National Oceanic and Atmospheric Administration's
National Marine Fisheries Service
Endangered Species Act Section 7 Consultation

Biological and Conference Opinion

Agency:	Permits and Conservation Division of the Office of Protected Resources, National Oceanic and Atmospheric Administration's National Marine Fisheries Service
Activity Considered:	Proposal to issue permit No. 14118 to Becky Woodward of Woods Hole Oceanographic Institution for cetacean research in the Atlantic and Pacific Oceans, pursuant to section 10(a)(1)(A) of the Endangered Species Act.
Consultation Conducted by:	Endangered Species Act Interagency Cooperation Division of the Office of Protected Resources, National Oceanic and Atmospheric Administration's National Marine Fisheries Service

Approved by: Helen Golde

Date: April 27, 2012

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1531 *et seq.*) requires each federal agency to insure 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 a federal agency's action "may affect" listed species or designated critical habitat, that agency is required to consult formally with either the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the listed resources that may be affected. Federal agencies are exempt from this requirement if they have concluded that an action "may affect", but is "unlikely to adversely affect" listed species or designated critical habitat, and NMFS and/or USFWS concur with that conclusion (50 CFR 402.14[b]).

For the actions described in this document, the action agency is NMFS' Office of Protected Resources – Permits and Conservation Division (Permits Division). The consulting agency is NMFS' Office of Protected Resources – Endangered Species Act Interagency Cooperation Division (ESA Interagency Cooperation Division). This document represents NMFS' Biological and Conference Opinion (Opinion) of the effects of the proposed research activities on listed and proposed threatened and endangered species and designated critical habitat in accordance with section 7 of the ESA. This Opinion is based on information submitted by the Permits Division as part of their initiation package (i.e., draft environmental assessment and draft permit), recovery plans, published and unpublished scientific information on the biology and ecology of the listed species affected, and other relevant sources of information.

CONSULTATION HISTORY

On November 14, 2011, the Permits Division requested formal consultation with the ESA Interagency Cooperation Division on a proposed action to issue scientific research permit No. 14118 to Becky Woodward of Woods Hole Oceanographic Institution for cetacean research to be conducted in the Atlantic and Pacific Oceans. The permit would be valid for five years from the date of issuance. The initiation package included the permit applications from the respective applicants, discussion of the effects of the proposed tagging activities on the target species as well as anticipated effects of other proposed activities, and drafts of the proposed permits. Upon reviewing the initiation package, the ESA Interagency Cooperation Division initiated formal consultation.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Permits Division proposes to issue a permit to Becky Woodward, Ph.D, of the Woods Hole Oceanographic Institution for directed “takes”[1] of marine mammals, including listed humpback whales (*Megaptera novaeangliae*), fin whales (*Balaenoptera physalus*), and sei whales (*Balaenoptera borealis*), for scientific research pursuant to section 104 of the Marine Mammal Protection Act of 1972, as amended (MMPA) (16 U.S.C. 1361 *et seq*.), and section 10(a)(1)(A) of the ESA. Research activities to be authorized include tagging, photo-identification, behavioral observations, tracking and monitoring, passive acoustics, photography and video both above and under water, and collection of sloughed skin. Takes to listed marine mammals are expected to be in the form of harassment[2]. Research objectives include studying the long-term movement and habitat use of humpback whales using three types of tags (i.e., satellite, GPS, and depth tags), conducting medium term acoustic studies by examining transmitted and received sounds, and investigating the fine-scale behavioral ecology of the targeted species using multi-sensor data recording packages. The proposed permit would be valid for five years after the date of issuance. **Tables 1a** and **1b** below display the take numbers proposed in the Permits Division’s draft permit.

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1 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.

2 The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. However, the Marine Mammal Protection Act defines harassment as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal population in the wild or has the potential to disturb a marine mammal or marine mammal population in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering” [16 U.S.C. 1362(18)(A)]. The latter portion of this definition (that is, “...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering”) is almost identical to the USFWS’ regulatory definition of “harass” pursuant to the ESA. For this Opinion, “harassment” is defined similarly: as 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.

Table 1a. Takes to Listed Species Proposed for Permit No. 14118 in the Atlantic Ocean (U.S. Exclusive Economic Zone from Maine to Texas)

SPECIES	STOCK	LIFESTAGE	SEX	ANNUAL TAKE	TAKES PER ANIMAL	OBSERVE/ COLLECT METHOD	PROCEDURES	DETAILS	YEARS
Whale, humpback	Western North Atlantic Stock	Adult/ Juvenile	Male	50	3	Survey, vessel	Acoustic, passive recording; Collect, sloughed skin; Instrument, belt/harness tag; Observation, monitoring; Observations, behavioral; Photo-id; Photograph/Video; Tracking; Underwater photo/video	Target animal; no more than 10 animals tagged	1
Whale, humpback	Western North Atlantic Stock	Adult/ Juvenile	Male and Female	150	3	Survey, vessel	Count/survey; Incidental harassment; Photo-id	Non-target animal	1
Whale, humpback	Western North Atlantic Stock	Adult/ Juvenile	Male	75	3	Survey, vessel	Acoustic, passive recording; Collect, sloughed skin; Instrument, belt/harness tag; Observation, monitoring; Observations, behavioral; Photo-id; Photograph/Video; Tracking; Underwater photo/video	Target animal; no more than 15 animals tagged per year	2-5
Whale, humpback	Western North Atlantic Stock	Adult/ Juvenile	Male and Female	225	3	Survey, vessel	Count/survey; Incidental harassment; Photo-id	Non-target animal	2-5
Whale, fin	Range-wide	Adult/ Juvenile	Male and Female	100	3	Survey, vessel	Count/survey; Incidental harassment; Photo-id	Non-target species	All
Whale, sei	Range-wide	Adult/ Juvenile	Male and Female	50	3	Survey, vessel	Count/survey; Incidental harassment; Photo-id	Non-target species	All

Table 1b. Takes to Listed Species Proposed for Permit No. 14118 in the Pacific Ocean (U.S. Exclusive Economic Zone along the coasts of California, Oregon, Washington, Alaska, and Hawaii)

SPECIES	STOCK	LIFESTAGE	SEX	ANNUAL TAKE	TAKES PER ANIMAL	OBSERVE/ COLLECT METHOD	PROCEDURES	DETAILS	YEARS
Whale, humpback	Central North Pacific Stock	Adult/ Juvenile	Male	50	3	Survey, vessel	Acoustic, passive recording; Collect, sloughed skin; Instrument, belt/harness tag; Observation, monitoring; Observations, behavioral; Photo-id; Photograph/Video; Tracking; Underwater photo/video	Target animal; no more than 10 animals tagged per year	1
Whale, humpback	Central North Pacific Stock	Adult/ Juvenile	Male and Female	150	3	Survey, vessel	Count/survey; Incidental harassment; Photo-id	Non-target animal	1
Whale, humpback	Central North Pacific Stock	Adult/ Juvenile	Male	75	3	Survey, vessel	Acoustic, passive recording; Collect, sloughed skin; Instrument, belt/harness tag; Observation, monitoring; Observations, behavioral; Photo-id; Photograph/Video; Tracking; Underwater photo/video	Target animal; no more than 15 animals tagged per year	2-5
Whale, humpback	Central North Pacific Stock	Adult/ Juvenile	Male and Female	225	3	Survey, vessel	Count/survey; Incidental harassment; Photo-id	Non-target animal	2-5
Whale, fin	Range-wide	Adult/ Juvenile	Male and Female	100	3	Survey, vessel	Count/survey; Incidental harassment; Photo-id	Non-target species	All
Whale, sei	Range-wide	Adult/ Juvenile	Male and Female	50	3	Survey, vessel	Count/survey; Incidental harassment; Photo-id	Non-target species	All

Researchers are proposing to tag no more than 10 humpback adult or sub-adult males in each region in the first year in order to obtain initial feedback on tag retention and performance as well as the effects to listed species. After the first year, researchers anticipate expanding their effort in both regions as is reflected in the Permits Division's anticipated take numbers displayed in **tables 1a** and **1b** above for years two through five. More details on the proposed research activities are described below.

<u>Close Vessel Approach, Photography, Video, and Sloughed Skin Collection</u>

Research will be carried out using two vessels. One larger vessel will be used for transit and act as a mother ship for general observation and a tracking platform once tags are deployed. Another smaller vessel [approximately 15-20 feet (ft) long] would be used to approach large whales for tagging and other activities. Researchers will first observe whale behavior for 15 minutes (min) prior to approach to record pre-tagging behaviors. Photographs would also be taken in order to identify the individual to be tagged. Researchers will then approach the targeted individual from the rear quarter within 10 meters (m) to deploy the tags. No more than three tagging attempts would be conducted on an individual in a single day and tagging attempts would be halted if the animal exhibits evasive behavior (e.g., avoiding the boat) or agitated behavior (e.g., tail slash, breaching, etc.). If reliable photo-identification is possible, every attempt would be made not to re-approach the same individual on different days within the same season. Tagging attempts would be recorded using a video camera above and below the surface to monitor and record behavioral responses to tagging activities. A hydrophone would be deployed to passively record humpback vocalizations. Sloughed skin samples would also be collected opportunistically following tagging attempts. After tag attachment, the researchers would then back away from the animal and record behaviors from a distance greater than 100 m.

The animal would be re-visited and observed after initial tracking. This may occur daily, weekly, or monthly depending on the length of tag deployment. Animals would be re-visited in order to monitor its health and to evaluate any potential impacts of the tags such as whether the harness becomes embedded in the flesh, hemorrhaging of the skin occurs, or any circumferential ulcer or loss of epithelium around the peduncle occurs, among others. Tail stock photographs would also be taken after tags release from the animal to record the conditions of the tag attachment area following detachment. If the health of the animal is compromised at any time during these follow up approaches, the tags would be removed from the animal using techniques established by NMFS and the Provincetown Center for Coastal Studies as part of the large whale disentanglement program (see *Mitigation Measures* section below for more information on these emergency removal techniques).

<u>Peduncle Saddle Pack Tag Attachment</u>

Researchers would target adult and sub-adult male humpback whales for tag attachment along with four other non-listed cetaceans. For the peduncle saddle pack tag to be used, a padded belt (harness) will fit around the tail stock of the whale at the narrowest portion of the peduncle just before the fluke insertion point. The belt consists of three main parts: (1) a semi-rigid saddle that fits over the dorsal ridge of the peduncle, (2) a "girth" which holds the saddle in place, and (3) an electronic package. The underside of the saddle will be padded using soft, flexible materials commonly used in prosthetics in order to minimize chafing. The electronics package will consist of location tracking devices [i.e., Mk10-AF ARGOS/Fast-loc GPS satellite tag plus VHF beacon from Wildlife Computers approximately 4 inches (in) long by 2 in wide by 1 in tall and weighing 225 grams or around a half pound (lb)]. In addition to monitoring whale location, the Mk10-AF satellite tags also monitor depth, temperature, and light level readings. An electronic timed release combined with a backup corrosive galvanic release form a redundant release system for reliably removing the harness and tag system at a pre-set time. A low strength (100-200 lb) breakaway link will also be included to minimize entanglement risk and ensure that the belt releases from the whale should the harness become fouled on any gear or other debris in the water. Together, the current proposed large whale saddle pack, electronics package, and redundant release system weigh approximately 4.25 lbs in air and are slightly positively buoyant in water.

After the first year, researchers expect that additional sensor suites may be incorporated including behavioral sensors (pressure transducer, accelerometer, magnetometer, gyroscope, velocity sensor), acoustic sensors (hydrophone), environmental sensors (light level sensor, temperature, salinity, wet/dry sensor), physiological sensors (heat flux sensor, heart rate, Doppler blood flow), and visual sensors (video and/or still camera). Although the instrumentation included in the electronics package may vary according to experimental design, the maximum total weight of the saddle packs with any electronics package and redundant release system would not be more than five lbs total in air according to information submitted by the researchers. No active acoustics would be emitted by any sensor package.

To deploy the belt, a cantilevered or handheld pole (maximum 12 m) will be used from the bow to drop a spring loaded or pneumatically powered armature on the targeted whale's peduncle (see **Figure 1** below). Once triggered, the armature's sickle shaped arms will close, latching a buckle under the whale's belly. As the arms lift away, the elasticized belt is cinched to snugly secure the semi-rigid saddle housing the electronics package to the dorsal ridge of the peduncle.

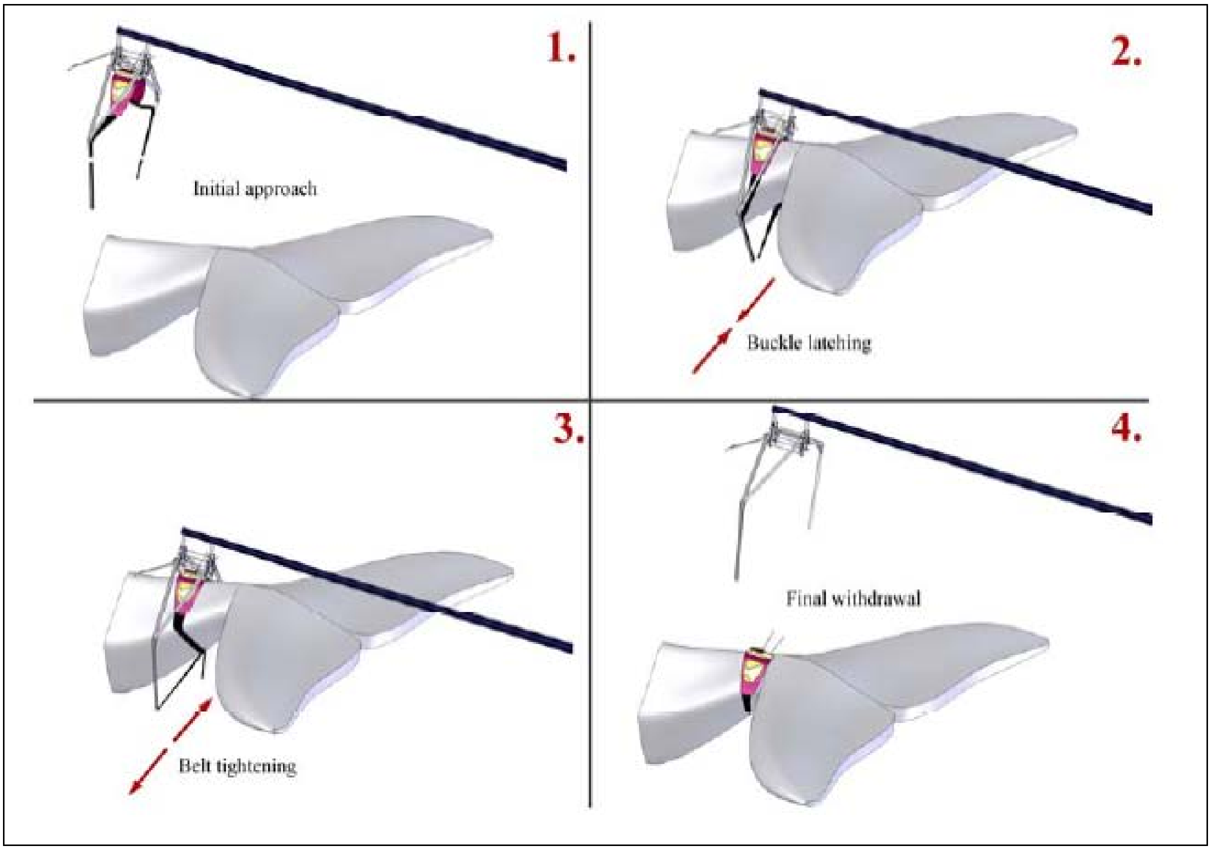

Figure 1. Sequential Stages of Deployment of the Peduncle Saddle Pack Tag. Figure included in the initiation package sent to the ESA Interagency Cooperation Division on November 14, 2011. Source: Becky Woodward, Woods Hole Oceanographic Institution.

Initial deployments of peduncle tags would follow with a conservative approach, starting with a single day and expanding slowly to a one week deployment. Tagged animals would be monitored and re-visited to observe the animal's condition. Focal follows would be used to relate data on the tag to observed surface behaviors. These follows are typically conducted from a distance of 100-500 m from the animal, depending on weather conditions and visibility from the platform. If there appears to be adverse effects from the tag, the tag would be removed immediately according to established procedures (see *Mitigation Measures* section below). Subsequent deployment times would gradually be increased to a period of several weeks, then a month, and finally several months if subsequent tag durations appear to not adversely affect the animal.

<u>Peduncle-let Harness with Towed Tag Attachment</u>

In this type of prototype tag, the electronics package is housed in a buoy that trails the whale rather than in a saddle which fits over the dorsal ridge of the peduncle. A harness is constructed from two strands of custom fabricated ½ in diameter, braided wool rope sewn together while a single ½ in diameter strand forms the tow tether. For the current large whale system proposed, this harness is 10 ft long and has stop rings connected with low strength biodegradable breakaways (100 lbs) at each end to prevent over-tightening of the loop on the peduncle.

A few different techniques may be used to deploy the peduncle-let harness and towed tag depending on the species of interest, their size, and behavior. A cantilevered or hand-pole deployment system similar to that used for the peduncle saddle pack tag may be employed. Such a system would use a spring or pneumatically powered unit to close a set sickle shaped arms around the peduncle and latch a buckle underneath. Alternatively, a remote line launcher such as a net gun or pneumatic device may be used to throw a "lasso" around the tail stock. This "lasso" technique is targeted at whales that fluke out on a terminal dive (see **Figure 2** below).

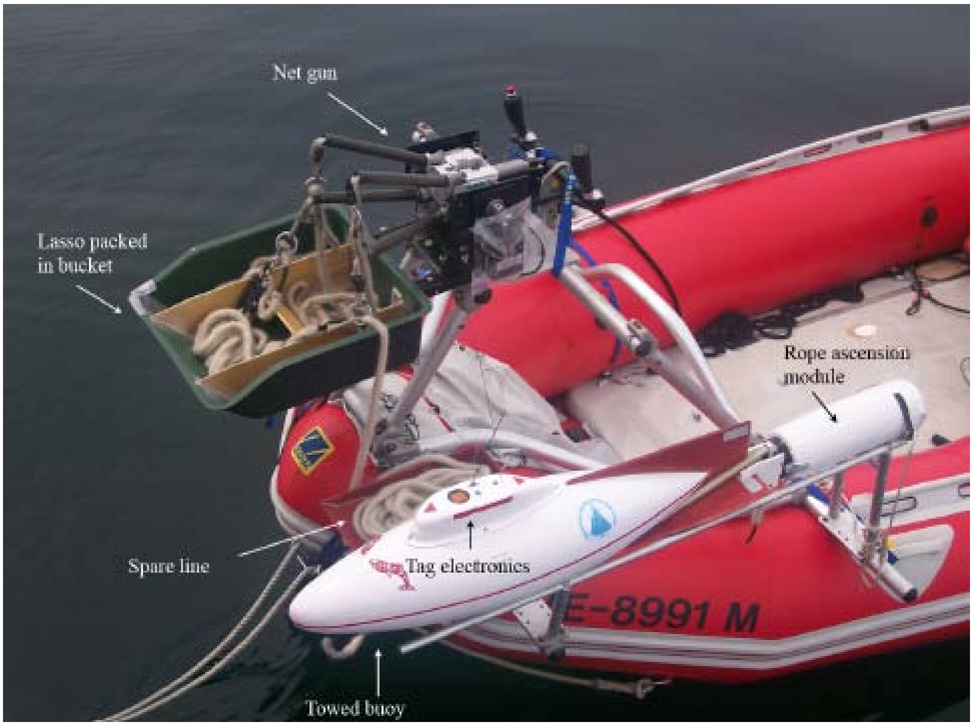

Figure 2. Net Gun Deployment System. Figure included in the initiation package sent to the ESA Interagency Cooperation Division on November 14, 2011. Photo Source: Becky Woodward, Woods Hole Oceanographic Institution.

Half pound cylindrical weights are attached to each of the lasso's four corners and loaded into the four barrels of the gun using an o-ring seal. The net gun uses a blank .308 cartridge to propel the weights out of its four barrels, and the splay of the gun barrels ensures that the corners of the lasso are widely spread to fully deploy the loop. Tests in the harbor using the deck mounted net gun system demonstrated an 80 percent lassoing success rate on a full-scale fiberglass model right whale tail (see **Figure 3** below). Maximum range is estimated to be 35 ft.

Figure 3. **Successful lasso attempt on a model right whale tail during on-the-water testing of the net gun deployment system.** Figure included in the initiation package sent to the ESA Interagency Cooperation Division on November 14, 2011. Photo Source: Becky Woodward, Woods Hole Oceanographic Institution.

Once the lasso clears the fluke tips, the forward motion of the whale away from the tag boat will close the lasso down to a 10 ft padded section. As the whale moves away, a rope ascension module will push the buoy up the line until it reaches a stop, at which point it will trim the trailing tether and leave the buoy trailing the whale at a distance of roughly 1 to 1 ½ body lengths behind the whale. Similar to the peduncle saddle pack tag, multiple redundant release systems (electronic timed release, galvanic timed release, breakaway link, and low strength biodegradable tow line) are incorporated in the peduncle-let towed tag system to ensure that the harness releases from the whale and minimizes entanglement risk. Initially, tags would be deployed using a 200 lb breaking strength. If necessary (i.e., the whale breaches and the rope breaks immediately), the line strength would be gradually increased by adding in a mixture of cotton fiber to the wool. Maximum single strand rope breaking strength would not exceed 500 lbs. The breakaway link strength would also be increased as necessary, but would always be less than that of the tow line.

A fusiform-shaped prototype buoy (a 36 in long by 9 in max diameter) containing the electronics package would be attached to the tether and trail the whale after harness attachment. This hydrodynamic torpedo shape offers a low drag alternative to the 14 in diameter round ball buoy traditionally used by the Large Whale Disentanglement Network. The buoy has an outer fiberglass shell for hydrostatic stability and flotation. Lighter foam in the upper half of the buoy combined with a lead counterweight in the belly work together to ensure that the buoy tows in an upright orientation. A set of 4-way tail fins attach behind the back of the tower and extend four inches beyond the tail of the buoy. The tag electronics are housed inside a small 12 in long by 4 in wide by 2 ¼ in tall removable climbing tower attached to the top of the buoy. The current electronics package is the same that is being used in the large whale peduncle saddle pack tag. Fully assembled, the buoy and electronics package weighs 35 lbs in air and has a reserve buoyancy of 17 lbs. When towed at a speed of 4 knots via a submerged tow point, which simulates a whale swimming just below the surface, the prototype buoy has approximately 20 lbs of drag with a 60 ft long 3/8 in diameter tow tether.

