1):33-42.

Tarpy, C. 1979. Killer Whale Attack! National Geographic 155(4):542-545.

Thompson, P. O. and W. A. Friedl. 1982. A long term study of low frequency sounds from several species of whales off Oahu, Hawaii. Cetology 45:1-19.

Tomilin, A. G. 1967. Mammals of the USSR, and adjacent countries. Volume 9, Cetacea. Israel Program Sci. Transl. No. 124, National Technical Information Service TT 65-50086. Springfield, Virginia (Translation of Russian text published in 1957).

Tyack, P. L. 1981. Interactions between singing Hawaiian humpback whales and conspecifics nearby. Behavioral Ecology and Sociobiology 8:105-116.

Tynan, C. T., D. G. Ainley, J. A. Barth, T. J. Cowles, S. D. Pierce, and L. B. Spear. 2005. Cetacean distributions relative to ocean processes in the northern California Current System. Deep-Sea Research II 52:145-167.

U.S. Department of Commerce. 1983. Draft Management Plan and Environmental Impact Statement for the Proposed Hawaii Humpback Whale National Marine Sanctuary.Prepared by the NOAA Office of Ocean and Coastal Resource Management and the State of Hawaii. 172p.

U.S. Navy. 2008. Southern California Range Complex Final Environmental Impact Statement /Overseas Environmental Impact Statement.

U.S. Navy Pacific Fleet. 2004. Report on the results of the inquiry into allegations of marine mammal impacts surrounding the use of active sonar by USS SHOUP (DDG 86) in the Haro Strait on or about 5 May 2003.

Walker, B. G., P. D. Boersma, and J. C. Wingfield. 2005. Physiological and behavioral differences in magellanic Penguin chicks in undisturbed and tourist-visited locations of a colony. Conservation Biology 19(5):1571-1577.

Walker, B. G. and P. L. Boveng. 1995. Effects of time-depth recorders on maternal foraging and attendance behavior of Antarctic fur seals. Canadian Journal of Zoology 73:1538-1544.

Waring, G. T., E. Josephson, C. P. Fairfield, and K. Maze-Foley. 2007. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2006. U.S. Department of Commerce. NOAA Technical Memorandum NMFS NE:201.

Waring, G. T., E. Josephson, C. P. Fairfield, and K. Maze-Foley. 2008. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2007. U.S. Department of Commerce. NOAA Technical Memorandum NMFS NE:205.

Waring, G. T., R. M. Pace, J. M. Quintal, C. P. Fairfield, and K. Maze-Foley. 2004. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2003. NOAA Technical Memorandum NMFS-NE-182:Woods Hole, Massachusetts, 300p.

Watkins, W. A., K. E. Moore, J. Sigujónsson, D. Wartzok, and G. N. di Sciara. 1984. Fin Whale (*Balaenoptera physalus*) tracked by radio in the Irminger Sea. Rit Fiskideildar 8:1-14.

Watkins, W. A., K. E. Moore, D. Wartzok, and J. H. Johnson. 1981. Radio tracking of finback (Balaenoptera physalus), and humpback (Megaptera novaeangliae) whales in Prince William Sound, Alaska, USA. Deep Sea Research Part A. Oceanographic Research Papers 28(6):577-588.

Weinrich, M. T., J. Bove, and N. Miller. 1993. Return and survival of humpback whale (*Megaptera novaeangliae*) calves born to a single female in three consecutive years. Marine Mammal Science 9(3):325-328.

Weinrich, M. T., R. H. Lambertsen, C. S. Baker, M. R. Schilling, and C. R. Belt. 1991. Behavioral responses of humpback whales (*Megaptera novaeangliae*) in the southern Gulf of Maine to biopsy sampling. Report of the International Whaling Commission (Special Issue 13):91-98.

Weinrich, M. T., R. H. Lambertsen, C. R. Belt, M. Schilling, H. J. Iken, and S. E. Syrjala. 1992. Behavioral reactions of humpback whales *Megaptera novaeangliae* to biopsy procedures. Fishery Bulletin 90:588-598.

Wenzel, F. W., D. K. Mattila, and P. J. Clapham. 1988. *Balaenoptera musculus* in the Gulf of Maine. Marine Mammal Science 4(2):172-175.

White, G. C. and R. A. Garrot. 1990. Effects of Tagging on the Animal. Chapter 3 In: Analysis of Wildlife Radio-Tracking Data. Academic Press, San Diego, CA. 383p.

Wilson, R. P. and C. R. McMahon. 2006. Measuring devices on wild animals: what constitutes acceptable practice? Frontiers in Ecology and the Environment 4(3):147-154.

Winn, H. E. and N. E. Reichley. 1985. Humpback whale - *Megaptera novaeangliae*. Handbook of Marine Mammals: Vol. 3 The Sirenians and Baleen Whales:241-274.

Wursig, B., S. K. Lynn, T. A. Jefferson, and K. D. Mullin. 1998. Behaviour of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. Aquatic Mammals 24(1):41-50.

Yochem, P. K. and S. Leatherwood. 1985. Blue whale *Balaenoptera musculus* (Linnaeus, 1758). In: Ridgway SH, Harrison R, editors. Handbook of Marine Mammals, vol. 3: The Sirenians and Baleen Whales.:London: Academic Press. p 193-240.