Tagged animals would be monitored and re-visited to observe the animal's condition similar to whales tagged with the peduncle saddle pack tag. Focal follows would be used to relate data on the tag to observed surface behaviors. These follows are typically conducted from a distance of 100-500 m from the animal, depending on weather conditions and visibility from the platform. If there appears to be adverse effects from the tag, the tag would be removed immediately according to established procedures (see *Mitigation Measures* section below). Subsequent deployment times would gradually be increased to a period of several weeks, then a month, and finally several months if subsequent tag durations appear to not adversely affect the animal.

<u>Mitigation Measures</u>
The following section summarizes the mitigation measures associated with permit No. 14118 to mitigate effects to targeted and any non-targeted protected species during research activities. More detailed information may be found in the associated permit and the Draft Environmental Assessment document. The following conditions are included in the Permits Division's draft permit:

1. In the event a serious injury or mortality of a protected species occurs, the Researchers must suspend permitted activities and contact the Chief of the Permits Division by phone within two business days. Researchers must also submit a written incident report. This includes events where tagging gear leads to entanglement of an animal. The Permits Division may grant authorization to resume permitted activities based on review of the incident report and in consideration of the Terms and Conditions of the permit.

2. If authorized take[3] is exceeded, including accidental takes of protected species not listed in this permit, the Researchers must cease all permitted activities and notify the Chief of the Permits Division by phone as soon as possible but not later than two business days. Researchers must also submit a written incident report within two weeks of the incident. The incident report must include a complete description of the events and identification of steps that will be taken to reduce the potential for additional exceedance of authorized take.

3. Annual re-authorization will be based on evaluation of the report and may be denied or delayed if the report has not been received or approved. Authorization of each year's

3 The permit does not allow for unintentional serious injury and mortality caused by the presence or actions of researchers. This includes, but is not limited to; deaths of dependent young by starvation following research-related death of a lactating female; deaths resulting from infections related to sampling procedures; and deaths or injuries sustained by animals during capture or handling, or while attempting to avoid researchers or escape capture. Note that for marine mammals, a serious injury is defined by regulation as any injury that will likely result in mortality.

research does not guarantee or imply that NMFS will authorize subsequent years' activities.

4. Counting and Reporting Takes:

   a. Any “approach”[4] of a cetacean constitutes a take by harassment and must be counted and reported regardless of whether an animal reacts.

   b. During an approach, researchers may attempt all procedures in a take table row once.

   c. For Level A procedures [tagging], each additional attempt to perform the suite of procedures during the same approach constitutes a new take and must be counted and reported against that row of takes. Attempts include misses, successful hits, and hits with no tag attachment.

   d. No individual may be taken more than 3 times in one day.

5. Tagging:

   a. If visual inspections indicate a tagged whale might be compromised, all gear must be removed from the animal. This includes, but is not limited to:

      i. weight loss

      ii. the harness embedded in the flesh

      iii. hemorrhage is noted from the skin below the harness

      iv. a circumferential ulcer or loss of epithelium is noted in association with the harness around the peduncle

6. 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.

7. Individuals conducting permitted activities must possess qualifications commensurate with their roles and responsibilities.

8. The Permit holder must submit annual reports to the Chief of the Permits Division and a final report must be submitted within 180 days after expiration of the permit, or, if the research concludes prior to permit expiration, within 180 days of completion of the research.

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4 An "approach" is defined as a continuous sequence of maneuvers (episode) involving a vessel or researcher's body in the water, including drifting, directed toward a cetacean or group of cetaceans closer than 100 yards for large whales, or 50 yards for smaller cetaceans.

9. Research results must be published or otherwise made available to the scientific community in a reasonable period of time. Copies of technical reports, conference abstracts, papers, or publications resulting from permitted research must be submitted the Permits Division.

10. The Permit Holder must provide written notification of planned field work to the applicable NMFS Region at least two weeks prior to initiation of each field trip/season. If there will be multiple field trips/seasons in a permit year, a single summary notification may be submitted per year.

    a. Notification must include:

        i. Location of the intended field study and/or survey routes

        ii. Estimated dates of activities

        iii. Number and roles of participants

11. To the maximum extent practical, the Permit Holder must coordinate permitted activities with activities of other Permit Holders conducting the same or similar activities on the same species, in the same locations, or at the same times of year to avoid unnecessary disturbance of animals. Contact the applicable Regional Office(s) for information about coordinating with other Permit Holders.

12. The Permit Holder must:

    a. Notify the relevant National Marine Sanctuary Superintendent prior to tagging in a Sanctuary.

    b. Provide detailed descriptions of the tag(s) and tagging system(s) to the local disentanglement network.

    c. Notify the disentanglement network, local whale watch vessels, and the Sanctuary Superintendent (if applicable) once a tag has been deployed and provide the identification of the tagged animal so they will not mistake the tag for an entanglement.

13. Researchers must comply with protocols provided by the Regional Administrators related to coordination of research, including additional measures deemed necessary to minimize unnecessary duplication, harassment, or other adverse impacts from multiple permit holders.

Prior to any peduncle tagging activities, researchers are proposing to contact the regional disentanglement network to inform them of the planned research activities and the new tagging methodology under development. This prior notification would place the disentanglement network on alert should any assistance be required to help remove a tag in the event of an emergency, and help avoid any mistaken reports of "entangled whales" when whales are actually tagged. In the event of an emergency, the regional disentanglement network would be contacted to aid in removal of the tag from the whale. If necessary, trained personnel would be flown to the site and emergency tag removal would be done under their direction. Also, the Permits Division, in response to comments submitted by the Marine Mammal Commission, will require annual reauthorization of the permit based on information provided in the annual reports. This annual review reflects the novel nature of the proposed tagging to be conducted and should help inform NMFS of the effects that these new tagging activities have on listed humpback whales. Of course, the requirement to cease research and consult with NMFS would still apply in the event that authorized take is exceeded at any point over the course of the permit period as is reflected in the permit conditions summarized above.

APPROACH TO THE ASSESSMENT

NMFS approaches its section 7 analyses of agency actions through a series of steps. The first step identifies those aspects of a proposed action likely to have direct and/or 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 establishes the risks those responses pose to listed resources (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 DPSs. The continued existence of these "species" depends on the fate of the populations that comprise them. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them – populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

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

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

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

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

Destruction or adverse modification[5] determinations must be based on an action‘s effects on the conservation value of habitat that has been designated as critical to threatened or endangered species. If an area encompassed in a critical habitat designation is likely to be exposed to the direct or indirect consequences of the proposed action on the natural environment, we ask if primary or secondary constituent elements included in the designation (if there are any) or physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species are likely to respond to that exposure. If primary or secondary constituent elements of designated critical habitat (or physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) are likely to respond given exposure to the direct and/or indirect consequences of the proposed action on the natural environment, we ask if those responses are likely to be sufficient to reduce the quantity, quality, or availability of those constituent elements or physical, chemical, or biotic phenomena.

If the quantity, quality, or availability of the primary or secondary constituent elements of the area of designated critical habitat (or physical, chemical, or biotic phenomena) are reduced, we ask if those reductions are likely to be sufficient to reduce the conservation value of the designated critical habitat for listed species in the action area. In this step of our assessment, we combine information about the contribution of constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species, particularly for older critical habitat designations that have no constituent elements) to the conservation value of those areas of critical habitat that occur in the action area, given the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area.

If the conservation value of designated critical habitat in an action area is reduced, the final step of our analyses asks if those reductions are likely to be sufficient to reduce the conservation value of the entire critical habitat designation. In this step of our assessment, we combine information about the constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) that are likely to experience changes in quantity, quality, and availability given exposure to an action with information on the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area. We use the conservation value of the entire designated critical habitat as our point of reference for this comparison. For example, if the designated critical habitat has limited current value or potential value for the conservation of listed species that limited value is our point of reference for our assessment.

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

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5 We are aware that several courts have ruled that the definition of destruction or adverse modification that appears in the section 7 regulations at 50 CFR 402.02 is invalid and do not rely on that definition for the determinations we make in this Opinion. Instead, as we explain in the text, we use the "conservation value" of critical habitat for our determinations which focuses on the designated area's ability to contribute to the conservation or the species for which the area was designated.

We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies whose operations extend into the marine environment.

During each consultation, we conduct electronic searches of the general scientific literature using *American Fisheries Society*, *Google Scholar*, *ScienceDirect*, *BioOne*, *Conference Papers Index*, *JSTOR*, and *Aquatic Sciences and Fisheries Abstracts* search engines, among others. We supplement these searches with electronic searches of doctoral dissertations and master's theses. These searches specifically try to identify data or other information that supports a particular conclusion (for example, a study that suggests large cetaceans will exhibit a particular response to a particular tagging procedure) as well as data that does not support that conclusion.

We rank the results of these searches based on the quality of their study design, sample sizes, level of scrutiny prior to and during publication, and study results. Carefully designed field experiments (for example, experiments that control potentially confounding variables) are rated higher than field experiments that are not designed to control those variables. Carefully designed field experiments are generally ranked higher than computer simulations. Studies that produce large sample sizes with small variances are generally ranked higher than studies with small sample sizes or large variances. Finally, in keeping with the direction from the U.S. Congress to provide the "benefit of the doubt" to threatened and endangered species [House of Representatives Conference Report No. 697, 96th Congress, Second Session, 12 (1979)], when data are equivocal, or in the face of substantial uncertainty, our decisions are designed to avoid the risks associated with incorrectly concluding an action has no adverse effect on a listed species when, in fact, such adverse effects are likely (i.e. avoiding statistical Type II error in our decisions).

ACTION AREA

The action area is defined in 50 CFR 402.2 as "all areas to be affected directly or indirectly by the Federal Action and not merely the immediate area involved in the action." The proposed research is expected to occur throughout the year in the Western North Atlantic Ocean from Maine to Texas and in the Central and Eastern North Pacific Oceans from Alaska to California, including Hawaii. While research effort would not occur in each region concurrently, the research applicant is proposing to conduct research in separate areas in separate years over the course of the research permit period. So, for the purposes of this consultation, the action area includes the entire U.S. Exclusive Economic Zone (EEZ) along the eastern U.S. mainland including the Gulf of Mexico, as well as the entire U.S. EEZ off the west coast of the U.S. (i.e., Washington, Oregon, and California), Alaska, and Hawaii.

STATUS OF THE SPECIES

The ESA Interagency Cooperation Division has determined that the following ESA-listed and proposed species and designated critical habitat occur within the action area and may be affected by proposed action:

LISTED RESOURCE	SCIENTIFIC NAME	LISTING
Cetaceans		
Blue Whale	*Balaenoptera musculus*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Humpback Whale	*Megaptera novaeangliae*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Cook Inlet Beluga Whale	*Delphinapterus leucas*	Endangered
Bowhead Whale	*Balaena mysticetus*	Endangered
Southern Resident Killer Whale	*Orcinus orca*	Endangered
North Atlantic Right Whale	*Eubalaena glacialis*	Endangered
North Pacific Right Whale	*Eubalaena japonica*	Endangered
Insular Hawaiian False Killer Whale	*Pseudorca crassidens*	Proposed Endangered
Pinnipeds		
Hawaiian Monk Seal	*Monachus schauinslandi*	Endangered
Steller Sea Lion	*Eumetopias jubatus*	
-Western DPS[6]		Endangered
-Eastern DPS		Threatened
Spotted Seal Southern DPS	*Phoca largha*	Threatened
Guadalupe Fur Seal	*Arctocephalus townsendi*	Threatened
Bearded Seal Beringia DPS	*Erignathus barbatus*	Proposed Threatened
Arctic Ringed Seal	*Phoca hispida hispida*	Proposed Threatened
Sea Turtles		
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Endangered
Green Sea Turtle	*Chelonia mydas*	
-Florida and Mexico's Pacific Coast Breeding Colonies		Endangered[7]
-All other areas		Threatened
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	
-Mexico's Pacific Coast Breeding Colonies		Endangered[8]
-All other areas		Threatened
Loggerhead Sea Turtle	*Caretta caretta*	
-North Pacific Ocean DPS		Endangered
-Northwest Atlantic Ocean DPS		Threatened

6 A Distinct Population Segment, or DPS, is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or distinct population segments of vertebrate species.

7 Green sea turtles in U.S. waters are listed as threatened except for the Florida and Mexico Pacific coast breeding colonies, which are listed as endangered. Due to difficulties in distinguishing between individuals from the Florida breeding population from other populations, green sea turtles are considered endangered wherever they occur in U.S. waters.

Marine and Anadromous Fish

Chinook Salmon	*Oncorhynchus tshawytscha*	
-California Coastal Evolutionarily Significant Unit (ESU[9])		Threatened
-Central Valley spring-run ESU		Threatened
-Lower Columbia River ESU		Threatened
-Upper Columbia River spring-run ESU		Endangered
-Puget Sound ESU		Threatened
-Sacramento River winter-run ESU		Endangered
-Snake River fall-run ESU		Threatened
-Snake River spring/summer-run ESU		Threatened
-Upper Willamette River ESU		Threatened
Chum Salmon	*Oncorhynchus keta*	
-Columbia River ESU		Threatened
-Hood Canal summer-run ESU		Threatened
Coho Salmon	*Oncorhynchus kisutch*	
-Central California Coast ESU		Endangered
-Lower Columbia River ESU		Threatened
-Oregon Coast ESU		Threatened
-Southern Oregon and Northern California Coasts ESU		Threatened
Sockeye Salmon	*Oncorhynchus nerka*	
-Ozette Lake ESU		Threatened
-Snake River ESU		Threatened
Steelhead Trout	*Oncorhynchus mykiss*	
-Puget Sound ESU		Threatened
-Central California Coast ESU		Threatened
-Snake River Basin ESU		Threatened
-Upper Columbia River ESU		Threatened
-Southern California ESU		Endangered
-Middle Columbia River ESU		Threatened
-Lower Columbia River ESU		Threatened
-Upper Willamette River ESU		Threatened
-Northern California ESU		Threatened
-South-Central California Coast ESU		Threatened
-California Central Valley ESU		Threatened
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	
-Gulf of Maine DPS		Threatened
-New York Bight DPS		Endangered
-Chesapeake Bay DPS		Endangered
-Carolina DPS		Endangered
-South Atlantic DPS		Endangered
Green Sturgeon Southern DPS	*Acipenser medirostris*	Threatened
Gulf Sturgeon	*Acipenser oxyrinchus desotoi*	Threatened
Shortnose Sturgeon	*Acipenser brevirostrum*	Endangered
Largetooth Sawfish	*Pristis perotteti*	Endangered

9 An Evolutionarily Significant Unit, or ESU, is a Pacific salmon population or group of populations that is substantially reproductively isolated from other conspecific populations and that represents an important component of the evolutionary legacy of the species. The ESU Policy (56 FR 58612) for Pacific salmon defines the criteria for identifying a Pacific salmon population as a DPS, which can be listed under the ESA.

Smalltooth Sawfish U.S. DPS	*Pristis pectinata*	Endangered
Pacific Eulachon Southern DPS	*Thaleichthys pacificus*	Threatened
Atlantic Salmon Gulf of Maine DPS	*Salmo salar*	Endangered
Yelloweye Rockfish Puget Sound/Georgia Basin DPS	*Sebastes ruberrimus*	Threatened
Bocaccio Puget Sound/Georgia Basin DPS	*Sebastes paucispinis*	Endangered
Canary Rockfish Puget Sound/Georgia Basin DPS	*Sebastes pinniger*	Threatened
Marine Invertebrates		
Black Abalone	*Haliotis cracherodii*	Endangered
White Abalone	*Haliotis sorenseni*	Endangered
Elkhorn Coral	*Acropora palmata*	Threatened
Staghorn Coral	*Acropora cervicornis*	Threatened
Critical Habitat		
North Pacific Right Whale Critical Habitat		Designated
North Atlantic Right Whale Critical Habitat (Northeast and Southeast)		Designated
Southern Resident Killer Whale Critical Habitat		Designated
Hawaiian Monk Seal Critical Habitat (Current Designation)		Designated
Hawaiian Monk Seal Revised Critical Habitat		Proposed
Steller Sea Lion Critical Habitat (Alaska and California/Oregon)		Designated
Leatherback Sea Turtle Critical Habitat (areas off California and Washington)		Designated
Green Sturgeon Critical Habitat		Designated
Black Abalone Critical Habitat		Designated
Elkhorn/Staghorn Coral Critical Habitat		Designated

Listed Resources Not Likely to be Adversely Affected

Cetaceans

The action area coincides with the ranges of endangered blue whales, sperm whales, Cook Inlet beluga whales, bowhead whales, Southern Resident killer whales, North Atlantic right whales, North Pacific right whales, and Insular Hawaiian false killer whales which are proposed for listing. Researchers are proposing to limit their research to the targeted species (i.e., humpback whales) as well as anticipate photographing two other listed cetaceans (i.e., fin and sei whales) that may be in the vicinity of targeted humpbacks. The directed focus of the research should avoid exposing any other listed cetacean in the action area to harassment and the potential for a ship strike during transit is highly unlikely given the experience of the observers at spotting listed species and avoiding any non-targeted species as they are encountered. We anticipate that other listed cetaceans in the action area are highly unlikely to be encountered and therefore are not likely to be exposed to the effects from the proposed action. Therefore, issuance of permit No. 14118 is not likely to adversely affect blue whales, sperm whales, Cook Inlet beluga whales, bowhead whales, southern resident killer whales, North Atlantic right whales, North Pacific right whales, and Insular Hawaiian false killer whales and these species will not be considered further in this Opinion.

Pinnipeds

The action area coincides with the ranges of five listed pinniped species (i.e., Hawaiian monk seal, spotted seal southern DPS, Guadalupe fur seal, Steller sea lion Western DPS and Eastern DPS) and two pinniped species proposed for listing (i.e., bearded seal Beringia DPS and Arctic ringed seal). The majority of the research is expected to occur offshore and would not be expected to occur near rookeries or high-density areas. Researchers are expected to have observers onboard to monitor for the presence of non-targeted pinnipeds and will avoid these species if encountered. We consider it highly unlikely that listed pinnipeds would be exposed to ship strikes or interactions with the tagging activities and any threats posed by the proposed action are discountable. Therefore, issuance of permit No. 14118 is not likely to adversely affect Hawaiian monk seals, Guadalupe fur seals, members of the spotted seal southern DPS, members of the Steller sea lion Western or Eastern DPS, members of the bearded seal Beringia DPS, or Arctic ringed seals and these species will not be considered further in this Opinion.

Sea Turtles

The action area coincides with the ranges of hawksbill sea turtles, leatherback sea turtles, Kemp's ridley sea turtles, green sea turtles (including Florida and Mexico's Pacific coast breeding colonies listed as endangered and threatened individuals in other areas), olive ridley sea turtles (including Mexico's Pacific Coast breeding colonies listed as endangered and threatened individuals in other areas) and loggerhead sea turtles (i.e., North Pacific Ocean and Northwest Atlantic Ocean DPSs). Researchers are expected to have observers onboard to monitor for the presence of non-targeted listed sea turtles and will avoid the species if encountered. We consider it highly unlikely that listed sea turtles would be exposed to ship strikes or interactions with the tagging activities given that research is targeted at humpback whales and any threats posed by the proposed action are discountable. Therefore, issuance of permit No. 14118 is not likely to adversely affect any listed sea turtles and these species will not be considered further in this Opinion.

Marine and Anadromous Fish

The action area coincides with the ranges of nine listed ESUs of chinook salmon, two listed ESUs of chum salmon, four listed ESUs of coho salmon, two listed ESUs of sockeye salmon, eleven listed ESUs of steelhead trout, five listed DPSs of Atlantic sturgeon, green sturgeon southern DPS, Gulf sturgeon, shortnose sturgeon, largetooth sawfish, smalltooth sawfish U.S. DPS, Pacific eulachon southern DPS, Atlantic salmon Gulf of Maine DPS, canary rockfish Puget Sound/Georgia Basin DPS, bocaccio Puget Sound/Georgia Basin DPS, and yelloweye rockfish Puget Sound/Georgia Basin DPS. Researchers are expected to focus a majority of their research offshore and will not be conducting research activities in nearshore coastal and estuarine habitats where a higher density of marine and anadromous fish species occur. Even when in the marine stages of their life histories, we consider it highly unlikely that listed marine and anadromous fish species would be exposed to ship strikes or interactions with the tagging activities given that research is targeted at humpback whales and any threats posed by the proposed action are discountable. Therefore, issuance of permit No. 14118 is not likely to adversely affect any listed marine and anadromous fish species and these species will not be considered further in this Opinion.

Marine Invertebrates

Four listed invertebrate species (i.e., black abalone, white abalone, elkhorn coral, and staghorn coral) occur within the action area. However, researchers are expected to direct their activities offshore in deeper water than where these species typically reside and would not alter water conditions or affect the ocean bottom. Researchers are expected to take all proper precautions to avoid and/or minimize the impact of accidental fuel spills during transit. We do not anticipate these species being exposed to the effects of the proposed action. Therefore, issuance of permit No. 14118 would not affect any listed invertebrate species and these species will not be considered further in this Opinion.

Critical Habitat

The action area overlaps with critical habitat designated for two cetaceans (i.e., North Atlantic right whales and North Pacific right whales), three pinnipeds [i.e., Hawaiian monk seals (both areas currently designated and areas to be added in the revised designation) and Western and Eastern DPSs of Steller sea lions], one sea turtle (i.e., leatherback sea turtle critical habitat off California and Washington), one anadromous fish species (i.e., green sturgeon), and three marine invertebrates (i.e., black abalone, elkhorn coral, and staghorn coral).

Critical habitat for the North Atlantic right whale includes portions of Cape Cod Bay and Stellwagen Bank, the Great South Channel (each off the coast of Massachusetts), and waters adjacent to the coasts of Georgia and the east coast of Florida. The critical habitat designation encompasses three primary feeding and nursery habitats in the United States used by right whales during their annual migration. The physical, chemical, and biotic features that form right whale critical habitat include the composition of zooplankton in feeding areas, the topographic and seasonal oceanographic characteristics conducive to zooplankton growth, water depth, water temperatures, and distance from shore for calving and nursery areas (59 FR 28793). As tagging activities may occur up and down the east coast in offshore waters of the U.S. EEZ, some portions of critical habitat designated for North Atlantic right whales may be exposed to research activities directed at humpback whales. However, research activities are not expected to affect the composition of zooplankton nor would they affect topographic or oceanographic characteristics of either the northern or southern portion of the critical habitat designation. It is highly unlikely that researchers would encounter a North Atlantic right whale but in the event than an individual is spotted in the vicinity, researchers would take all precautions necessary to avoid the individual and not cause it to abandon its critical habitat. Therefore, issuance of permit No. 14118 is not expected to affect critical habitat for North Atlantic right whales and this resource will not be discussed further in this Opinion.

Critical habitat for the North Pacific right whale was designated in the eastern Bering Sea and in the Gulf of Alaska and could be exposed to the proposed research activities for the tagging of humpback whales that would occur off the Alaskan coastline. The primary constituent elements deemed necessary for the conservation of North Pacific right whales include the presence of specific copepods (*Calanus marshallae*, *Neocalanus cristatus*, and *N. plumchris*), and euphausiids (*Thysanoessa Raschii*) that act as primary prey items for the species. The proposed research activities would not affect zooplankton abundance or composition. It is highly unlikely that researchers would encounter a North Pacific right whale but in the event that an individual is spotted in the vicinity, researchers would take all precautions necessary to avoid the individual and not cause it to abandon its critical habitat. Therefore, issuance of permit No. 14118 is not expected to affect critical habitat designated for North Pacific right whales and this resource will not be discussed further in this Opinion.

Critical habitat for Southern Resident killer whales includes three specific marine areas of Puget Sound, Washington, and includes all waters relative to a contiguous shoreline delimited by the line at a depth of 20 ft (6.1 m) relative to extreme high water. The primary constituent elements essential for conservation of the Southern Resident killer whale are: (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging. A majority of research activities is expected to occur offshore; however, in the event that research occurs within designated critical habitat for Southern Resident killer whales, the proposed activities would not affect water quality, essential prey items, or migratory pathways. It is highly unlikely that researchers would encounter Southern Resident killer whales given that their research is focused on humpback whales. However, in the event than an individual is spotted in the vicinity, researchers would take all precautions necessary to avoid the individual and not cause it to abandon its critical habitat. Therefore, issuance of permit No. 14118 is not expected to affect critical habitat designated for Southern Resident killer whales and this resource will not be discussed further in this Opinion.

Critical habitat for the Hawaiian monk seal was designated in 1986 for all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and ocean waters out to a depth of 10 fathoms (18.3 m) around Kure Atoll, Midway Islands (except Sand Island), Pearl and Hermes Reef, Lisianski Island, Laysan Island, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island in the Northwestern Hawaiian Islands (51 FR 16047). In 1988, critical habitat was expanded to include Maro Reef and waters around previously designated areas out to the 20 fathom (36.6 m) isobath (53 FR 18988). NMFS has proposed to revise critical habitat for Hawaiian monk seals by extending the current designation in the Northwestern Hawaiian Islands out to the 500 m depth contour, including Sand Island at Midway Islands, and by designating six new areas in the main Hawaiian Islands. The essential features of critical habitat important to the conservation of the species include (1) areas with characteristics preferred by monk seals for pupping and nursing, (2) shallow, sheltered aquatic areas adjacent to coastal locations preferred by monk seals for pupping and nursing, (3) marine areas from 0 to 500 m in depth preferred by juvenile and adult monk seals for foraging, (4) areas with low levels of anthropogenic disturbance, (5) marine areas with adequate prey quantity and quality, and (6) significant areas used by monk seals for hauling out, resting or molting. The majority of research activities are expected to occur further offshore from areas designated as critical habitat for the Hawaiian monk seal. Research activities would not be expected to impact pupping and nursing behavior, foraging behavior, disturb habitats at any significant level, affect prey quantity and quality, and wouldn't affect areas used for hauling out, resting, or molting. Researchers are expected to avoid Hawaiian monk seals if they are spotted in the vicinity and are not expected to cause individuals to abandon critical habitat areas Therefore, issuance of permit No. 14118 is not expected to affect critical habitat designated for the Hawaiian monk seal including areas proposed under the revised designation and these resources are not discussed further in this Opinion.

Critical habitat was designated for the Eastern and Western DPSs of Steller sea lions on August 27, 1993 (58 FR 45269). Critical habitat designated for the Eastern and Western DPSs of Steller sea lions occurs along the Alaskan coastline and extends 3,000 ft [0.91 kilometers (km)] seaward in state and federally managed waters from the baseline or basepoint of each major rookery for the Eastern DPS and extends 20 nautical miles (37 km) seaward in state and federally managed waters for the Western DPS. 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 breeding, pupping, refuge and resting occurs. More than 100 major haulouts are documented. 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 majority of research activities are expected to occur further offshore from areas designated as critical habitat for the Steller sea lions. Research activities are not expected to affect terrestrial or aquatic habitat conditions nor would they affect reproduction, pupping, foraging, resting, or refuge behavior. Researchers are expected to avoid Steller sea lions if they are spotted in the vicinity and are not expected to cause individuals to abandon critical habitat areas. Therefore, issuance of permit No. 14118 is not likely to adversely affect critical habitat designated for the Eastern or Western DPSs of Steller sea lions and these resources are not discussed further in this Opinion.

Critical habitat for the leatherback sea turtle was recently revised to include additional habitat off the U.S. west coast in addition to the habitat previously designated off St. Croix in the U.S. Virgin Islands. The recently revised designation includes approximately 16,910 square miles (43,798 square km) stretching along the California coast from Point Arena to Point Arguello east of the 3,000 m depth contour; and 25,004 square miles (64,760 square km) stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 m depth contour. The designated areas comprise approximately 41,914 square miles (108,558 square km) of marine habitat and include waters from the ocean surface down to a maximum depth of 262 ft (80 m). The primary constituent element essential for conservation of leatherback turtles is the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (*Chrysaora, Aurelia, Phacellophora*, and *Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks. Research activities are not expected to affect the condition, distribution, diversity, or abundance of prey items essential to leatherback sea turtles and researchers are expected to avoid non-targeted sea turtles if they are spotted in the vicinity in order to prevent leatherbacks from abandoning critical habitat areas. Therefore, issuance of permit No. 14118 is not expected to affect critical habitat designated for leatherback sea turtles and this resource will not be discussed further in this Opinion.

Critical habitat for green sturgeon (southern DPS) includes coastal nearshore marine areas in addition to certain estuarine and riverine habitats off the west coast of the U.S. Primary constituent elements for the coastal nearshore marine areas included in the designation include (1) A migratory pathway necessary for the safe and timely passage of Southern DPS fish within marine and between estuarine and marine habitats; (2) Nearshore marine waters with adequate dissolved oxygen levels and acceptably low levels of contaminants (e.g., pesticides, organochlorines, elevated levels of heavy metals) that may disrupt the normal behavior, growth, and viability of subadult and adult green sturgeon; and (3) Abundant prey items for subadults and adults, which may include benthic invertebrates and fishes. Research activities are expected to occur offshore in deeper water than areas critical habitat designated for green sturgeon and are not expected to affect migratory pathways, water quality, or prey abundance. Researchers are expected to avoid non-targeted green sturgeon and would be expected to take proper precautions to avoid and/or minimize the impact of accidental fuel spills during transit. Therefore, issuance of permit No. 14118 is not expected to affect critical habitat designated for green sturgeon and this resource will not be discussed further in this Opinion.

Black abalone critical habitat occurs off the southern California coastline and offshore islands out to the six meter depth interval. Primary constituent elements of black abalone critical habitat includes: (1) Suitable rocky substrate (i.e. rocky benches formed from consolidated rock of various geological origins that contain channels with macro- and micro-crevices or large boulders and occur from mean higher high water to a depth of six m); (2) Abundant food resources including bacterial and diatom films, crustose coralline algae, and a source of detrital macroalgae; (3) Juvenile settlement habitat (i.e. rocky intertidal habitat containing crustose coralline algae and crevices or cryptic biogenic structures; (4) Suitable water quality necessary for normal settlement, growth, behavior, and viability of black abalone; and (5) Suitable nearshore circulation patterns that retain eggs, sperm, fertilized eggs and ready-to-settle larvae so that successful fertilization and settlement to suitable habitat can take place. Research activities are expected to occur further offshore in deeper water than critical habitat areas designated for black abalone. Also, research activities are not expected to affect habitat conditions, food resources, or water quality. Researchers are expected to take all proper precautions to avoid and/or minimize the impact of accidental fuel spills during transit. Therefore, issuance of permit No. 14118 is not expected to affect black abalone critical habitat and this resource will not be considered further in this Opinion.

Joint critical habitat designated for elkhorn and staghorn coral occurs in the Atlantic off the east coast of Florida and the Florida Keys. The essential feature important to the conservation of these coral species includes natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover. Research activities are expected to occur further offshore in deeper water than critical habitat areas designated for elkhorn and staghorn coral. Researchers are also expected to take all proper precautions to avoid and/or minimize the impact of accidental fuel spills during transit. Therefore, issuance of permit No. 14118 is not expected to affect critical habitat designated for elkhorn and staghorn coral and this resource will not be considered further in this Opinion.

Listed Resources Likely to be Adversely Affected

The sections below provide information on the status of listed resources likely to be adversely affected by the proposed action. The biology and ecology of these species as well as their global status and trends are described below, and inform the effects analysis for this Opinion.

Humpback Whale

Species Description, Distribution, and Population Structure

Humpback whales are large baleen whales known for their long pectoral fins (up to 15 ft in length) and complex whale songs. Humpback whales occur throughout the world's oceans and are generally found over continental shelves, shelf breaks, and around oceanic islands (Balcomb and Nichols, 1978; Whitehead, 1987). Humpback whales exhibit seasonal migrations between warmer temperate and tropical waters in winter and cooler waters of high prey productivity in summer (Gendron and Urban, 1993), although the seasonal distributions of this species have yet to be fully understood (Reeves et al., 2004). Humpback whales have the longest known migratory movements of any mammal, with one-way distances up to 8,461 km (Rasmussen et al., 2007). They usually migrate through deep, pelagic waters before settling in shallower, coastal waters at each end of the migration route (Winn and Reichley, 1985).

In the North Atlantic, humpback whales summer in six different regions: off the eastern coast of the United States, the Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and northern Norway (Katona and Beard, 1990; Christensen et al., 1992; Palsbøll et al., 1997; Perry et al., 1999). These regions represent relatively discrete subpopulations (Clapham and Mayo, 1987). In the fall and winter, humpback whales from all feeding areas migrate to calving and mating grounds in the Caribbean, where mixing among subpopulations occurs (Katona and Beard, 1990; Clapham et al., 1993; Palsbøll et al., 1997; Stevick et al., 1998; Bérubé et al., 2004). In addition, there are reports of humpback whales wintering off Greenland, Norway, Newfoundland, the southern Gulf of Maine, Bermuda, and also in the eastern North Atlantic off the Cape Verde Islands (Katona and Beard, 1990). The species uses U.S. mid-Atlantic and U.S. southern waters as a migratory pathway and apparently as a feeding area, at least for juveniles (Wiley et al., 1995; Barco et al., 2002).

In the North Pacific, the species is found off the Hawaiian Islands, from Mexico north to the Gulf of Alaska and Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and Sea of Okhotsk (Nemoto, 1957; Tomilin, 1957; NMFS, 1991). Humpback whales that occur off Central America and Mexico in the winter and spring migrate to the coast of California north to British Columbia in summer and fall (Steiger et al., 1991). Although the Pacific coast of Central America is not considered a major wintering area for this species, humpback whales are reported off the west coast of Panama as well as Costa Rica (Steiger et al., 1991). In Asia, humpbacks have been observed in the vicinity of Taiwan, the Ogasawara Islands, and the Northern Mariana Islands (NMFS, 1991). Humpback whales are also found in the Arabian Sea in the northern Indian Ocean (Mikhalev, 1997; Perry et al., 1999).

In the Southern Ocean, humpback whales occur in waters off Antarctica and migrate to the waters off Venezuela, Brazil, southern Africa, western and eastern Australia, New Zealand, and islands in the southwest Pacific during the austral winter (Perry et al., 1999). 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 (Mikhalev, 1997).

Data compiled by the International Whaling Commission (IWC) on breeding stocks suggests multiple groupings of humpback whales (Bannister, 2005); however, it is uncertain how such aggregations translate into individual biological populations. Nevertheless, NMFS recognizes three stocks of humpback whales in the North Pacific for management purposes under the MMPA: the western North Pacific, central North Pacific, and eastern North Pacific stocks. In the past, humpback whales in the North Atlantic were treated as a single population for management purposes (Waring et al., 1999). However, humpback whales in the Gulf of Maine were subsequently recognized by NMFS as a separate feeding aggregation based upon the strong fidelity of individual whales to the region (Palsbøll et al., 2001 *as cited in* Waring et al., 2011). In 2002, the IWC also acknowledged the evidence for treating the Gulf of Maine as a separate management unit (IWC, 2002 *as cited in* Waring et al., 2011). In the Southern Hemisphere, Donovan (1991) reported four groupings of humpback whales found in IWC Areas II through IV; however, migration of the species between ocean basins is also noted (Pomilla and Rosenbaum, 2005).

Life History Information

Sexual maturity in humpback whales is reached between 5 and 11 years of age (Clapham, 1992; Gabriele et al., 2007). Humpback whale reproductive activities occur primarily in winter and gestation takes about 11 months (Winn and Reichley, 1985), followed by a nursing period of up to 12 months (Baraff and Weinrich, 1993). Calving primarily occurs in the shallow coastal waters of continental shelves and some oceanic islands (Perry et al., 1999). The calving interval is likely 2-3 years (Clapham and Mayo, 1987), although there is some evidence of calving occurring in consecutive years (Glockner-Ferrari and Ferrari, 1985; Clapham and Mayo, 1987; Weinrich et al., 1993). During the breeding season, humpback whales form small unstable groups (Clapham, 1996), and males sing long, complex songs directed toward females and other males.

Humpback whales exhibit seasonal migrations from warmer temperate and tropical waters where they give birth to calves and cooler, temperate or sub-Arctic waters in the summer months where they feed (Gendron and Urban, 1993). Despite this known migration pattern, the seasonal distributions of this species have yet to be fully understood (Reeves et al., 2004).

In a review of the social behavior of humpback whales, Clapham (1996) reported that they can form small, unstable social groups during the breeding season while more stable aggregate groups form in areas with high prey densities. There is also evidence that humpbacks exhibit territoriality for both feeding (Clapham, 1996) and calving areas (Tyack, 1981). Humpbacks exhibit a wide range of foraging behaviors, and feed on a range of prey types including small schooling fishes, euphausiids, and other large zooplankton (Nemoto, 1957; Nemoto, 1959; Nemoto, 1970; Krieger and Wing, 1984). Although largely solitary, humpback whales often cooperate during feeding activities (Elena et al., 2002).

Diving Behavior, Hearing, and Vocalization

Since a majority of humpback whale prey is found above 300 meters (or 984 feet), most dives are relatively shallow (approximately 60-170 meters) (Hamilton et al., 1997). Dives usually range between 2-5 minutes, but can last as long as 20 minutes in some cases (Dolphin, 1987).

Humpback whale vocalization is much better understood than hearing sensitivity, although like other baleen whales, evidence indicates the species can hear at least low frequency sounds (less than 1 kHz) based on the morphology of its hearing apparatus suggesting that the auditory system of the species is more sensitive to low frequency sounds than that of smaller toothed whales (Ketten, 1997). Houser et al. (2001) reported the hearing range of humpback whales to be in the range of 700 Hz to 10 kHz. In terms of vocalization, different calls by humpback whales have been associated with different functions including feeding, breeding, and other social calls. Humpback whales are reported to be less vocal when found on their high-latitude feeding grounds in summer compared with their lower-latitude winter ranges (Richardson et al, 1995). Au (2000) compiled information on humpback whale vocalizations and reported sounds to include grunts in the frequency range of 25-1,900 Hz, pulses in the frequency range of 25-89 Hz, and songs with components ranging from 30-8,000 Hz.

Listing Status

Humpback whales have been listed as endangered under the ESA since 1973. The IWC first protected humpback whales in the North Pacific in 1965, and this species is also protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the MMPA. No critical habitat is currently designated for the species.

Abundance and Trends

It is difficult to assess the current status of humpback whales since there is no general agreement on the size of the humpback whale population prior to whaling. While current abundance estimates of the species' worldwide population varies, some robust estimates do exist for more regional areas (i.e. western North Atlantic). Historically, humpback whale populations worldwide were greatly affected by commercial whaling activities. Based on mitochondrial DNA analysis, Roman and Palumbi (2003) estimated pre-exploitation populations of humpback whales to be as many as 1,000,000 worldwide with 240,000 occurring in the North Atlantic alone. Between 1805 and 1909, American whalers harvested between 14,164-18,212 humpback whales in the North Atlantic while the Pacific kill was estimated to be about 28,000 (Best, 1987 *as cited in* NMFS, 1991). Records also show that from the late 1880's to the mid-1970's, whaling operations took 1,397 humpback whales off eastern Canada and 522 off West Greenland in the western North Atlantic (Kapel, 1979; Mitchell, 1974a), 1,579 in the eastern North Atlantic and Arctic Oceans (Perry et al., 1999), nearly 30,000 in the Pacific Ocean (Perry et al., 1999), and over 68,000 in the Southern Ocean (Bonner, 1982).

Current estimates for the North Atlantic humpback whale population include the estimates by Palsbøll et al. (1997) of 4,894 males and 2,804 females, based on genetic tagging data. However, some authors believe this combined total of 7,698 whales to be an underestimate of the true population size in the North Atlantic (Clapham et al., 1995; Palsbøll et al., 1997). Several researchers report an increasing trend in abundance for the North Atlantic population, and an independent increase in numbers of individuals sighted within the Gulf of Maine feeding aggregation (Katona and Beard, 1990; Barlow and Clapham, 1997; Smith et al., 1999; Waring et al., 2011). Stevick et al., (2003) estimated that approximately 11,570 animals existed in 1993 with an estimated rate of increase of 3.1 percent per year. Assuming that this rate of increase has remained constant, the estimated 2012 population size for North Atlantic humpback whales would be around 20,700 individuals, a number still significantly lower than Roman and Palumbi's (2003) pre-exploitation estimate of 240,000 individuals.

In the 1980s, North Pacific humpback whale population estimates ranged from 1,407 to nearly 2,100 (Darling and Morowitz, 1986; Baker and Herman, 1987); however, by the mid-1990s, the population was estimated to have risen to around 6,000 (Calambokidis et al., 1997). Between 2004 and 2006, a comprehensive assessment of the population of humpback whales in the North Pacific identified 7,971 unique individuals from photographic records (Calambokidis et al., 2008). Based on the results of that effort, Calambokidis et al. (2008) estimated that the current population of humpback whales in the North Pacific Ocean consisted of about 18,300 adult individuals. Rice (1978) estimated pre-exploitation numbers of humpback whales in the North Pacific to be around 15,000; however, this data has been shown to be statistically unreliable.

In the Southern Hemisphere, the IWC estimated the humpback whale population at 19,851 individuals extrapolated from survey data of whales south of latitude 60°S (IWC, 1996) although this estimate has been shown to be statistically unreliable and should be taken with caution (Perry et al., 1999). Nevertheless, these estimates are far lower than the pre-exploitation abundances reported by Gambell (1976) who estimated the humpback whale numbers in the Southern Ocean to be as high as 100,000 individuals.

Current Threats

At present, there are several stressors affecting humpback whales globally, although the significance of any effects emanating from these individual stressors remains uncertain. Historically, whaling represented the greatest threat to every population of humpback whales and was ultimately responsible for listing humpback whales under the ESA. Entanglement in commercial fishing gear continues to be a problem as there were 81 confirmed reports of humpback whales being entangled in fishing gear between 2004 and 2008 off the Atlantic coast of the U.S. and Maritime Provinces of Canada, with 5 whales dying of their wounds and an additional 11 sustaining serious injuries (Glass et al., 2010). Mortality from ship strikes is also a threat to recovery. Along the Pacific coast, a humpback whale is known to be killed about every other year by ship strikes (Barlow et al., 1997). Along the Atlantic coast of the U.S. and Canada between 2004 and 2008, there were 14 confirmed reports of humpback whales being struck by vessels with 8 whales dying of their wounds (Glass et al., 2010).

Entanglement in commercial fisheries also occurs in Hawaiian waters. In 1995, a humpback whale in Maui waters was found trailing numerous lines (not fishery-related) and entangled in mooring lines. The whale was successfully released, but subsequently stranded and was attacked and killed by tiger sharks in the surf zone. From 2001-2007, there were five observed interactions between humpback whales and gear associated with the Hawaii-based shallow-set and deep-set longline fisheries (Allen and Angliss, 2011), one of which was later determined to be a serious injury. According to NMFS observer characterizations of the event, the whale was entangled several times in the main longline and branchline around the body and flukes and was released by cutting the main lines on either side of the whale (NMFS, 2010a). NMFS issued an incidental take permit for the take of Central North Pacific humpback whales in Hawaii-based longline fisheries which was published on May 28, 2010 (75 FR 29984).

Organochlorines, including PCB and DDT, have been identified from humpback whale blubber samples (Gauthier et al., 1997). These contaminants are transferred to young through the placenta, leaving newborns with contaminant loads equal to that of mothers before bioaccumulating additional contaminants during life and passing the additional burden to the next generation (Metcalfe et al., 2004). Bioaccumulation as a result of ingesting contaminated prey continues to affect the health of whale populations throughout the Atlantic and Pacific ocean basins.

The current IWC quota for subsistence harvest of western North Atlantic humpback whales is 20 total individuals over the seasons 2008-2012, to be caught by the Bequians of St. Vincent and the

Grenadines. Japan is currently conducting its scientific whaling program (i.e. JARPA II) with anticipated harvests of 50 humpback whales from two stocks each year (Nishiwaki et al., 2006). Other current threats affecting humpback whale recovery include effects of ocean noise as well as disturbance from whale watching and other scientific research activities.

Fin Whale

Species Description, Distribution, and Population Structure

Fin whales are the second largest baleen whale by length, and are long-bodied and slender, with a prominent dorsal fin set about two-thirds of the way back on the body. They are dark gray dorsally and white ventrally, but the pigmentation pattern is often complex. Distinctive features of pigmentation, along with dorsal fin shapes and body scars, are useful for photo-identification (Agler et al., 1993).

Fin whales are widely distributed throughout the world's oceans; however, they 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 warmer tropical waters approximately 15° C (Sergeant, 1977). They are less concentrated in nearshore environments while appearing to favor deeper waters. Although fin whales are certainly migratory, moving seasonally into and out of high latitude feeding areas, the overall migration pattern is confusing and likely complex (Christensen et al., 1992).

NMFS currently recognizes three fin whale management stocks in U.S. Pacific waters: Alaska (Northeast Pacific), California/Oregon/Washington, and Hawaii (NMFS, 2010b). In the North Pacific Ocean, the IWC recognizes two "stocks" of fin whales for management purposes: (1) East China Sea and (2) rest of the North Pacific (Donovan, 1991). However, Mizroch et al. (1984a) concluded that there were atleast five possible "stocks" of fin whales within the North Pacific based on histological analyses and tagging experiments: (1) East and West Pacific that intermingle around the Aleutian Islands; (2) East China Sea; (3) British Columbia; (4) Southern-Central California to Gulf of Alaska; and (5) Gulf of California. Fin whales have been observed feeding in Hawaiian waters during mid-May (Balcomb, 1987; Shallenberger, 1981), and their sounds have been recorded there during the autumn and winter (Northrop et al., 1968; Thompson and Friedl, 1982; Shallenberger, 1981). Fin whales have also been observed year-round off central and southern California, with peak numbers in summer and fall (Dohl et al., 1983; Barlow, 1995; Forney et al., 1995), in summer off Oregon (Green et al., 1992), and in summer and fall in the Gulf of Alaska (including Shelikof Strait), and the southeastern Bering Sea (Leatherwood et al., 1986; Brueggeman et al., 1990) Their regular summer occurrence has also been noted in recent years around the Pribilof Islands in the northern Bering Sea (Baretta and Hunt, 1994).

Based on other genetic analyses, Bérubé et al. (1998) concluded that fin whales in the Sea of Cortez represent an isolated population that has very little genetic exchange with other populations in the North Pacific Ocean (although the geographic distribution of this population and other populations can overlap seasonally). They also concluded that fin whales in the Gulf of St. Lawrence and Gulf of Maine are distinct from fin whales found off Spain and in the Mediterranean Sea. Regardless of how different authors structure the fin whale population, mark-recapture studies have demonstrated that individual fin whales migrate between management units (Mitchell, 1974a; Gunnlaugsson and Sigurjónsson, 1990), which suggests that these management units are not geographically isolated populations.

In the North Atlantic Ocean, fin whales occur in summer foraging areas from the coast of North America to the Arctic, around Greenland, Iceland, northern Norway, Jan Meyers, Spitzbergen, and the Barents Sea. In the western Atlantic, they winter from the edge of sea ice south to the Gulf of Mexico and the West Indies. In the eastern Atlantic, they winter off southern Norway, the Bay of Biscay, and Spain with some whales migrating into the Mediterranean Sea (Gambell, 1985a).

In the Southern Hemisphere, fin whales are distributed broadly south of latitude 50° S in the summer while in the winter the whales migrate into the Atlantic, Indian, and Pacific Oceans along the coast of South America (as far north as Peru and Brazil), Africa, and the islands in Oceania north of Australia and New Zealand (Gambell, 1985a).

Life History Information

Most reproductive activity for fin whales, including mating and births, takes place in the winter season (Haug, 1981; Mitchell, 1974b), although some out-of-season births are known to occur off the eastern United States (Hain et al., 1992). The gestation period is probably somewhat less than a year, and calves are nursed for approximately six to seven months (Haug, 1981; Gambell, 1985a). Fin whales become sexually mature between 5 and 15 years of age (Gambell, 1985a; COSEWIC, 2005) have a calving interval of 2-3 years (Agler et al., 1993), and have a life expectancy between 70 and 80 years (Kjeld et al., 2006).

Fin whales feed on euphausiids and large copepods in addition to schooling fish (Nemoto, 1970; Kawamura, 1982; Watkins et al., 1984) although their diet varies seasonally and geographically (Watkins et al., 1984; Shirihai, 2002). The movements and distribution of fin whales are thought to be based on prey availability. The availability of sand lance, in particular, is thought to have had a strong influence on the distribution and movements of fin whales along the east coast of the United States (Kenney and Winn, 1986; Payne et al., 1990; Hain et al., 1992).

Fin whales occur year-round in a wide range of latitudes and longitudes, but the density of individuals in any one area changes seasonally. Most fin whales in the northern hemisphere migrate seasonally from the Arctic in summer to lower latitudes in the winter to breed. However, the locations of these breeding grounds are not known and their migration patterns are less predictable than for other species (Perry et al., 1999). They are known to occur in high densities in the northern Gulf of Alaska and southeastern Bering Sea from May to October, with some movement through the Aleutian passes into and out of the Bering Sea (Reeves et al., 1985; NMFS, 2010b). Although some fin whales apparently are present in the Gulf of California year-round, there is a marked increase in their numbers in the winter and spring (Tershy et al., 1990) which is thought to be related to the high seasonal abundance of krill (Tershy, 1992).

Diving Behavior, Hearing, and Vocalization

The percentage of time fin whales spend at the surface varies. Gambell (1985a) reported fin whales making 5-20 shallow dives each lasting 13-20 seconds followed by a deep dive lasting between 1.5 and 15 min (Gambell, 1985a). Other authors have reported common dives lasting between two and six minutes, with two to eight blows between dives (Watkins, 1981; Hain et al., 1992).

Fin whales can be found singly or in pairs, but can also form larger groupings of more than three individuals, particularly while feeding. Balcomb (1987) noted that fin whales commonly travel in herds ranging from six to more than 100 individuals. They have also been reported grouped with other balaenopterid whale species at times (e.g. blue whales) while feeding (Corkeron et al., 1999; Shirihai, 2002).

Fin whales produce a variety of low-frequency sounds in the 10-200 Hz band range (Watkins, 1981; Watkins et al., 1987; Edds, 1988; Thompson et al., 1992). The most typical signals are long, patterned sequences of short duration (0.5-2 second) infrasonic pulses in the 18-35 Hz range (Patterson and Hamilton, 1964). Estimated source levels are as high as 190 decibels (dB) in some cases (Patterson and Hamilton, 1964; Watkins et al., 1987; Thompson et al., 1992; McDonald et al., 1995). In temperate waters, intense bouts of long patterned sounds are very common from fall through spring, but also occur to a lesser extent during the summer in high latitude feeding areas (Clark and Charif, 1998).

Listing Status

Fin whales were originally listed as endangered 1970, and this status remained following the inception of the ESA in 1973. They are also listed as endangered on the IUCN Red List of Threatened Species and are also protected by CITES and the MMPA. Critical habitat has not been designated for the species.

Abundance and Trends

Historically, fin whale populations worldwide were severely affected by commercial whaling in the 20th century in the North Atlantic, North Pacific, and Southern oceans (Cherfas, 1989 *as cited in* Perry et al., 1999). Braham (1991) compiled available regional estimates and estimated the global population of fin whales in 1991 to be about 119,000 individuals, which represented about a quarter of his estimated pre-exploitation abundance of 464,000 individuals.

Sergeant (1977) estimated that prior to commercial exploitation there may have been as many as 30,000 to 50,000 fin whale individuals in the North Atlantic. Currently, no reliable population estimates exist for the entire North Atlantic; however, estimates do exist for portions of the North Atlantic. For the year’s 1996-2001, the IWC’s best estimate for the population of fin whales in the central and northeastern Atlantic was 30,000 individuals. Braham (1991) estimated the western North Atlantic to contain between 3,590 and 6,300 individuals while Hain et al. (1992) estimated that there were approximately 5,000 fin whales in the western North Atlantic Ocean based on a 1978-1982 survey. The most recent abundance estimate for the western North Atlantic stock was 3,985 individuals (CV=0.24) (Waring et al., 2011).

In the North Pacific, there may have been as many as 42,000-45,000 fin whales prior to commercial exploitation; however, it is estimated that this population was reduced to between 13,620 and 18,630 by the early 1970's (Ohsumi and Wada, 1974). Moore et al. (2000) conducted surveys for whales in the central Bering Sea in 1999 and estimated the fin whale population to be approximately 4,951 individuals while more recent survey data estimated the fin whale population west of the Kenai Peninsula to be 5700 individuals (Moore et al., 2002; Zerbini et al., 2006, *both as cited in* Allen and Angliss, 2011). Results from ship surveys performed off the coasts of Washington, Oregon, and California in the years 1996 and 2001 estimated the fin whale population at 3,279 individuals (Barlow and Taylor, 2001) while results of surveys conducted in 2005 and 2008 in the same region estimated the fin whale population at 3,044 individuals (CV=0.18) (Carretta et al., 2011). A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 174 individuals (CV=0.72) which currently represents the best available abundance estimate for the Hawaiian stock (Barlow, 2003). Based on the available information, it is feasible that the North Pacific population as a whole has failed to increase significantly over the past 30 years.

In the Southern Hemisphere, there may have been as many as 400,000 fin whales prior to exploitation by whaling vessels; however it is estimated this population may have been reduced to 85,200 fin whales by the late 1970's (IWC, 1979). A joint Conservation of Antarctic Marine Living Resources/IWC survey in the Scotia Sea and Antarctic Peninsula during the austral summer of 2000 (January-February) resulted in a more recent abundance estimate of 4,672 individuals in the Southern Hemisphere (Hedley et al., 2001; Reilly et al., 2004).

Current Threats

The main stressors affecting the ability of the species to recover include ongoing effects from prior commercial whaling, interaction with fishing gear, ship strikes, and various sources of habitat degradation. Historically, whaling represented the greatest threat to every population of fin whales and was ultimately responsible for listing fin whales as an endangered species. From 1904 to 1975, the IWC estimates that 703,693 fin whales were captured and killed in Antarctic whaling operations alone (IWC, 1990). Whaling in the Southern Ocean originally targeted humpback whales, but by 1913, those whales had become so rare that whalers shifted their focus to other species including fin and blue whales (Mizroch et al., 1984a). From 1911 to 1924, it was estimated that whalers harvested between 2,000–5,000 fin whales each year. After the introduction of factory whaling ships in 1925, the number of whales killed each year increased substantially which had a major impact on global fin whale populations prior to the ban on international whaling.

As is the case with other large whale species, entanglement in commercial fishing gear and mortality from ship strikes continue to affect the species’ ability to recover. There were 14 confirmed reports of fin whales being entangled in fishing gear between 2004 and 2008 off the Atlantic coast of the U.S. and Maritime Provinces of Canada, with 3 whales dying of their wounds and an additional 3 sustaining serious injuries (Glass et al., 2010). For ship strikes, there were 13 confirmed reports of fin whales being struck by vessels with 10 dying of their wounds (Glass et al., 2010).

Organochlorines, including PCB, DDT, and DDE have been identified from fin whale blubber samples with females containing lower burdens than males. This is likely due to mobilization of contaminants during pregnancy and lactation (Aguilar and Borrell, 1988; Gauthier et al., 1997). Contaminant levels increase steadily with age until sexual maturity, at which time levels begin to drop in females and continue to increase in males (Aguilar and Borrell, 1988).

Fin whales are still hunted in subsistence fisheries off West Greenland and are hunted by Japanese whalers in the Southern Ocean as part of Japan's JARPA II research program with anticipated harvests of 50 fin whales each year expected for the period 2007-2019 (Nishiwaki et al., 2006). Other current threats affecting fin whale recovery include effects of ocean noise as well as disturbance from whale watching and other scientific research activities.

Effects of current climate change trends also present potential threats to fin whales, particularly in the Mediterranean Sea, where fin whales appear to prey exclusively on northern krill. These krill species occupy the southern extent of their range and increases in water temperature could result in their decline in the Mediterranean Sea thereby potentially affecting food availability for fin whales in this region (Gambaiani et al., 2009). However, there are insufficient data to know the effects that current climate-related trends are having on fin whale populations.

Sei Whale

Species Description, Distribution, and Population Structure

Sei whales have a long, sleek body that is dark bluish-gray to black in color and pale underneath and have baleen plates that are dark in color with gray/white fine inner fringes in their enormous mouths. The distribution of the sei whale population is not well known, but this whale is found in all oceans and appears to prefer mid-latitude temperate waters often associated with deeper waters and areas along continental shelf edges (Hain et al., 1985). However, this general offshore pattern is disrupted during occasional incursions into shallower inshore waters (Waring et al., 2011). The difficulty of distinguishing sei whales at sea from their close relatives (e.g., fin whales) has created confusion about distributional limits and frequency of occurrence (NMFS, 2011a).

During summer in the North Pacific, the sei whale can be found from the Bering Sea to the northern Gulf of Alaska and south to southern California, and in the western Pacific from Japan to Korea (Leatherwood et al., 1982; Nasu, 1974). Its winter distribution is concentrated at about latitude 20° N, and sightings have been made between southern Baja California and the Islas Revilla Gigedo (Rice, 1998) with some sightings occurring in the waters off Hawaii as well (Smultea et al., 2010). Masaki (1977) reported sei whales concentrating in the northern and western Bering Sea from July-September, although many researchers question those findings and many believe the sei whale occurs mainly south of the Aleutian Islands (Leatherwood et al., 1982; Nasu, 1974).

In the western North Atlantic, a major portion of the sei whale population occurs in northern waters, believed to include the Scotian Shelf, along Labrador and Nova Scotia, the Gulf of Maine, and the Georges Bank region (Mitchell and Chapman, 1977; Waring et al., 2011). These whales summer in northern areas before migrating south to Florida, in the Gulf of Mexico, and the northern Caribbean Sea (Gambell, 1985b; Mead, 1977). In the U.S. EEZ, the greatest abundance of sei whales occurs during spring, with most sightings occurring on the eastern edge of Georges Bank, in the Northeast Channel, and in Hydrographer Canyon (CETAP, 1982). During years of greater prey abundance (e.g., copepods), sei whales are found in more inshore waters (Payne et al., 1990; Schilling et al., 1992). In the eastern Atlantic, sei whales occur in the Norwegian Sea, occasionally occurring as far north as Spitsbergen Island, and migrate south to Spain, Portugal, and northwest Africa (Gambell, 1985b; Jonsgård and Darling, 1977).

The population structure of sei whales is generally unknown although NMFS currently recognizes four distinct stocks for management purposes: (1) Hawaiian Stock, (2) Eastern North Pacific Stock, (3) Nova Scotia Stock, and a (4) Western North Atlantic Stock. Wada and Numachi (1991) concluded that a single sei whale population existed in the North Pacific based on genetic studies while Masaki's (1977) evaluation of tag recoveries, catch distributions, sightings, and baleen morphology led him to propose three North Pacific stocks, divided by longitudes 175° W and 155° W. The fact that sei whales seem to occur in two main centers of abundance off eastern Canada was used as the primary basis for recognizing two stocks in the northwestern Atlantic, one from the southeastern coast of Newfoundland northward (Labrador Sea stock) and the other south from Newfoundland (Nova Scotia stock) (Mitchell and Chapman, 1977). There is little information on the population structure of sei whales in Antarctic waters, although some degree of separation among IWC Areas I–VI in the Southern Ocean has been noted (Donovan, 1991).

Life History Information

Best and Lockyer (2002) calculated an average age of sexual maturity for sei whales at 8.2 years and 8.6 years for Southern Hemisphere females and males, respectively. Reproductive activities generally occur during the winter months with calving thought to occur from September to March each year (Rice, 1977). The gestation period is approximately 12-13 months, calves are weaned at 6-9 months, and the calving interval is 2-3 years (Gambell, 1985b; Rice, 1977).

Sei whales are highly mobile, and there is no indication that any population remains in a particular area year-round, but studies are lacking to make definitive conclusions regarding possible residency. Poleward summer feeding migrations occur, and sei whales generally winter in warm temperate or subtropical waters (Horwood, 1987; Jefferson et al., 2008). Pregnant females are believed to lead the migration to and from northern feeding grounds (Mizroch et al., 1984b), and the migration along the Canadian coast is believed to occur in stages based both on gender and age (Gregr et al., 2000).

Sei whales are primarily planktivorous, feeding mainly on euphausiids and copepods, although they are also known to consume fish (Waring et al., 2006). In the Northern Hemisphere, sei whales consume small schooling fish such as anchovies, sardines, and mackerel when locally abundant (Mizroch et al., 1984b; Rice, 1977). Sei whales in the North Pacific feed on euphausiids and copepods, which make up about 95 percent of their diets (Calkins, 1986). The dominant food for sei whales off California during June-August is northern anchovy before switching to krill from September-October (Rice, 1977). In the Southern Ocean, analysis of stomach contents indicates sei whales consume *Calanus spp*. and small-sized euphasiids with prey composition showing latitudinal trends (Kawamura, 1974). Sei whales in the Southern Hemisphere may reduce direct interspecific competition with blue and fin whales by consuming a wider variety of prey and by arriving later to feeding grounds (Kirkwood, 1992). Rice (1977) suggested that the diverse diet of sei whales may allow them greater opportunity to take advantage of variable prey resources, but may also increase their potential for competition with commercial fisheries.

Diving Behavior, Hearing, and Vocalization

Sei whales, unlike fin whales, tend not to roll high out of the water as they dive (NMFS, 2011a). The blowholes and dorsal fin are often exposed above the water surface simultaneously and they rarely breach or raise their flukes out of the water (Jefferson et al., 2008). The species appears to lack a well-defined social structure and individuals are usually found alone or in small groups of up to six whales (Perry et al., 1999). However, larger groupings have been observed when on feeding grounds (Gambell, 1985b).

Data on sei whale vocal behavior is limited, but includes records off the Antarctic Peninsula of broadband sounds in the 100-600 Hz range with 1.5 second duration and tonal and upsweep calls in the 200-600 Hz range of 1-3 second durations (McDonald et al., 2005). It is reasonable to assume that sei whale hearing includes, and likely extends beyond, the frequencies described for these vocalizations (NMFS, 2011a). Rankin and Barlow, (2007) suggest that differences in vocalizations may exist between ocean basins.

Listing Status

The sei whale was originally listed as endangered in 1970 (35 FR 18319), and this status remained following inception of the ESA in 1973. Sei whales are listed as endangered on the IUCN Red List of Threatened Species are also protected by CITES and the MMPA. No critical habitat is currently designated for the species.

Abundance and Trends

While there are insufficient data to determine population trends for the species (Waring et al., 2011), application of various models to whaling catch and effort data suggests that the total population of adult sei whales in the North Pacific declined from about 42,000 to 8,600 individuals between 1963 and 1974 (Tillman, 1977). This was consistent with the dropoff in catch per unit effort for sei whales in California shore whaling during the same period (Rice, 1977). There have been no direct estimates of sei whale populations for the eastern Pacific Ocean (or the entire Pacific for that matter). The minimum estimate of individuals along the U.S. west coast between 1996-2001 was estimated at a mere 35 individuals (Carretta et al., 2006).

In 1974, the North Atlantic stock was estimated to number about 2,078 individuals, including 965 whales in the Labrador Sea group and 870 whales in the Nova Scotia group (Mitchell and Chapman, 1977). Sei whale sighting information from surveys conducted in summer 2004 in waters north of Maryland (38º N) yielded an abundance estimate of 386 individuals (CV=0.85) (Palka, 2006) while an abundance estimate of 207 (CV=0.62) was obtained from an aerial survey conducted in August 2006 which covered 10,676 kilometers of trackline in the region on the southern edge of Georges Bank to the upper Bay of Fundy and the entrance of the Gulf of St. Lawrence (Waring et al., 2009). In another location, MacLeod et al. (2005) reported that an estimated 1,011 (CI: 497-2058) sei whales occur in waters off Scotland, based on vessel-based surveys in that region.

Mizroch et al. (1984b) and Braham (1991) provided pre-exploitation estimates of 63,100 and 65,000 sei whale individuals, respectively, in the Southern Hemisphere prior to whaling. In the Southern Hemisphere, more recent population estimates range between 9,800 and 12,000 individuals (Perry et al., 1999). The IWC reported an estimate of 9,718 sei whales based on results of surveys performed between 1978 and 1988 in the region (IWC, 1996).

Current Threats

Just as with other listed baleen whales, there are several stressors affecting sei whales globally such as effects from prior commercial whaling, current whaling under subsistence or special permit programs, and the threat of ship strike from increasing maritime vessel traffic. Historically, whaling represented the greatest threat to every population of sei whales and was ultimately responsible for listing sei whales as an endangered species. Sei whales in the North Pacific declined from about 42,000 individuals to 8,600 individuals between 1963 and 1974 (Tillman, 1977). This drastic reduction in abundance has slowed down recovery even after commencement of the worldwide ban on commercial whaling.

Sei whales also face the threat of ship strikes in many regions throughout its range. In a database of nearly 300 vessel strike records worldwide between 1975 and 2002, Jensen and Silber (2004) reported two sei whale vessel strikes in the North Atlantic (one each off Massachusetts and Maryland) and one record of a whale struck in 1994 in Hauraki Gulf, New Zealand. A total of three sei whale deaths were attributed to collisions with vessels between 2003 and 2008 in the waters off of the U.S. eastern seaboard (one each off Maine, Maryland, and Virginia) (Nelson et al. 2007; Waring et al. 2009; Glass et al., 2010).

Sei whales are also known to accumulate DDT, DDE, and PCBs in their tissues (Borrell, 1993; Borrell and Aguilar, 1987; Henry and Best, 1983). Males carry larger burdens than females, as gestation and lactation transfer these toxins from mother to offspring. The highest concentrations of organochlorines found in cetaceans, including sei whales, are in the Mediterranean Sea. High concentrations of organochlorines in cetaceans also occur, although to a lesser extent, along the Pacific coast of the U.S. and generally in other mid-latitudes in the Northern Hemisphere (Aguilar et al., 2002).

Subsistence whaling in Greenland targeted at fin whales, occasionally result in the killing of sei whales (Kapel, 1985). In recent years sei whales were a target species for Japanese North Pacific whalers as exempted under a special permit. Between 2001 and 2003, 91 individuals were believed to be taken while 100 sei whales were believed to be taken each year between 2004 and 2008 based on the special conditions of the permit (IWC, 2010 *as cited in* NMFS, 2011a). Other current threats affecting sei whale recovery include effects of ocean noise as well as the potential for climate variability to affect prey resources similar to fin and humpback whales.

ENVIRONMENTAL BASELINE

By regulation, environmental baselines for biological 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 purpose of the *Environmental Baseline* section is to step down from the species level discussion in the *Status of the Species* section and establish the current and projected viability or fitness of individuals and populations within the action area so that the effects of the proposed research activities can be measured and assessed. The following sections summarize the natural phenomena as well as the anthropogenic activities that have affected and continue to affect listed species within the action area. While some stressors uniquely occur within the action area and are thus easily identified for their respective impacts, there are other stressors where the impacts are felt only in part within the action area at an unspecified magnitude (e.g. disease, effects from prior commercial exploitation, etc.). In those situations, we will discuss impacts generally and make the assumption that listed species are exposed to these ongoing effects in the action area at an unspecified degree.

<u>Natural Sources of Stress and Mortality</u>

Natural stressors acting on listed species in the action area include predation, diseases and parasitic infections, and other stochastic phenomena. Killer whales and/or large sharks are known to occasionally prey on very young or sick fin, sei, and humpback whales (Perry et al., 1999; Ford and Reeves, 2008; Steiger et al., 2008). Highly migratory species such as large whales can carry pathogens across large distances thus potentially introducing new diseases in the action area (Perry et al., 1999). The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in humpback and fin whales and may be affecting recovery of these species throughout their ranges (Lambertsen, 1992). Endoparasitic helminths (worms) are commonly found in sei whales and can result in pathogenic effects when infestations occur in the liver and kidneys (Rice, 1977). Parasites and biotoxins from red-tide blooms are other potential causes of mortality of listed baleen whales in the action area (Perry et al., 1999).

Other stochastic events, such as strandings, are known to occur in the action area the cause of which is not always known. For example, Nitta (1991) reported that between 1936 and 1988, 8 humpback whales, 1 fin whale, and 5 sperm whales stranded in the Hawaiian Archipelago. In a partial update of that earlier report, Maldini et al. (2005) identified 202 cetaceans (mostly toothed whales) that had stranded between 1950 and 2002. Although these studies did not specify the causes or causes of death in these cases, we include these types of stranding events as a source of natural mortality occurring in the action area.

<u>Oceanographic Features and Climate Variability</u>

Oceanographic conditions in the Atlantic and Pacific Oceans can be altered due to periodic weather patterns such as El Niño, La Niña, the Pacific Decadal Oscillation (PDO), and the North Atlantic Oscillation (NAO) that can alter habitat conditions and prey distribution for listed cetaceans in the action area (Mantua et al., 1997; Francis et al., 1998; Beamish et al., 1999; Hare et al., 1999; Benson and Trites, 2002; Stabeno et al., 2004; Mundy and Cooney, 2005; Mundy and Olsson, 2005). For example, decade-scale climatic regime shifts have been related to changes in zooplankton in the North Atlantic (Fromentin and Planque, 1996) and decadal trends in the NAO (Hurrell, 1995) can affect the position of the Gulf Stream (Taylor et al., 1998) and other circulation patterns in the North Atlantic that act as migratory pathways for various fish species.

The PDO is the leading mode of variability in the North Pacific and operates over longer periods than either El Niño or La Niña and is capable of altering sea surface temperature (SST), surface winds, and sea level pressure (Mantua, 2002; Mantua and Hare, 2002; Stabeno et al., 2004). During positive PDOs, the northeastern Pacific experiences above-average SSTs while the central and western Pacific Ocean undergoes below-normal SSTs (Mundy and Olsson, 2005; Royer, 2005). Warm PDO regimes, as with El Niño events, tends to decrease productivity along the U.S. west coast (Hare et al., 1999; Childers et al., 2005). Opposite SST regimes occur during negative PDOs (Mundy and Olsson, 2005). Recent sampling of oceanographic conditions (via GAK-1) just south of Seward, Alaska has revealed anomalously cold conditions in the Gulf of Alaska from 2006-2009 suggesting a shift to a colder PDO phase; however, the most recent sampling season in 2010 yielded a return to near average temperatures thus running counter to these results (Hopcroft et al., 2011). More research needs to be done to determine if the region is indeed shifting to a colder PDO phase as well as the effects these phase shifts have on the dynamics of prey populations important to listed cetaceans throughout the action area. A shift to a colder phase would be expected to impact prey populations over the five year duration of the proposed permit, although the magnitude of this effect is uncertain at the time of this consultation.

In addition to periodic weather patterns affecting oceanographic conditions in the action area, longer term trends in climate change and/or variability also have the potential to alter habitat conditions suitable for listed species in the action area on a much longer time scale. For example, from 1906-2006, global surface temperatures have risen 0.74º C and this trend is continuing at an accelerating pace. Twelve of the warmest years on record since 1850 have occurred since 1995 (Poloczanska et al., 2009). Possible effects of this trend in climate change and/or variability for listed whales in the action area include the alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, and altered timing of breeding (MacLeod et al., 2005; Robinson et al., 2005; Kintisch, 2006; Learmonth et al., 2006; McMahon and Hays, 2006). Climate change can influence reproductive success by altering prey availability, as evidenced by the low success of northern elephant seals during El Niño periods (McMahon and Burton, 2005) as well as data suggesting that sperm whale females have lower rates of conception following periods of unusually warm sea surface temperature (Whitehead, 1997). However, gaps in information and the complexity of climatic interactions complicate the ability to predict the effects that climate change and/or variability may have to these species from year to year in the action area (Kintisch, 2006; Simmonds and Isaac, 2007).

<u>Anthropogenic Sources of Stress and Mortality</u>

Historical Whaling

As discussed in the *Status of the Species* section of this Opinion, whale populations occurring in the action area have historically been impacted by commercial exploitation (i.e. in the form of directed whaling). For example, from 1900 to 1965, nearly 30,000 humpback whales were captured and killed in the Pacific Ocean (Perry et al., 1999), while the sei whale population in the North Pacific was reduced by nearly 20 percent from historical numbers as a result of whaling (Tillman, 1977). American whalers alone harvested 14,164-18,212 humpbacks in the North Atlantic between 1805-1909 (Best, 1987 *as cited in* NMFS, 1991) and fin whales also saw their populations drastically reduced from historical estimates.

While commercial whaling no longer occurs in the action area due to the moratorium established in 1982, we acknowledge that heavy exploitation significantly reduced these species abundances in both the Atlantic and Pacific Oceans and many of the affected populations have yet to recover. Prior exploitation may have altered the population structure and social cohesion of these species such that effects on abundance and recruitment may continue for years. Significantly lower numbers have resulted in a loss of genetic diversity that could affect the ability of the current populations to successfully reproduce in the future (e.g., decreased conceptions, increased abortions, increased neonate mortality). Also, significantly lowered population numbers decreases these species' resistance to the effects of deleterious phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, thereby greatly affecting the ability of these species to recover to pre-exploitation levels.

Subsistence Harvest

Subsistence hunters in Alaska have reported one subsistence take of a humpback whale in South Norton Sound in 2006 (Allen and Angliss, 2011) although no other takes have been reported for other whale species affected by the proposed action.

Fishing Gear Entanglement

Entrapment in commercial fishing gear continues to impact listed cetaceans in the action area (particularly humpback whales). Robbins and Mattila (2001) studied entanglement-related scarring on 134 individual humpback whales and concluded that between 48 and 65 percent had experienced entanglements. An estimated 78 baleen whales were killed annually in the offshore southern California drift gillnet fishery during the 1980's (Heyning and Lewis, 1990) and 22 humpback whale entanglements were reported from 1996-2000 (Angliss and Lodge, 2004). More recent records show that during the period 2004-2008 there were 18 reported entanglements of humpback whales off the U.S. west coast (Carretta et al., 2011). Eleven were reported entangled at sea in trap/pot fishery gear off California and Oregon, including two animals later found dead (Northwest Regional Stranding Program, unpublished data). Off the U.S. east coast, there were five humpback whales killed and an additional 11 sustaining serious injuries from entanglement during the same period (Glass et al., 2010). In the Northeast Pacific, fishery-related minimum mortality and serious injury rate for humpbacks is 3.8 individuals per year based on observer and stranding data from Alaska and Hawaii (Allen and Angliss, 2011).

Fin and sei whales also interact with fishing gear although reported takes are much lower than those reported for humpbacks. According to the most recent stock assessment reports for the western North Atlantic region, the annual rate of serious injury and mortality of fin and sei whales from fishery interactions is 1.2 and 0.6 individuals per year, respectively (Waring et al., 2011). During the period 2004-2008, there were 3 confirmed fin whale deaths and an additional 3 reports of fin whales sustaining serious injury as a result of entanglement while for sei whales, there was 1 confirmed mortality and 2 reports of serious injury as a result of entanglement (Glass et al., 2010). In the Pacific, there was one observed fin whale mortality in the Bering Sea/Aleutian Island pollock trawl fishery between 2002 and 2006 (Allen and Angliss, 2011) while for the offshore drift gillnet fishery, there has been one fin whale death reported since 1990 (Carretta et al., 2011).

In addition to direct injury and/or mortality, entanglements also make listed species more vulnerable to additional dangers (e.g., predation and ship strikes) by restricting agility and swimming speed. Robbins and Mattila (2001) found that female humpbacks showing evidence of prior entanglements produced significantly fewer calves, suggesting entanglement may significantly reduce reproductive success. Also, 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. This, in addition to a lack of observer coverage in the case of many fisheries operating in the action area, mean that many “takes” associated with commercial fisheries are likely being underreported for many of the listed species affected.

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 and migratory routes. Jensen and Silber’s (2004) review of the NMFS’ ship strike database revealed fin whales as the most frequently confirmed victims of ship strikes (i.e., 26 percent of the recorded ship strikes) although humpbacks are also frequently struck. Most collisions occur off the U.S. east coast, followed by the west coast of the U.S. and Alaska/Hawaii. Recent data for the period 2004-2008 report 14 humpbacks getting struck (including 8 confirmed mortalities), 13 fin whales getting struck (including 10 confirmed mortalities), and 3 sei whales getting struck (including 2 confirmed mortalities) off the U.S. east coast and Canada (Glass et al., 2010). In addition to confirmed ship strike events, we also assume that many incidents go unreported or the whale doesn’t strand ashore making it difficult to get a measure of the true population-level impact that ship strikes pose to listed whales in the action area.

In the North Atlantic, NMFS has several programs in place to help reduce ship strikes to whales. One of these measures is the implementation of new rules that limit vessel traffic of ships greater than 65 feet to speeds of 10 knots or less in areas when right whales are known to congregate. Other programs include the modification of shipping lanes from areas of high right whale concentrations. Although these efforts are targeted primarily to help conserve North Atlantic right whales, they are also beneficial to other whales which inhabit the same waters and are subject to similar threats. Despite these measures, the threat of ship strikes is expected to continue in the action area as commercial shipping lanes continue to cross important breeding habitats and may actually increase in the future as whale populations recover and individuals populate new areas or areas where they were previously extirpated (Swingle et al., 1993; Wiley et al., 1995).

Whale Watching

Private and commercial shipping vessels engaged in marine mammal watching also have the potential to impact whales in the action area. A 2001 study of whale watch activities worldwide found that the business of viewing whales and dolphins in their natural habitat has grown rapidly in the past couple decades (Hoyt, 2001). In 1988, a workshop sponsored by the Center for Marine Conservation and NMFS was held in Monterey, California to review and evaluate whale watching programs and management needs. That workshop produced several recommendations for addressing potential harassment of marine mammals during wildlife viewing activities that included developing regulations to restrict operating thrill craft near cetaceans, swimming and diving with the animals, and feeding cetaceans in the wild.

Several studies have specifically examined the effects of whale watching on marine mammals, and investigators have observed a variety of short-term responses from animals, ranging from no apparent response to changes in vocalizations, duration of time spent at the surface, swimming speed, swimming angle or direction, respiration rate, dive time, feeding behavior, and social behavior. Responses appear to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity (Watkins, 1986; Corkeron, 1995; Au and Green, 2000; Erbe, 2002; Magalhaes et al., 2002; Williams et al., 2002a; Williams et al., 2002b; Richter et al., 2003; Scheidat et al., 2004). Although numerous short-term behavioral responses to whale watching vessels are documented, little information is available on possible long-term effects to listed whales. One concern is that animals may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle et al., 1993; Wiley et al., 1995). Another concern is that preferred habitats may be abandoned if disturbance levels are too high. We expect that a portion of the individuals targeted in this proposed action may be exposed to whale watching activities, especially off the northeastern U.S. and Hawaii.

Increased Ambient Background Noise from Shipping and Transportation

Increases in underwater sound generated from various man-made sources such as commercial shipping, recreational vessels, cruise ships, research vessels, helicopters, and airplanes have the potential to affect listed whales in the action area through decreased communication and habituation to sound sources. Marine mammals use sound in the ocean environment to find prey, locate mates, rear young, navigate, and to avoid predators (Bradley and Stern, 2008). Several investigators have argued that anthropogenic sources of noise have increased ambient noise levels in the ocean over the last 50 years (Richardson et al., 1995; NRC, 2003; Jasny et al., 2005; NRC, 2005) with surface shipping being the most widespread in terms of low frequency (0 to 1,000 Hz) anthropogenic noise. The Navy estimated that the 60,000 vessels of the world's merchant fleet annually emit low frequency sound into the world's oceans for the equivalent of 21.9 million days, assuming that 80 percent of the merchant ships are at sea at any one time (U.S. Navy, 2001).

Continual increases in background ambient noise levels in the action area from these various sources can cause masking of marine animals' communication systems, their ability to hear mating calls, and their ability to pick up acoustic environmental cues that animals use to navigate and/or sense their surroundings, including sounds that are used to detect predators (Hatch et al., 2008; OSPAR, 2009). Changes in acoustic communication in call rates and frequencies has already been proposed in right whales (Parks et al., 2009; Parks et al., 2007), blue whales (Di Iorio and Clark, 2009), and fin whales (Castelotte et al., *in press*) as a result of increasing background ambient noise levels in the marine environment. It is expected that listed cetaceans will continue to exhibit these types of behavioral responses in the action area in the near future.

Another concern of increased sound from vessels is the gradual habituation of listed whales to vessels and other sound sources. Habituation to this increasing ambient noise may increase the risk of vessel strikes since the whales do not actively avoid the acoustic noise generated by an oncoming vessel. A study looking at the use of acoustic tags and controlled exposure experiments with North Atlantic right whales resulted in five of six individual whales responding strongly (interrupted dive pattern and swimming rapidly to the surface) to the presence of an artificial alarm stimulus while ignoring the playbacks of vessel noise, citing evidence of habituation (Nowacek et al., 2004). Several investigators have suggested that vessel noise may have caused humpback whales to avoid or leave feeding or nursey areas (Jurasz and Jurasz, 1979; Glockner-Ferrari and Ferrari, 1985; Salden, 1988; Glockner-Ferrari and Ferrari, 1990), while others have suggested humpback whales may become habituated to vessel traffic and its associated noise (e.g. Watkins, 1986). Croll et al. (2001) examined exposure of fin whales to low frequency noise and found that whale foraging activity continued after exposure, and there were no apparent responses of whales to loud, low frequency noise sources; however, the authors acknowledged that these results do not address the cumulative impact of this noise over larger spatial and time scales.

Pulsed Sound Generated by Seismic Surveys, Military Activities, and In-Water Construction
High energy pulsed sound generated in the marine environment from seismic surveys, military sonar training and underwater detonations, and construction (e.g., pile driving and blasting) has the potential to increase stress levels, alter behavior, result in temporary or permanent hearing loss, and/or, in extreme cases, result in direct injury and even death to listed cetaceans depending on the proximity of the animal is to the sound source (Richardson et al., 1995; NRC, 2003; Clark and Ellison, 2004; NRC, 2005; Nowacek et al., 2007; Southall et al., 2007; Wright et al., 2008).

Numerous surveys have been conducted in the northeast Pacific, Arctic, and northwest Atlantic using seismic airguns. Airguns are typically fired every 10-15 seconds with theoretical source levels of about 255 dB ± 3 dB which are detectable 50-75 km away in shallow water and over 100 kilometers away in survey areas deeper than 50 m (Richardson et al., 1995). As a general mitigation measure, airguns are shutdown if marine mammals approach too closely (generally within the 180 dB isopleths for cetaceans), presumably avoiding the potential for temporary or permanent threshold shifts in cetaceans exposed to the airgun pulses. While onboard observers and passive acoustic monitoring help identify the presence of whales, the possibility exists that some non-vocalizing whales beneath the surface may be temporarily exposed to higher sound levels at an unspecified degree. In addition to possible physical trauma and stress, whales are known to respond behaviorally by actively avoiding the sound of the seismic survey vessel, thus causing some temporary habitat displacement upon exposure (Greene, 1982; Richardson et al., 1985; Wartzok et al., 1989; Richardson et al., 1990; Gallagher and Hall, 1993; Richardson et al., 1995; Schick and Urban, 2000; Richardson and Williams, 2003; Richardson et al., 2004; Richardson and Williams, 2004; Streever et al., 2008; George, 2010).

Since 2008, the majority of seismic survey activities have occurred in the Northeast Pacific and Arctic regions in the action area. During September-October 2008, Colombia University's Lamont-Doherty Earth Observatory (L-DEO) conducted a seismic survey in northeastern Gulf of Alaska (40-4,000 meters water depth) aboard the *R/V Langseth* using a 36-airgun array. It was estimated that 80 humpback whales were likely to be exposed to seismic sound[10] in excess of 160 dB re: 1 μParms presumably causing avoidance behavior and temporary habitat displacement to occur as a result. Subsequent passive acoustic monitoring effort resulted in 14 sightings of humpback whales (35 individuals), 2 sightings of unidentified whales (4 individuals), and 2 sightings of unidentified baleen whales (7 individuals). From July-September 2010, L-DEO conducted a seismic survey in the northwestern Pacific Ocean in deepwater using a 36-airgun array and estimated that up to 10 humpback whales and 16 fin whales were likely exposed to seismic sound in excess of 160 dB re: 1 μPa_{rms} (Holst and Beland, 2010). Two other seismic surveys, one by USGS and another by L-DEO, were completed in the Gulf of Alaska in the summer/fall months of 2011. Incidental takes exempted in the respective biological opinions were 607 fin whales, 1,803 humpback whales, and 1 sei whale in addition to other species for the L-DEO survey (NMFS, 2011b) and 76 fin whales and 68 humpback whales for the USGS survey (NMFS, 2011c). Another seismic survey was conducted in the central-western Bering Sea in September 2011. Incidental takes exempted for this survey were 61 fin whales, 6 humpback whales, and 1 sei whale in addition to other species (NMFS, 2011d). While exposure to these sound sources ended at the completion of the seismic surveys, we anticipate that some whales targeted by the proposed tagging activities would be exposed to harassment from pulses generated by other seismic surveys conducted in the action area during the permit period as well as after the permit ceases.

Naval activities occurring throughout the action area to which individuals could be exposed include, among others, vessel and aircraft transects, munition detonations, and sonar activities at various frequencies. The action area overlaps several naval training ranges/activities listed below along with their annual takes to humpback, fin, and sei whales exempted:

- Marianas Island Range Complex (1,740 humpback, 69 fin, and 65 sei whale annual takes exempted)
- The Southern California Range Complex (13 humpback, 138 fin whale annual takes exempted)
- The Gulf of Alaska Operating Area (1,395 humpback, 11,037 fin, and 8 sei whale annual takes exempted)
- The Hawaii Range Complex (1,487 humpback, 22 fin, and 1 sei whale annual takes exempted)
- Atlantic fleet sonar training along the Atlantic coast and Gulf of Mexico (2 humpback and 2 fin whale annual takes exempted)
- Surveillance Towed Array Sensor System Low Frequency Active Sonar (SURTASS LFA) in the North Pacific Ocean (672 humpback, 247 fin, and 52 sei whale annual takes exempted)

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10 Sound pressure is the sound force per unit area, and is usually measured in micropascals (μPa), where 1 pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. Sound pressure level (SPL) is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in underwater acoustics is 1 μPa, and the units for SPLs are decibels (dB) re: 1 μPa. SPL is an instantaneous measurement and can be expressed as the peak, the peak-peak (p-p), or the root mean square (rms). Root mean square, which is the square root of the arithmetic average of the squared instantaneous pressure values, is typically used in discussions of the effects of sounds on vertebrates.

Effects from these navy training exercises and other activities are expected to be similar to seismic surveys (notably masking effects to whale communication and avoidance behavior leading to temporary habitat displacement). All exempted takes from naval activities are non-lethal based on a review of recent biological opinions. The anti-warfare and sonar training exercises conducted by the Navy are expected to result in multiple and repeated exposures of targeted whales in the action area throughout the duration of the proposed permit as well as after this permit ceases. Naval activity, notably sonar use during training exercises, has gained notoriety for its coincidence with marine mammal strandings. No stranding or mortality events have been documented in or around other operating areas or training ranges within the action area that appear linked to naval sonar, although five beaked whales were discovered stranded or floating dead coincident in time with the Alaska Shield/Northern Edge 2004 exercise between June 17-19, 2004 in the Gulf of Alaska Operating Area. However, no mid-frequency sonar or explosives were used during this exercise and evidence linking the exercise to mortalities is circumstantial at best. However, the lack of direct observations of adverse responses to these activities does indicate that that no responses occurred as a result of these activities. NMFS and the U.S. Navy have been working cooperatively to establish a policy for monitoring and managing acoustic impacts from anthropogenic sound sources in the marine environment.

Other sound fields are generated by coastal construction, pile driving, dredging and blasting activities in nearshore environments throughout the action area. Source sound pressure levels vary widely between construction activities with drilling operations being relatively low while pile-driving and the use of explosives comprising very high source levels (OSPAR, 2009). The majority of the sound energy associated with pile driving and dredging is in the low frequency range (less than 1,000 Hz) within the hearing range of large cetaceans (Illingworth and Rodkin Inc., 2001; Reyff, 2003; Clarke et al., 2003; Illingworth and Rodkin Inc., 2004). Several measures have been adopted to reduce the sound pressure levels associated with in-water construction activities or prevent exposure of marine mammals to sound. For example, six inch blocks of wood placed between the pile and the impact hammer used in combination with a bubble curtain can reduce sound pressure levels by about 20 dB (NMFS 2008). Alternatively, pile driving with vibratory hammers produces peak pressures that are about 17 dB lower than those generated by impact hammers (Nedwell and Edwards, 2002). Other measures used in the action area to reduce the risk of disturbance from these activities include avoidance of in-water construction activities during times of year when listed whales may be present; monitoring for marine mammals during construction activities; and maintenance of a buffer zone around the project area (NMFS 2008). Injuries from either dredging or drilling operations are unlikely, except those located very close to the source (Southall et al., 2007). Underwater explosions, on the other hand, have the ability to permanently injure the auditory systems of marine mammals as Ketten et al. (1993) reported injury in the ears of two humpback whales stranded after underwater explosions.

While noise generated from marine construction has the potential to affect individuals in the action area, it is unknown how these activities affect these listed whales at the population level. As more coastal construction and renewable energy facilities are built in marine environments, studies will need to be done to understand the full range of effects that such operations have on whale population dynamics.

Pollution and Ocean Debris
Anthropogenic activities such as discharges from wastewater systems, dredging, ocean dumping and disposal, aquaculture, and additional impacts from coastal development are known to degrade coastal waters utilized by listed whales in the action area. Multiple municipal, industrial and household sources as well as atmospheric transport introduce various pollutants such as pesticides, hydrocarbons, organochlorides (e.g., DDT and PCBs), and other pollutants that may cause adverse health effects to listed whales (Iwata, 1993; Grant and Ross, 2002; Garrett, 2004; Hartwell, 2004). The accumulation of persistent pollutants through trophic transfer may cause mortality and sub-lethal effects including immune system abnormalities, endocrine disruption and reproductive effects (Krahn et al., 2007). Recent efforts have led to improvements in regional water quality in the action area, although the more persistent chemicals are still detected and are expected to endure for years (Grant and Ross, 2002).

Acute exposure to hydrocarbons from petroleum products released into the environment via oil spills and other discharges are known to cause behavioral changes in marine mammals (Grant and Ross, 2002) and may directly injure individuals through skin contact with oils (Geraci, 1990), inhalation at the water's surface, and ingesting compounds while feeding (Matkin and Saulitis, 1997). The *Exxon Valdez* released an estimated 11 million gallons of Alaskan crude oil in 1989. The Alaska Department of Environmental Conservation estimated that 149 kilometers of shoreline was heavily oiled and 459 kilometers were at least lightly oiled. The Gulf of Mexico also represents an area of high-density offshore oil extraction with chronic, low-level spills and occasional massive spills (such as the *Deep Horizon* oil spill event in 2010, *Ixtoc I* oil well blowout and fire in the Bay of Campeche in 1979, and the explosion and destruction of a loaded supertanker, the *Mega Borg*, near Galveston in 1990). Experience gained during the *Exxon Valdez* spill indicates that large-scale spills can cause persistent negative effects on wildlife that can last for decades (Peterson et al., 2003). Matkin et al. (2008) utilized photo-identification methods to monitor two killer whale populations five years prior to and 16 years after the *Exxon Valdez* oil spill and noted that in both cases, the two populations had not recovered from pre-spill numbers. It is expected that marine mammals continue to feel the effects of these major oil spill events and will continue to be threatened by any future spills as oil and gas exploration and extraction expands throughout the action area.

Habitat in the action area may also be degraded by various sources of marine debris such as plastics, glass, metal, polystyrene foam, rubber, and derelict fishing gear. Marine debris is introduced into the marine environment through ocean dumping, littering, or hydrologic transport of these materials from land-based sources. Listed whales may become entangled in marine debris or directly ingest it while feeding, potentially leading to digestive problems, injury, or even death. For instance, the stomach contents of two sperm whales that stranded separately in California included extensive amounts of discarded fishing netting and another individual from the Pacific was found to contain nylon netting in its stomach when it washed ashore in 2004 (NMFS, 2009). Recently in March of 2011, a significant amount of debris was scattered into the western Pacific as a result of an earthquake and tsunami occurring in Japan. The Japanese Ministry of the Environment estimated the total quantity of the disaster waste at 25 million tons.[11] Independent models run by NOAA and the University of Hawaii anticipate the debris passing close or washing ashore in the Northwestern Hawaiian Islands in winter 2012,

11 Data obtained at http://www.env.go.jp/en/ Accessed February 17, 2012.

approaching the West Coast of the U.S. in 2013, and circling back to Hawaii in 2014 to 2016 (NOAA, unpublished[12]). Thus, it is expected that some targeted whales may be exposed to this marine debris over the course of the permit period although the risk of ingestion or entanglement and the resulting impacts are uncertain at the time of this consultation.

Research Activities

Listed whales are exposed to numerous non-lethal scientific research activities throughout the action area as authorized by NMFS permits. Activities include close vessel and aerial approaches, biopsy sampling, suction cup tagging, dart tagging, implantable tagging, ultrasound, and acoustic playback activities. All takes are considered harassment or wounding (in the case of implantable tagging, dart tagging, and biopsy) but no serious injury is exempted and no mortalities are currently exempted. A total of 34 permits authorizing research are currently active within the action area, 21 of which authorize research in the Pacific, 9 of which authorize research in the Atlantic, and 4 of which authorize research in both ocean basins. Since issuance of a permit is a federal activity, each scientific research permit currently authorized in the action area or will be authorized is reviewed for compliance with section 7(a)(2) of the ESA to ensure that issuance of the permit does not jeopardize the continued existence of listed species. A review of the active permits show that humpback whales are the most heavily targeted for research, especially in the eastern north Pacific where tens of thousands of vessel approaches are authorized each year. Fin whales in the eastern north Pacific are next heavily targeted, followed by humpbacks in the western Atlantic and sei whales in the eastern North Pacific.

The stress response associated with a particular research activity is often directly tied to the speed and direction of the approach. For instance, whales that are biopsied or tagged following a fast approach or a head-on approach may respond more intensely to the impact of the dart than if approached slowly and from the side (Whitehead et al., 1990; Brown et al., 1991; Weinrich et al., 1991; Weinrich et al., 1992; Jahoda et al., 2003). Researchers operating in the action area are required to approach marine mammals slowly using a converging course technique in order to minimize the stress response and are required to coordinate their activities so that repeated exposure can be either avoided or minimized.

The fact that multiple permitted "takes" of listed whales is already permitted will continue to be permitted in the future means that listed whales will be repeatedly harassed throughout the action for the purposes of scientific research. The point at which this leads to a measurable cumulative impact on the survival and recovery of these species in the action area, however, is uncertain. Our ability to detect long-term population-level effects from research activities will depend on several factors including our ability to better detect sub-lethal effects, our ability to differentiate an animal that has become habituated to a particular activity from one who has learned to cope with the added stress (both of which have very different consequences), and our ability to prioritize long-term studies investigating survival and reproduction of species targeted by similar types of research in the past. The latter in particular may lead to statistically significant trends showing whether or not repeated disturbances by research activities are affecting the ability of listed species to survive and recover in the wild to an appreciable degree and may help to further refine research methods to minimize stress to listed species.

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12 Data obtained at http://marinedebris.noaa.gov/info/japanfaqs.html. Accessed February 17, 2012.

The ESA Interagency Cooperation Division, in cooperation with the Permits Division, reviews monitoring reports submitted by researchers in order to monitor the effects of permitted activities and requires researchers to suspend research and consult with NMFS in the event that additional take occurs that was not anticipated and/or evaluated in the biological opinion. At the time of this consultation, we are aware that listed whales are repeatedly harassed by research activities throughout the action area as a result of previously issued permits all of which have been shown to not jeopardize the continued existence of any species targeted by this proposed action. The consequences of exposing listed whales to the additional activities to be authorized in the proposed permit is the subject of this consultation and will be assessed in the *Effects of the Proposed Action* section below.

EFFECTS OF THE PROPOSED ACTION

Pursuant to Section 7(a)(2) of the ESA, federal agencies are directed to insure 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. In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed action, the probability of individuals of listed species being exposed to these stressors, and the probable responses of those individuals (given probable exposures) based on the best scientific and commercial evidence available. 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(s) those individuals comprise and to the listed species those populations represent. The purpose of this assessment is to determine if it is reasonable to expect the proposed research activities to have effects on listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.

For this consultation, we are particularly concerned about behavioral disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level consequences. The proposed permit would authorize non-lethal "takes" by harassment and wounding of listed species during survey activities. The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. However, the MMPA defines harassment as any act of pursuit, torment, or annoyance which has the potential to injure or disturb a marine mammal or marine mammal population in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [16 U.S.C. 1362(18)(A)]. The latter portion of this definition (that is, "...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering") is almost identical to the U.S. Fish and Wildlife Service's regulatory definition of "harass"[13] pursuant to the ESA. For this Opinion, we define harassment similarly: an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents.

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

Potential Stressors

Our effects analysis begins by identifying all possible stressors for which listed species would be exposed. During this consultation, we identified the following stressors associated with the proposed action:

- Habitat contamination due to unexpected oil or fuel spill,
- Ship strikes during transit and during surveys,
- Disturbance from engine noise and the presence of the vessels themselves,
- Disturbance due to close vessel approaches (both initial approach and revisits following tag attachment),
- Disturbance from underwater photography and video,
- Disturbance from attaching saddle pack tags and/or harness with towed tags to whale's peduncle using cantilevered or hand-held pole,
- Disturbance from attaching harness with towed tags using net gun deployment system,
- Disturbance from focal follows and tracking,
- Disturbance from sloughed skin collection

Exposure Analysis

Exposure analyses identify the ESA-listed species that are likely to co-occur with the actions' effects on the environment in space and time, and identify the nature of that co-occurrence. The analysis identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the actions' effects and the population(s) or subpopulation(s) those individuals represent. Our exposure analyses are based on the best information available to us including recent population estimates, expected growth rates over the life of the permits, the maximum survey effort expected, and data from past surveys conducted in the action area. Annual reports remain one of the most valuable resources for estimating exposure levels of similar permit actions and were thus utilized in this consultation as appropriate.

Listed species as well as their prey are not expected to be exposed to fuel or oil spills from the survey vessel as researchers are expected to take all proper precautions to avoid a spill or minimize the impact of a spill if it were to occur thus preventing any type of widespread, high-dose contamination. Therefore, we consider the threats posed by this stressor to be discountable. Ship strikes are generally considered extremely rare for research conducted on listed whales. Researchers will have trained observers on board watching for any listed species located in the direct path of the vessel so they can be avoided and will direct their research to the targeted species only. Researchers plan to use a slow, converging course technique and will not approach a whale head on. Therefore, we do not anticipate exposure of listed whales to ship strikes and the threats posed by this stressor are discountable. Sloughed skin would be collected opportunistically as tags are retrieved and would not involve engaging whales for the purposes of collecting skin samples. We do not anticipate any measurable effect of exposing whales to sloughed skin collection and any threats are therefore discountable.

This consultation focused our assessment on the following stressors for which listed species are likely to be exposed and may have a measurable effect: (1) Disturbance from engine noise and physical presence of the vessel, (2) disturbance due to close vessel approaches (including initial approach and revisits following tag attachment), (3) disturbance due to underwater photography and video, (4) disturbance from attaching saddle pack tags and/or harness with towed tags to whale's peduncle using cantilevered or hand-held pole, (5) disturbance from attaching harness with towed tags using net gun deployment system, and (6) disturbance from focal follows and tracking.

Exposure expected in the first year was differentiated from exposure expected for years 2-5 based on the researcher's plans to increase survey effort following the first year and is broken down by stressor type (see **Tables 2a-d** below). In terms of sequential exposure, listed whales are first exposed to engine noise and visual disturbance of the vessel. Whales targeted for tag attachment are then closely approached where they are exposed to tagging attempts and other research activities in conjunction with tagging. Finally, tagged whales are tracked and monitored with focal follows and later re-approached to monitor for the effects of the tag attachment. Only adult and sub-adult male humpbacks would be targeted for tag attachments and no cow-calf pairs of any species would be approached. Fin and/or sei whales would be identified and photographed but would not be tagged. No more than three attempts per day would be made to approach a humpback whale for tag attachment. Individual animals would not be tagged more than once per year; however, repeat tagging between years is possible. We cannot accurately estimate the duration of exposure to tag attachment since this aspect of the research is expected to evolve over the course of the permit period. For example, tags are expected to be deployed in short time intervals (days) initially and would then gradually be increased to several weeks, a month, and finally several months if subsequent tag durations appear to not adversely affect the tagged individual. Subsequent monitoring reports submitted by the researchers may further inform this analysis as well as any future permits issued authorizing these types of tagging procedures.

Likely exposure is difficult to estimate given the fact that little data exists on past efforts given the relatively novel use of the proposed tags on humpbacks and the fact that research is expected to vary across the action area from year to year. Therefore, we are provisionally accepting the take numbers proposed by the Permits Division (broken down by stressor type) although subsequent monitoring reports submitted by the researchers should further inform this analysis. Such data would provide insights into the success rates of the proposed tags, the relative effort conducted by researchers in each ocean basin, and the density of individuals encountered. This data may be utilized in future consultations conducted for similar permit actions conducted in the action area as they become available.

Table 2a. Anticipated Annual Exposure* for Year 1 in the Atlantic Portion of the Action Area (U.S. Exclusive Economic Zone from Maine to Texas)

Species	Sex and Life Stage	Exposure to Engine Noise and Visual Disturbance	Exposure to Close Vessel Approaches (including Re-Visits Following Tag Attachment)	Exposure to Photography and Video (above and underwater)	Exposure to Tagging Attempts using Cantilevered/Hand-Held Pole or Net Gun Deployment System (Maximum 3 per individual per day)	Exposure to Peduncle Saddle Pack Tag or Peduncle-let Harness with Towed Tag Attachment (unspecified duration)	Exposure to Focal Follows and Tracking
Humpback Whales (tagged individuals)	Male Adults and Sub-Adults	50	50	50	50	10	10
Humpback Whales (non-tagged individuals)	All	150	0	0	0	0	0
Fin Whales	All	100	0	0	0	0	0
Sei Whales	All	50	0	0	0	0	0

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Table 2b. Anticipated Annual Exposure for Year 1 in the Pacific Portion of the Action Area (U.S. Exclusive Economic Zone along the coasts of California, Oregon, Washington, Alaska, and Hawaii)

Species	Sex and Life Stage	Exposure to Engine Noise and Visual Disturbance	Exposure to Close Vessel Approaches (including Re-Visits Following Tag Attachment)	Exposure to Photography and Video (above and underwater)	Exposure to Tagging Attempts using Cantilevered/Hand-Held Pole or Net Gun Deployment System (Maximum 3 per individual per day)	Exposure to Peduncle Saddle Pack Tag or Peduncle-let Harness with Towed Tag Attachment (unspecified duration)	Exposure to Focal Follows and Tracking
Humpback Whales (tagged individuals)	Male Adults and Sub-Adults	50	50	50	50	10	10
Humpback Whales (non-tagged individuals)	All	150	0	0	0	0	0
Fin Whales	All	100	0	0	0	0	0
Sei Whales	All	50	0	0	0	0	0

Table 2c. Anticipated Annual Exposure for Years 2-5 in the Atlantic Portion of the Action Area (U.S. Exclusive Economic Zone from Maine to Texas)

Species	Sex and Life Stage	Exposure to Engine Noise and Visual Disturbance	Exposure to Close Vessel Approaches (including Re-Visits Following Tag Attachment)	Exposure to Photography and Video (above and underwater)	Exposure to Tagging Attempts using Cantilevered/Hand-Held Pole or Net Gun Deployment System (Maximum 3 per individual per day)	Exposure to Peduncle Saddle Pack Tag or Peduncle-let Harness with Towed Tag Attachment (unspecified duration)	Exposure to Focal Follows and Tracking
Humpback Whales (tagged individuals)	Male Adults and Sub-Adults	75	75	75	75	15	15
Humpback Whales (non-tagged individuals)	All	225	0	0	0	0	0
Fin Whales	All	100	0	0	0	0	0
Sei Whales	All	50	0	0	0	0	0

Table 2d. Anticipated Annual Exposure for Years 2-5 in the Pacific Portion of the Action Area (U.S. Exclusive Economic Zone along the coasts of California, Oregon, Washington, Alaska, and Hawaii)

Species	Sex and Life Stage	Exposure to Engine Noise and Visual Disturbance	Exposure to Close Vessel Approaches (including Re-Visits Following Tag Attachment)	Exposure to Photography and Video (above and underwater)	Exposure to Tagging Attempts using Cantilevered/Hand-Held Pole or Net Gun Deployment System (Maximum 3 per individual per day)	Exposure to Peduncle Saddle Pack Tag or Peduncle-let Harness with Towed Tag Attachment (unspecified duration)	Exposure to Focal Follows and Tracking
Humpback Whales (tagged individuals)	Male Adults and Sub-Adults	75	75	75	75	15	15
Humpback Whales (non-tagged individuals)	All	225	0	0	0	0	0
Fin Whales	All	100	0	0	0	0	0
Sei Whales	All	50	0	0	0	0	0

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 animals themselves. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal, physiological or behavioral responses expected given the results seen in the literature as well as published and unpublished data on the effects of similar actions. Where information on the responses of the target individuals was lacking, we relied on documented responses of similar species to serve as a proxy for our analysis.

Behavioral Responses to Engine Noise and Close Vessel Approaches
Vessel surveys and close approaches have the potential to disturb listed whale species and induce behavioral and physiological stress to whales targeted by the approach as well as other whales in the vicinity of the vessel (such as non-tagged humpback, fin, and sei whales). Detection of vessel noise is dependent on several factors, including weather, vessel engine type and size, habituation, and other ambient noise. The sound generated by the research vessels is expected to be at higher frequencies than larger vessels like supply ships, container/cargo ships, and cruise vessels operating in the action area (OSPAR, 2009). Since large cetaceans tend to hear and vocalize at lower frequencies, the contribution of marine ambient noise generated by the research vessels is expected to be minimal and would not adversely affect listed whales' ability to hear mates and other conspecifics but may induce behavioral reactions as described below.

Whales may respond differently to vessel surveys depending on what behavior the animals are engaged in before the vessel approaches (Würsig et al., 1998; Hooker et al., 2001; Jahoda et al., 2003) and the degree to which they become accustomed to vessel traffic (Lusseau, 2004; Richter et al., 2006). Reactions include little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation, diving and time spent submerged, foraging, respiratory patterns, and also may include aerial displays like breaching and/or lobtailing (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005). Reactions to vessel noise have been observed when engines are started at distances of 3,000 feet or less (Malme et al., 1983; Richardson et al., 1995), suggesting that some level of disturbance may result even if the vessel does not undergo a close approach. In addition, changes in whale behavior have also been reported to correspond to vessel speed, size, and distance from the whale, as well as the number of vessels operating in the proximity (Baker et al., 1988; Koehler, 2006).

For humpback whales, studies on summering grounds as summarized by Baker and Herman (1989) and Baker et al. (1983), and on wintering grounds as summarized by Bauer (1986), found patterns of disturbance in response to vessel activity that indicate such approaches are probably stressful to some individuals. Baker et al. (1983) described two responses of whales to vessels, including: (1) "horizontal avoidance" of vessels 2,000 to 4,000 meters away characterized by faster swimming and fewer long dives; and (2) "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 (e.g., Au and Green, 2000; Scheidat et al., 2004; Koehler, 2006), with some evidence that swimming speed then decreased after boats left the area.

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-calf pairs. Smaller pods and pods with calves also seem more responsive to approaching vessels (Bauer, 1986; Bauer and Herman, 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 strong responses that might indicate stress.

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 (or 16-33 ft) for approximately one hour for 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 the 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 fin whales to vessel disturbance cannot be ruled out, but concluded that approaching vessels maneuvering at low speeds were less likely to cause visible reactions than those approaching at higher speeds.

Best et al. (2005) conducted a study on the responses of southern right whale adults and calves (including neonates) to close approaches for the purposes of biopsy sampling off South Africa and found no evidence that these approaches affected calf survival, caused whales to emigrate outside the area, or curtailed reproduction in females; however, the authors note the power of the statistical tests for this conclusion was low. The authors conducted repeat approaches on 20 cow-calf pairs and were unable to detect a trend of increased or decreased sensitivity of calves to the approach and that resightings of approached whales that underwent sampling have been documented and so far provide no evidence of any long-term effects such as abandonment of important habitat or reductions in reproductive success (Best et al., 2005).

NMFS expects that the slow converging course technique employed by the researchers should minimize the stress response of the approached whales for purposes of tagging, behavioral observation, and photographs and video to be conducted above and below the surface. Also, while temporary changes in whale behavior may occur as the whale reacts to the approaching vessel, the literature suggests these reactions are expected to be short in duration and that the whales would resume normal behavior after the approach consistent with the literature (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005).

Behavioral Responses of Tag Deployment

Adult and sub-adult male humpback whales would be exposed to two different types of tagging activities and two different deployment procedures. Saddle pack tags would be deployed by closely approaching target whales (within 10 m) and attaching the tags to the peduncle using a cantilevered or hand-held pole. Peduncle-let harness with towed tether tags may be deployed using similar techniques (pole delivered) or by way of a net gun deployment system that would attempt to attach the tag to the whales peduncle by a type of "lasso" technique of firing the tow line at the point a whale flukes out. Up to three repeat tagging attempts would occur per individual per day for all tagging activities and only one type of tag would be attached at a time.

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. Although these experiments represent the first use of a peduncle belt attachment on large cetaceans, animals tagged with suction cup attached tags have been reported to typically respond with a quick startle followed by a short dive (Hooker and Baird, 1999). The whales then fairly quickly fall into typical swim patterns that are seen throughout the rest of the tag record, such as similar velocity, dive times/depths, and surface times, etc. (Hooker and Baird, 1999; Hooker et al., 2001). 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 (Goodyear, 1981; Watkins et al., 1981; Watkins et al., 1984; Goodyear, 1989; Goodyear, 1993; Baird, 1994; Mate et al., 1997; Mate et al., 1998; Hooker et al., 2001). Infrequently, aerial displays like breaching are also noted (Goodyear, 1989); and Mate et al. (2007) reports other infrequent behavioral responses such as 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).

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. After all tagging attempts, the author noted that pre-tagging behavior resumed within a few minutes. Baird et al. (2000) tagged humpback whales using suction-cup tags and reported that reactions to tagging occurred in only 5 of 31 tagging attempts (17 percent). Two of these were low-level behavioral responses, and three were moderate responses. The authors did not observe any strong responses to suction-cup tagging during the study.

To date three field seasons involving tagging using the peduncle-let harness with towed tether tag have been conducted on humpback whales in the Bay of Fundy, Canada by the researchers involved with this proposed action. In total, 18 attempts were conducted in 2009, 7 attempts were conducted in 2010, and 5 attempts were conducted in 2011. A total of 46 behavioral reactions were recorded across the three field seasons and included in field season reports submitted to Fisheries and Oceans Canada. Reactions were recorded for both whales targeted by the attempt as well as any companion whales located at the surface at the time of the attempt. Researchers grouped behavioral reactions into the following categories based on the intensity and duration of the reaction: (1) No reaction, (2) low level reaction, (3) moderate reaction, and (4) strong reaction. "No reaction" meant that the whale exhibited a continuation of pre-tagging activities without observable behavioral change. "Low level" reactions meant the whale exhibited a low energy response such as a minor tail flick, slight increase in swim speed, aborted surfacing, or fluke out. "Moderate" reactions meant the whale exhibited a higher energy response such as a hard tail flick, rapidly aborted fluke out, or head lunge. "Strong" reactions meant the whale exhibited continued high-energy displays in response to the tagging attempt (e.g., multiple breaches, tail lobs, etc.). The researchers provided reaction data in the package of information submitted to the Permits Division which showed that 14 (or 30 percent) of whales exhibited no reaction, 25 (or 54 percent) exhibited a low-level reaction, 4 (or 7 percent) exhibited a moderate reaction, and 2 (or 4 percent) exhibited a strong reaction to the tagging attempts.

Researchers noted that whales proved sensitive to the touch of the line and were quite adept at "ducking" the loop. Prior to the field effort, it was anticipated that the whales would respond to the touch of a line on their peduncle or back with a high fluke out and accelerated dive forward and away from the boat. Instead, the typical response elicited was an extremely agile readjustment of posture in such a way as to suck the contacting portion of the body down and away from the line and to instantaneously abort the fluke out. If the tail was already out of the water and the line landed across the fluke blade or hooked on the trailing edge, the whales were quite adept at dislodging the line with a slight flick of the fluke tip. The difference in the response intensity appeared to be directly related to whether or not the line contacted the whale. Line touches on the back or fluke typically resulted in a low level response (e.g., minor tail flick, aborted fluke out, slight acceleration, etc.) whereas if the line fell in the water around the body without contacting the whale, there generally was no noticeable response. Animals also appeared to respond to the sound of the shot as much as to the touch of the line which was supported by the fact that companion animals at the surface often reacted despite not being touched by the tag lines.

In the case of a moderate reaction observed in 2011, a tag attempt resulted in the whale swiping its tail downward, contacting the harness line and triggering the breakaway system. A large white water fluke print indicative of a strong fluke stroking appeared under the bow of the boat and again 60 yards ahead. Researchers noted that the whale gradually slowed, resuming its typical slow travel, pre-tagging dive pattern behavior 17 minutes after the tagging attempt. There was also one instance in 2010 where both the target whale and its companion showed a delayed, but strong reaction separating from each other after a brief time and suddenly breaching simultaneously. They performed multiple breaches and tail lobs with trumpet blows then moved back toward one another with tail swishes at the surface. Towards the end of the display, the whales performed another 5 minute dive, surfacing with some flipper slapping before returning to their pre-tagging slow travel behavior.

Despite the limited data on responses of large cetaceans to peduncle tagging, reactions of other forms of tagging indicate that the reactions of whales are frequently mild and quickly followed by a return to “normal behavior” within a “short time” (Watkins, 1981; Watkins et al., 1981; Watkins and Tyack, 1991; Mate et al., 2007; Weller, 2008) similar to the reactions seen for the initial field trials. Therefore, while we anticipate that some whales exposed to tagging attempts may respond with some moderate to strong responses such as multiple breaches, tail lobs, and trumpet blows, we anticipate that all whales exposed to tagging attempts would be expected to return to pre-tagging behaviors a short time (less than 20 min) following this response consistent with the responses seen in the literature for other types of tagging as well as in the initial field trials conducted by the researchers in the Bay of Fundy, Canada, during field trials.

Physical Responses of Tag Attachment

The attachment of the tagging devices to the whale’s peduncle has the potential to generate physiological effects, depending on factors such as device weight, shape, and attachment location (White and Garrot, 1990; Hawkins, 2004). Attached tagging devices may cause abrasion and/or infection at the tag attachment site, may result in increased energy expenditure of the tagged whale during normal swimming activities due to the increased drag, and also may result in unexpected entanglement if the whale were to doubleback on itself or cause entanglement of any companion whales during social or reproductive activities. The latter response would be expected to be most concerning given that serious injury and death due to entanglement is one of the major threats to listed whale populations worldwide. We reviewed information submitted by the researchers on past tagging efforts, the mitigation measures and permit conditions proposed, and the responses seen in the literature for tests performed on fluke samples or responses recorded for other species fitted with similar tag types to determine responses reasonably expected to occur.

Saddle pack and harnesses attached to the peduncle of humpback whales may cause localized abrasion and infection at the attachment site which may be detrimental to the health of the tagged whale for as a long as the tags remain attached. In a recent study evaluating the factors influencing the depth and severity of wounds generated during whale entanglements, Winn et al., (2008) demonstrated that draw-length, or linear motion of the entangling line relative to the skin tissue, is one of the key factors in determining whether a line will cut into the tissues or benignly press against the skin. The authors note that abrasive testing of fishing gear on fluke samples suggests that the tissue exhibits a pliant ability to deform in response to a shear load, but yet readily return to its original state when the load is removed. This tissue compliance appears to limit the abrasive impact of the test line by preventing it from sliding across the epidermal surface. It is anticipated that this natural skin compliance will tend to absorb any rocking motion of the saddle or slippage of the harness due to normal swimming activity and prevent motion of the belt relative to the skin, keeping total chafing of the peduncle at a minimum. The following information provided by the applicant provides additional examples of physical responses at the tag site:

1) Beamish (1978) tethered a humpback to shore using a “padded harness” around the peduncle just in front of the flukes for a period of 29 days. The resultant publication does not detail the “padded harness”, but recent discussions with two participants in the study, Scott Kraus and Joseph Geraci, revealed that the tether could have been a 1-2 inch diameter hawser. No chafing of the tail stock was recalled by either individual.

2) In 2002, Moore towed a dead 14.65-m sperm whale by the tail at 8 knots, 60 miles from Nantucket to New Bedford using a 4 inch cargo strap wrapped around the peduncle. There was no damage to the skin except where the tow line was oscillating on the moving fluke blade (Moore, unpublished necropsy report, June 7, 2002). The proposed peduncle belt attachment mechanisms are not expected to contact the fluke blade which should avoid this type of physical damage to the targeted whales.

3) In 2003, a dead 13.7 m North Atlantic right whale was towed by the tail by a 50 ft dragger at a speed of 3 knots. The whale was secured using a 1 ¼ inch nylon line tied tightly with a bowline onto itself to make a choke knot around the peduncle just in front of the fluke insertion. The carcass was missing the skin at the onset, but a post-towing inspection of the line anchor point showed only a moderate compression furrow with minimal chafing of the dermis despite 12 hours of towing into a 35 knot gale in the Bay of Fundy (Moore, unpublished necropsy report, Oct. 4, 2003).

4) Woodward et al. (2006) developed an abrasion tester to simulate the action of a tail harness on the leading edge of the fluke. A fluke tissue sample was obtained from an adult stranded right whale. The outer sleeve of a 1 inch double braided nylon rope was looped around the leading edge of the fluke specimen that was firmly clamped in a small static sea water tank. Both ends of the harness were clipped into a caribener which hung below a driving sleigh. This simulated a loose loop around the peduncle. A second line attached the caribener to a driving sleigh which slid 6 inches back and forth along a rail, wiggling the bitter end of the line in a manner intended to induce a back and forth sawing motion on the tissue. This setup mimicked a harness encircling the peduncle with a telemetry buoy trailing at a distance behind the whale. The fluke tissue showed a substantial amount of flexure and compliance even though the sample was firmly clamped in the static sea water tank. There was very little movement of the harness in relation to the skin tissues, suggesting that the frictional force of the harness against the skin and the compliance of the tissue itself were sufficient to prevent the harness from slipping back and forth and sawing on the skin tissues. An accelerated test (60 strokes/minute) was run over a 36 hour period using 20 lbs. of weight on the test system. This sawing rate is roughly 5 times the normal fluke stroke rate for a right whale (Nowacek et al., 2001) and would be indicative of approximately 7 days of normal swimming. There was no apparent abrasion to the fluke tissue, just a slight polishing of the surface and a compression mark where the harness contacted the skin (see **Figure 4** below). A little bit of bubbling of the skin was seen within the harness track. However, this bubbling was apparent in untested portions of the fluke sample as well.

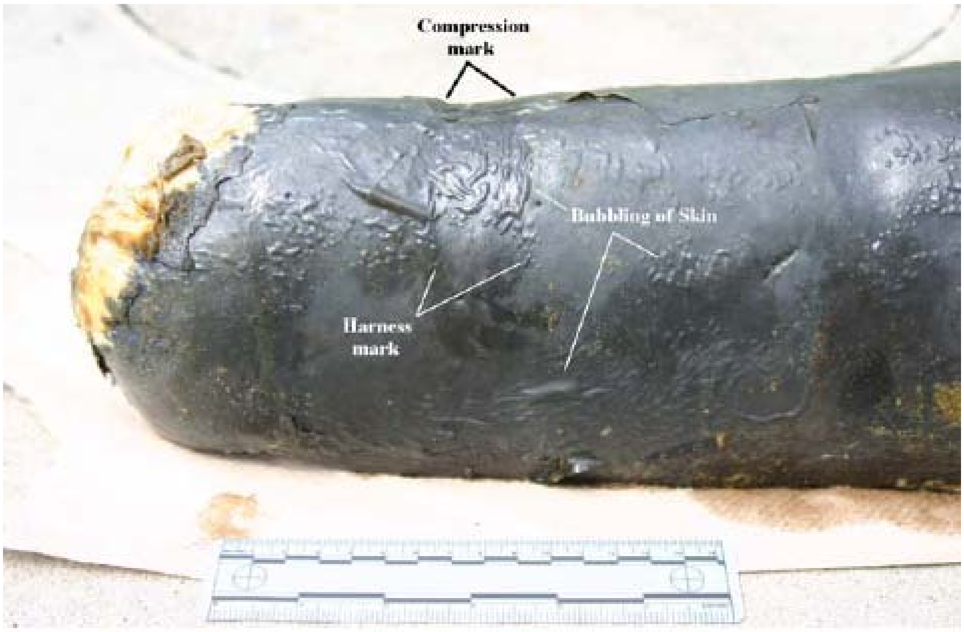

Figure 4. Compression mark left after 36+ hour accelerated abrasion test using 1" Yalon harness. Figure included in the initiation package sent to the ESA Interagency Cooperation Division on November 14, 2011. Photo Source: Becky Woodward, Woods Hole Oceanographic Institution.

Based on a review of the available literature, we anticipate that humpback whales fitted with saddle pack and harness with towed tags are expected to undergo some minor skin abrasion and compression of the skin at the attachment site that may result in some localized callusing or minor scarring once the harnesses are removed. It is expected that this minor scarring would eventually heal a short time after the tags are removed. Researchers are proposing to revisit tagged whales in order to monitor the whale's health as well as to document the physical and behavioral effects of the tagging procedure, especially in the early stages of the research. If it appeared from photographs taken of the tail stock that the tags were causing unintentional harm such as the harness embedding in the flesh, evidence of hemorrhaging, or any presence of a circumferential ulcer or loss of epithelium then researchers will contact the local disentanglement network and work with them to remove the tags from the affected whale to minimize this effect and avoid further compromising the health of the whale.

In addition to physical abrasions at the attachment site, tagged whales may also be affected from the increased drag caused by the tagging apparatus. 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, meaning that the weight and size of the device may be of less concern for larger cetaceans such as adult humpbacks than they would be for smaller non-listed cetaceans also proposed to be tagged in the study. Although the size and weight of the saddle pack or towed tag would vary according to the electronics package, the unit would be scaled according to the size of the target species. Researchers anticipate the relative size of the peduncle type tags compared to the size of the animal to be similar to that of a watch on a human wrist. The towed buoy and electronics package weighs 35 lbs in air and has a reserve buoyancy of 17lbs. When towed at a speed of 4 knots via a submerged tow point, which simulates a whale swimming just below the surface, the prototype buoy has approximately 20 lbs of drag with a 60 ft long 3/8 inch diameter tow tether. Tow speeds tested ranged from 1 knot (3.5 lbs. drag) up to 5 knots (25lbs of drag). This drag is roughly 40 percent less than the drag of the Disentanglement ball buoy that has been used on numerous entangled right and humpback whales. The low drag generated by either tag may cause increased energy expenditure as the duration of tag attachment increases during the study. However, researchers will monitor the health of the tagged whales during revisits and will remove the tag if the whale appeared to exhibit significant weight loss that could be evidence of interrupted feeding and/or increased energy burdens.

Attachment of peduncle-let harness with towed tags to humpback whales may also cause entanglement for the tagged whale itself or companion whales located in the vicinity for as long as the tag remains attached. The tagged whale may become entangled if has a strong reaction to the tag attempts and/or doublebacks or swims through the lines trailing the whale. They may also be entangled if the whale were to encounter fishing gear or other debris that may become attached to either the trailing lines or the harness itself. In addition, companion whales become entangled if they swim the lines trailing the tagged whale during social interactions or reproductive activities.

Most fatal entanglements in commercial fishing gear involve high strength lines that run through the mouth or wrap around the body or a body part. To minimize this entanglement risk, the tow tether is designed to have a low strength line (starting with a 200 lbs breaking strength, increased if necessary up to a maximum of 500 lbs. breaking strength) that can be easily broken by the tagged whale in the event that the whale swims through its own line or if a companion whale interacts with the towed line. During field trials conducted in the Bay of Fundy, the lines were easily broken and detached by whales that exhibited moderate to strong responses to tagging attempts as discussed in the previous section and it is expected that similar responses would occur should the whale interact with the towed lines in this proposed study as well. In addition to a low strength tow line, the harness itself has a low strength breakaway link if the harness itself were to attach to any debris encountered by the whale. The USFWS has used a similar attachment method with manatees for three decades and noted that weak links incorporated into the system were successful as a release mechanism as tags were frequently detached when entangled in vegetation or dock pilings (Rathbun et al., 1987; Reid et al., 1995; Deutsch et al., 1998).

In addition to low strength breakaway links, the towed tag is expected to trail at a maximum distance of 40 feet (approximately one body length) behind the whale which is shorter in length than has been typically utilized in towed tag deployments conducted by the Large Whale Disentanglement Network (50-120 ft or more) for which no entanglements have been observed thus far (CCS, unpublished[14]). Given these mitigation measures and past observations we do not anticipate any entanglement resulting in mortality or serious injury. Temporarily entanglement may occur before the breakaway links are engaged which may result in stress responses similar to those anticipated from the tagging attempt. Researchers will monitor the health of the whales before and after tag attachment and will respond to any unforeseen entanglement events by contacting the local disentanglement network and assisting them in removing the tags as necessary.

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14 Data obtained at: http://www.coastalstudies.org/what-we-do/whale-rescue/previous-rescues.htm. Accessed February 29th, 2012.

Behavioral Responses to Focal Follows and Tracking
Focal follows would be used to relate data on the tag to observed surface behaviors of the whales following tag deployment. These follows are typically conducted from a distance of 100-500 m from the animal, depending on weather conditions and visibility from the platform. Whales may respond to focal follows and tracking similarly to vessel surveys including little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation, diving and time spent submerged, etc (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005). However, whales exposed to focal follows and tracking have already been closely approached and fitted with either a saddle pack tag or a peduncle-let harness with towed tag, both of which are anticipated to elicit a stronger behavioral response than tracking a whale at a distance beyond 100m. We do not believe that focal follows and tracking would elicit a measurable response to tagged whales separate from and/or beyond those already anticipated from the approach itself.

Risk Analysis
Our risk analyses reflect 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 given their exposure to the action's effects and the likely responses given that exposure. Ideally, risk analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences. We then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses then determine the consequences those population-level risks have to the species as a whole. Our final jeopardy 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. For more information the specific parameters used to evaluate risk at each phase, please refer to the *Approach to the Assessment* section of this Opinion.

Fin and Sei Whales
Based on a review of available information, we would expect listed fin and sei whales exposed to vessel surveys under the proposed permit to exhibit either no visible response or short-term behavioral responses similar to those seen for predator avoidance. We assume vessel surveys targeting humpback whales conducted under the proposed permit might be stressful for some fin and/or sei whale individuals, and might temporarily interrupt behaviors such as foraging, but evidence in the literature for similar actions (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005) suggests that responses are expected to be short-lived. Assuming an animal is no longer disturbed after it responds to the presence of the vessel, we do not expect long-term adverse fitness consequences for fin and/or sei whale individuals exposed to the activities authorized in the proposed permit. Since we do not anticipate any long term fitness consequences for individuals, we do not, in turn, anticipate adverse consequences for the populations those individuals represent or the species for which those populations comprise.

Humpback Whales
For humpback whales located in the general vicinity of research activities but not exposed to tagging, we expect similar responses for fin and sei whales including short term stress and

temporary avoidance of the of the vessel that would not be expected to result in any long-term fitness consequences for individuals. A maximum of 75 humpback whales would be exposed annually to close approaches and tagging attempts of which a maximum of 15 individuals would be fitted with either a peduncle saddle pack tag or a peduncle-let harness with towed tag. Exposure to close approaches and tagging attempts would occur for whales targeted for tagging (adult and sub-adult males) and any companion individuals located near the target individual. Reactions to close approaches include little to no change in behavior to momentary changes in swimming speed, pattern, orientation, diving and time spent submerged, foraging respiratory patterns, and also may include aerial displays such as breaching and/or lobtailing (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005). NMFS anticipates the slow, converging course technique proposed by the researchers should minimize the stress response of the whales to the close vessel approach given observations seen in the recent past as well as observations reported in the literature (e.g., Clapham and Mattila, 1993; Best et al., 2005).

Pole-delivered tagging attempts are expected to result in behavioral reactions similar to those already occurring from the approach itself. The net gun deployment technique may result in additional reactions due to the sound of the gun in addition to the ropes coming in contact with the whale after firing. Past data on effects is limited to the initial field trials conducted by the researchers in the Bay of Fundy, Canada, from 2009-2011 for which researchers exposed wild humpbacks to the peduncle-let harness with towed tag deployment technique. As discussed in the *Response Analysis* conducted for this Opinion, of the total 46 humpback whales exposed during those field trials, 30 percent exhibited no reaction, 54 percent exhibited low-level reactions (e.g., minor tail flick, slight increase in swim speed, etc.), 7 percent exhibited moderate reactions (e.g., hard tail flick, rapidly aborted fluke out, head lunge, etc.), and 4 percent exhibited strong reactions (e.g., high energy displays, multiple breaches, tail lobs, etc.). Applying these response ratios to the proposed action, we expect that 9 of the 75 exposures each year would likely result in a moderate to strong behavioral response to the tagging attempt. These higher energy responses would impact the animal's energy budget that would normally be used for other essential behaviors such as feeding, swimming, and/or reproduction.

While these behavioral responses would likely impact an individual's fitness in the short term, a review of the literature suggests that repeat exposures are not likely to result in any long term fitness consequence (e.g., impacts to growth, survival, and lifetime reproductive success, etc.). For example, Glockner-Ferrari and Ferrari (2006) noted several female humpback whales that had been subjected to close vessel approaches multiple times over a 20 year period were resighted in the same area and were known to have reproduced several times suggesting that the multiple approaches did not affect survival and/or reproduction. Best et al. (2005) conducted repeat approaches on 20 North Atlantic right whale cow-calf pairs and were unable to detect a trend of increased or decreased sensitivity of calves to the approach and noted that the same whales were resighted in subsequent years. Best and Mate (2007) examined sighting patterns and reproductive intervals for southern right whales tagged off South Africa and found that six of seven reproductive females that were resighted post-tagging had given birth to a new calf and exhibited calving intervals that were similar to untagged whales, supporting the null hypothesis of no major effect on the reproductive success of adult females or (by inference) the survival of their calves. While we cannot definitively know whether repeat exposures to close approaches and/or tagging attempts have longer term consequences (as many responses would be sub-lethal and/or difficult to detect), a review of the literature suggests that individuals subjected to repeat exposures are resighted with no apparent interruptions to survival and reproductive success, suggesting no long-term adverse fitness consequences.

In addition to behavioral effects, we also considered the physical risks associated with attaching the saddle pack and harness with towed tags to humpback whales. With any "collar" or belt, there is always a possibility that epidermal abrasion may occur at the attachment site. However, as discussed in the *Response Analysis*, previous tests on fluke tissues suggests that the proposed tags would cause only minor abrasion and compression of the skin at the attachment site that should gradually return to normal after the tags are removed (see Beamish, 1978; Woodward et al., 2006). Researchers are proposing to monitor the health of the tagged whales with repeat visits and will take multiple photographs of the tail stock to monitor for any evidence of tissue damage or hemorrhaging at the attachment site. If photographs show any physical effects beyond minor skin abrasion and/or compression, researchers will remove the tags with assistance from local disentanglement networks where possible to minimize any long term physical injury to the affected whale. The applicant anticipates that a saddle pack tag could be cut off using a hook knife on a hand pole and the tether of a towed tag could be grappled and tension applied to the line until the harness breakaway link engages and the unit detaches from the whale. Based on these mitigation measures, we do not expect tag attachment to have any long term fitness consequences for individuals.

The increased drag that could occur from the tags may impact an animal's energy budget for as long as the tags remain attached. Researchers intend to slowly increase the tag duration from days to weeks to months provided that the increased duration does not appear to affect the health of the tagged individual. Researchers will monitor the whale's health through repeat visits and the proposed permit includes a condition that tags be removed if there is evidence of significant weight loss of the tagged individual. Weight loss may suggest the tag may be significantly burdening the whale and affecting its ability to feed. Only adult or sub-adult males will be fitted with tags so no females or calves would be exposed to these effects. The maximum drag from the tags is expected to be 20 lbs for a whale traveling at 4 knots underneath the surface which is 40 percent less than the drag created by disentanglement ball buoys that are commonly used to disentangle large whales. The energy burdens would be greater as the duration of tag attachment is increased during the study. However, we do not anticipate any long term fitness consequences given the fact that only larger males would be fitted with the tags (which should lessen the device to body weight ratio) and the fact that researchers will remove the tags if any significant weight loss is observed during revisits. Also, the permit is expected to require annual reauthorization which should help minimize health risks by requiring a thorough review of the previous year's tagging activities before continuing. Based on these mitigation measures, we do not anticipate any long term fitness consequences to result from the increased drag generated by the proposed tags.

We also assessed the risk of entanglement for both the tagged whales and any companion whales that could swim through the lines. Entanglement can cause physical injury or even death in large whales if lines become wrapped around appendages or continually cut through the whale's skin as it swims. Most entanglements occur from whales encountering high strength lines used for commercial fishing activities. Researchers intend to minimize the entanglement risk by using lower strength lines (200-500 breaking strength) for both the harness and the tow tether that can be easily broken by the whale or release if the lines get caught on debris. As discussed in the *Response Analysis*, whales were observed breaking lines during unsuccessful tagging attempts conducted during field trials and previous studies using similar tags on manatees showed the release mechanisms frequently detached when they were caught on vegetation or rock pilings (see Rathburn et al., 1987; Reid et al., 1995; Deutsch et al., 1998). Whales tagged in the Pacific are expected to have a greater chance of encountering debris during the permit period due to the large amount of debris that was scattered into the western Pacific as a result of the earthquake and tsunami that occurred in Japan in March of 2011 (see the *Environment Baseline* section of this Opinion for more information). However, the low strength lines are expected to break easily if they were to get caught on any large debris consistent with the observations seen in the prior studies. Tagged animals would be closely monitored and in the event of an emergency, the regional disentanglement network would be contacted to aid in removal of the tag from the whale to the extent possible. Given these mitigation measures, we expect it highly unlikely that unintentional serious injury or death from entanglement would occur for any individuals tagged during the study.

In summary, we anticipate that research activities may result in short term fitness consequences for exposed individuals but are not likely to result in any long term consequences such as mortality, serious injury, or disruption of essential behaviors such as feeding, mating, or nursing, to a degree that the individual's likelihood of successful reproduction or survival would be substantially reduced. Since we do not anticipate any long term fitness consequences for individuals, we do not, in turn, anticipate adverse consequences for the populations those individuals represent or the species for which those populations comprise.

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 in this Opinion. Future Federal actions, including research authorized under ESA Section 10(a)1(A), 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. Future cumulative effects from these and other types of federal actions will be investigated in future consultations, most notably in the *Status of the Species* and *Environmental Baseline* sections of Opinions which inform the effects analyses for specific federal actions. Other possible effects that may be acting in conjunction with federal actions and could possibly contribute to a cumulative impact on listed species are described below.

NMFS expects the natural phenomena (e.g., disease, predation, stochastic events such as strandings, etc.) will continue to influence humpback, fin, and sei whale populations in the action area as described in the *Environmental Baseline* section of this Opinion. Climatic variability has the potential to affect listed species in the action area in the future; however, the prediction of any specific effects leading to a decision on the future survival and recovery of listed species is currently speculative. Nevertheless, possible effects of climatic variability for listed whales include the alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, alterations to prey composition and altered timing of breeding (MacLeod et al., 2005; Robinson et al., 2005; Kintisch, 2006; Learmonth et al., 2006; McMahon and Hays, 2006).

We also expect anthropogenic effects described in the *Environmental Baseline* will continue, including habitat degradation, vessel traffic and risk of ship strikes, interactions with fishing gear, and tourism activities. Expected increases in vessel traffic would further increase collision risks for large whales by the increased traffic itself and/or through habituation of whales to the sounds of oncoming traffic making them more prone to being struck. The number of vessels and tonnage of goods shipped by the U.S. fleet are increasing (e.g. there has been nearly a 30 percent increase in volume between 1980 and 2000) (NRC, 2003) and will lead to more vessel traffic throughout the action area in the future. The primary concern of increased levels of shipping noise expected from increased vessel traffic is not related to acute exposures, but rather to the general increase in continuous background ambient noise and the potential masking of marine animals' communication systems, their ability to hear mating calls, and their ability to pick up acoustic environmental cues that animals use to navigate and/or sense their surroundings, including sounds that are used to detect predators (OSPAR, 2009). Expanded use of commercial sonars is also expected to increase, further exacerbating these effects (NRC, 2003).

Due to insufficient information on future management regimes associated with commercial and recreational fisheries, we cannot estimate the probability of future injuries or deaths of listed whales due to interactions with these fisheries. However, given whale interactions with fisheries in the action area during the recent past, such interactions remain a major threat to the survival and recovery of listed whale species in the action area.

As the size of human communities increase, there is an accompanying increase in habitat alterations resulting from an increase in housing, roads, commercial facilities, and other infrastructure that result in increased discharge of sediments and pollution into the marine environment. These activities are expected to continue to degrade the habitat of listed whales as well as that of the prey on which they depend.

Additionally, unrelated factors may be acting together to affect listed species and/or the conservation value of designated critical habitat. For example, vessel effects combined with the stresses of reduced prey availability or increased contaminant loads may reduce foraging success and lead to chronic energy imbalances and poorer reproductive success which all may work to lower an animal's ability to suppress disease (Williams et al., 2002b; NMFS, 2008). The net effect of these disturbances is dependent on the size and percentage of the population affected, the ecological importance of the disturbed area to the animals, the parameters that influence an animal's sensitivity to disturbance or the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980). More studies need to be done to identify the long term effects to listed whales and critical habitat from current stressors as well as the potential additive effect that multiple stressors acting in conjunction over time will have on the survival and recovery of listed whales.

After reviewing the available information, NMFS is not aware of any additional future non-federal activities or potential stressors acting in the action area that would not require federal authorization or funding and are reasonably certain to occur during the foreseeable future and could contribute to a cumulative impact on listed species in the action area.

INTEGRATION AND SYNTHESIS OF EFFECTS

The following text integrates and synthesizes the *Description of the Action, Approach to the Assessment, Status of the Species, Environmental Baseline, Effects of the Proposed Action, and Cumulative Effects* sections of this Biological and Conference Opinion. This information was used to assess the effects and subsequent risks the proposed action poses to ESA-listed humpback, fin, and sei whales.

As explained in the *Approach to the Assessment* section, risks to listed individuals are measured using changes to an individual's "fitness." 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; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). When individuals of listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions can reduce the abundance, reproduction, or growth rates of the populations that those individuals represent (see Stearns, 1992). If we determine that reductions in individual plants' or animals' fitness reduce a population's viability, we consider all available information to determine whether these reductions are likely to appreciably reduce the viability of the species as a whole.

The Permits Division proposes to issue scientific research permit No. 14118 to Becky Woodward of Woods Hole Oceanographic Institution for cetacean research to be conducted in the Atlantic and Pacific Oceans within the U.S. EEZ. Research activities to be authorized include tagging, photo-identification, behavioral observations, tracking and monitoring, passive acoustics, photography and video both above and under water, and collection of sloughed skin. Takes to listed humpback, fin, and sei whales are expected to be in the form of harassment. Research objectives include studying the long-term movement and habitat use of humpback whales, conducting medium term acoustic studies by examining transmitted and received sounds, and investigating the fine-scale behavioral ecology of the targeted species using multi-sensor data recording packages. No direct mortality of listed species is authorized or expected. Tagging of male sub-adult or adult humpback whales will be conducted using two different types of tag packages: (1) a peduncle saddle pack tag delivered by cantilevered or handheld pole with a spring-loaded or pneumatically powered armature and (2) a peduncle-let harness and towed tag delivered by pole or by a net gun system to be used to throw a "lasso" around the tail stock. Researchers are proposing to tag no more than 10 humpback adult or sub-adult males in each region in the first year in order to obtain initial feedback on tag retention and performance as well as the effects to listed species. After the first year, researchers anticipate expanding their effort (i.e., up to 15 humpbacks in both regions plus additional non-targeted takes of humpback, fin, and sei whales that may be located in the vicinity of tagging activities).

Historically, humpback, fin, and sei whale populations worldwide were severely affected by commercial whaling in the 20^{th} century in the North Atlantic, North Pacific, and Southern oceans. The main stressors affecting the ability of fin and humpback whales to recover include ongoing effects from prior commercial whaling, interaction with fishing gear, ship strikes, and various sources of habitat degradation. Taken together, the components of the environmental baseline for the action area include sources of natural mortality such as predation, disease, and parasites as well as influences from natural oceanographic and climatic features. The baseline also includes human activities resulting in disturbance, injury, or mortality of individuals. These activities include habitat degradation (e.g., due to contaminants); vessel traffic and risk of ship strikes; entrapment or entanglement in fishing gear; increasing ambient background noise from shipping and boating as well as pulse noise sources such as under water blasting, sonar, seismic surveys and other military activities; and harassment from other permitted scientific research activities.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, natural mortality) will continue to influence listed species in the action area. Climatic variability has the potential to affect listed species in the action area through alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, alterations to prey composition and altered timing of breeding (MacLeod et al., 2005; Robinson et al., 2005; Kintisch, 2006; Learmonth et al., 2006; McMahon and Hays, 2006). We also expect anthropogenic effects to continue as well. The net effect of these disturbances (or cumulative effect) is dependent on the size and percentage of the population affected, the ecological importance of the disturbed area to the animals, the parameters that influence an animal's sensitivity to disturbance, or the accommodation time in response to the prolonged disturbance (Geraci and St. Aubin, 1980). More studies need to be done to identify the long term effects to listed whales from current stressors as well as the potential additive effect that multiple stressors acting in conjunction over time have on the survival and recovery of listed whales in the action area.

For this consultation, we were 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 consequences. The proposed permit would authorize non-lethal "takes" by harassment of listed species during tagging of male adult or sub-adult humpback whales as well as other approaches for photo-identification and video. In terms of sequential exposure, listed whales are first exposed to engine noise and the visual disturbance of the vessel. Whales targeted for tag attachment are then closely approached where they are exposed to tagging attempts and other research activities in conjunction with tagging. Finally, tagged whales are tracked and monitored with focal follows and later re-approached to monitor for the effects of the tag attachment. After reviewing the best available information, we assessed exposure at the levels proposed by the Permits Division. Therefore, we expect that for year one, a maximum of 50 humpbacks in each region (Atlantic and Pacific) would be exposed to close approaches and tagging attempts with 10 humpbacks successfully fitted with tags. In addition, 150 humpbacks, 100 fin, and 50 sei whales would be exposed to engine noise and visual disturbance. For years 2-5, the exposure would increase due to the expected increase in research effort. Therefore, 75 humpbacks would be exposed annually in each region to close approaches and tagging attempts with 15 humpbacks successfully fitted with tags. In addition, 225 humpbacks, 100 fin, and 50 sei would be exposed to engine noise and visual disturbance annually as well during those years.

Whales may respond differently to vessel surveys depending on what behavior the animals are engaged in before the vessel approaches (Würsig et al., 1998; Hooker et al., 2001; Jahoda et al., 2003) and the degree to which they become accustomed to vessel traffic (Lusseau, 2004; Richter et al., 2006). Documented reactions include little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation, diving and time spent submerged, foraging, respiratory patterns, and also may include aerial displays like breaching and/or lobtailing (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005). While temporary changes in whale behavior may occur as the whale reacts to the approaching vessel, the literature suggests these reactions are expected to be short in duration and that the whales would resume normal behavior after the approach consistent with the literature (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005).

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 (Goodyear, 1981; Watkins et al., 1981; Watkins et al., 1984; Goodyear, 1989; Goodyear, 1993; Baird, 1994; Mate et al., 1997; Mate et al., 1998; Hooker et al., 2001). Reaction data from initial field trials showed that 14 (or 30 percent) of whales exhibited no reaction, 25 (or 54 percent) exhibited a low-level reaction, 4 (or 7 percent) exhibited a moderate reaction, and 2 (or 4 percent) exhibited a strong reaction to the peduncle-let harness with towed tag package. Despite the limited data on responses of large cetaceans to peduncle tagging, reactions of other forms of tagging indicate that the reactions of whales are frequently mild and quickly followed by a return to "normal behavior" within a "short time" (Watkins, 1981; Watkins et al., 1981; Watkins and Tyack, 1991; Mate et al., 2007; Weller, 2008) similar to the reactions seen for the initial field trials.

Attached tagging devices may cause abrasion and/or infection at the tag attachment site, may result in increased energy expenditure of the tagged whale during normal swimming activities due to the increased drag, and also may result in unexpected entanglement if the whale were to doubleback on itself or cause entanglement of any companion whales during social or reproductive activities. It is expected that any minor scarring from tag attachment would eventually heal a short time after the tags are removed. Researchers will monitor the health of the tagged whales during revisits and will remove the tag if the whale appeared to exhibit significant weight loss that could be evidence of interrupted feeding and/or increased energy burdens or other detrimental health effects from the tag itself. To minimize this entanglement risk, the tow tether is designed to have a low strength line (starting with a 200 lbs breaking strength, increased if necessary up to a maximum of 500 lbs. breaking strength) that can be easily broken by the tagged whale in the event that the whale swims through its own line or if a companion whale interacts with the towed line. In addition to a low strength tow line, the harness itself has a low strength breakaway link if the harness itself were to attach to any debris encountered by the whale.

We analyzed the risks to individuals based on their expected responses to research activities. We expect non-target humpback, fin, and sei whales exposed to vessel surveys under the proposed permit to exhibit either no visible response or short-term behavioral responses similar to those seen for predator avoidance. We assume vessel surveys under the proposed permit might be stressful for some individuals, and might temporarily interrupt behaviors such as foraging, but evidence in the literature for similar actions (Watkins et al., 1981; Bauer, 1986; Brown et al., 1991; Clapham and Mattila, 1993; Jahoda et al., 2003; Best et al., 2005) suggests that responses are expected to be short-lived. Assuming an animal is no longer disturbed after it responds to the presence of the vessel, we do not expect long-term adverse fitness consequences for humpback, fin and/or sei whale individuals located in the vicinity of vessels and tagging activities.

A maximum of 75 humpback whales would be exposed annually to close approaches and tagging attempts of which a maximum of 15 individuals would be fitted with either a peduncle saddle pack tag or a peduncle-let harness with towed tag. NMFS anticipates the slow, converging course technique proposed by the researchers should minimize the stress response of the whales to the close vessel approach given observations seen in the recent past as well as observations reported in the literature (e.g., Clapham and Mattila, 1993; Best et al., 2005). Pole-delivered tagging attempts are expected to result in behavioral reactions similar to those already occurring from the approach itself. The net gun deployment technique may result in additional reactions due to the sound of the gun in addition to the ropes coming in contact with the whale after firing. We expect that 9 of the 75 exposures each year would likely result in a moderate to strong behavioral response to the tagging attempt. These higher energy responses would impact the animal's energy budget that would normally be used for other essential behaviors such as feeding, swimming, and/or reproduction. While these behavioral responses would likely impact an individual's fitness in the short term, a review of the literature suggests that repeat exposures are not likely to result in any long term fitness consequence (e.g., impacts to growth, survival, and lifetime reproductive success, etc.) (Glockner-Ferrari and Ferrari, 2006; Best et al., 2005; Best and Mate, 2007).

In addition to behavioral effects, we also considered the physical risks associated with attaching the saddle pack and harness with towed tags to humpback whales. With any "collar" or belt, there is always a possibility that epidermal abrasion may occur at the attachment site. However, previous tests on fluke tissues suggests that the proposed tags would cause only minor abrasion and compression of the skin at the attachment site that should gradually return to normal after the tags are removed (see Beamish, 1978; Woodward et al., 2006). Researchers are proposing to monitor the health of the tagged whales with repeat visits and will take multiple photographs of the tail stock to monitor for any evidence of tissue damage or hemorrhaging at the attachment site. If photographs show any physical effects beyond minor skin abrasion and/or compression, researchers will remove the tags with assistance from local disentanglement networks where possible to minimize any long term physical injury to the affected whale. Based on these mitigation measures, we do not expect tag attachment to have any long term fitness consequences for individuals.

The increased drag that could occur from the tags may impact an animal's energy budget for as long as the tags remain attached. Researchers intend to slowly increase the tag duration from days to weeks to months provided that the increased duration does not appear to affect the health of the tagged individual. Researchers will monitor the whale's health through repeat visits and the proposed permit includes a condition that tags be removed if there is evidence of significant weight loss of the tagged individual. The maximum drag from the tags is expected to be 20 lbs for a whale traveling at 4 knots underneath the surface which is 40 percent less than the drag created by disentanglement ball buoys that are commonly used to disentangle large whales. We do not anticipate any long term fitness consequences given the fact that only larger males would be fitted with the tags (which should lessen the device to body weight ratio) and the fact that researchers will remove the tags if any significant weight loss is observed during revisits. Based on these mitigation measures, we do not anticipate any long term fitness consequences to result from the increased drag generated by the proposed tags.

We also assessed the risk of entanglement for both the tagged whales and any companion whales that could swim through the lines. Entanglement can cause physical injury or even death in large whales if lines become wrapped around appendages or continually cut through the whale's skin as it swims. Most entanglements occur from whales encountering high strength lines used for commercial fishing activities. Researchers intend to minimize the entanglement risk by using lower strength lines (200-500 breaking strength) for both the harness and the tow tether that can be easily broken by the whale or release if the lines get caught on debris. Whales were observed breaking lines during unsuccessful tagging attempts conducted during field trials and previous studies using similar tags on manatees showed the release mechanisms frequently detached when they were caught on vegetation or rock pilings (see Rathburn et al., 1987; Reid et al., 1995; Deutsch et al., 1998). Tagged animals would be closely monitored and in the event of an emergency, the regional disentanglement network would be contacted to aid in removal of the tag from the whale to the extent possible. Given these mitigation measures, we expect it highly unlikely that unintentional serious injury or death from entanglement would occur for any individuals tagged during the study.

In summary, we anticipate that research activities may result in short term fitness consequences for exposed individuals but are not likely to result in any long term consequences such as mortality, serious injury, or disruption of essential behaviors such as feeding, mating, or nursing, to a degree that the individual's likelihood of successful reproduction or survival would be substantially reduced. Since we do not anticipate any long term fitness consequences for individuals, we do not, in turn, anticipate adverse consequences for the populations those individuals represent or the species for which those populations comprise.

CONCLUSION

After reviewing the current status of the affected species, the environmental baseline for the action area, the anticipated effects of the proposed research activities and the possible cumulative effects, it is the ESA Interagency Cooperation Division's opinion that the Permits Division's proposed action of issuing permit No. 14118, as proposed, is not likely to jeopardize the continued existence of Humpback, fin, or sei whales under NMFS' authority.

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.

However, as discussed in the accompanying Opinion, only the species targeted by the proposed research activities will be harassed as part of the intended purpose of the proposed action. Therefore, NMFS does not expect the proposed action will incidentally take any 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 permits that may affect listed whales and/or sea turtles as well as reduce harassment related to the authorized activities:

1. *Evaluation of Tagging Methods.* Given the limited data on past effects from the proposed tagging methods, the Permits Division should review all annual and final reports submitted by investigators and evaluate the impacts to listed species before issuing additional permits authorizing similar types of tagging. Results should be compared with other tag types and/or means of deployment in order to assist in identifying the methods that result in the least amount of "take" to listed species. The results of this review should be provided to ESA Interagency Cooperation Division for use in future consultations.

2. *Cumulative Impact Analysis*. The Permits Division should work with the Marine Mammal Commission, International Whaling Commission, and the research community to identify a research program with sufficient scope and depth to determine cumulative impacts of existing levels of research on listed whales. This includes the cumulative sub-lethal and behavioral impacts of research permits on listed species.

In order for 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 ESA Interagency Cooperation Division of any conservation recommendations they implement in their final action.

REINITIATION NOTICE

This concludes formal consultation on the proposal to issue scientific research permit No. 14118. 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 proposed 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 Permits Division must immediately request reinitiation of section 7 consultation.

You may ask the ESA Interagency Cooperation Division to confirm the conference opinion as a biological opinion issued through formal consultation if Insular Hawaiian false killer whales, the Beringia DPS for bearded seals, or Arctic ringed seals are officially listed or the Hawaiian monk seal critical habitat is officially revised to designate the additional areas proposed. The request must be in writing. If NMFS reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, NMFS will confirm the conference opinion as the biological opinion on the project and no further section 7 consultation will be necessary.

After Insular Hawaiian false killer whales, the Beringia DPS for bearded seals, or Arctic ringed seals are officially listed or Hawaiian monk seal critical habitat is revised and any subsequent adoption of this conference opinion, the Federal agency shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect the species or critical habitat in a manner or to an extent not considered in this conference opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the species or critical habitat that was not considered in this conference opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

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