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

Biological Opinion

Agency:	Permits, Conservation and Education Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service
Activity Considered:	Proposal to Issue Permit No. 15483 to Dr. Bruce Mate of Oregon State University for Research on the Effects of Acoustic Deterrents to Gray Whales (*Eschrictius robustus*) in Central Oregon Coastal Waters.
Consultation Conducted by:	Endangered Species Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service
Approved by:	
Date:	NOV - 2 2010

Section 7(a)(2) of the Endangered Species Act (ESA) (16 U.S.C. 1531 *et seq.*) requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency's action "may affect" listed species or critical habitat that has been designated for them, that agency is required to consult formally with either NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service, depending upon the listed resources that may be affected. 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 or USFWS conclude with that conclusion (50 CFR 402.14[b]).

NMFS' Office of Protected Resources – Permits, Conservation and Education Division proposes to issue a permit for direct "takes" of non-target endangered Southern Resident killer whales (SRKWs) (*Orcinus orca*) and threatened Eastern Distinct Population Segment (DPS) Steller sea lions (*Eumetopias jubatus*) pursuant to the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). For the actions described in this document, the action agency is NMFS' Office of Protected Resources – Permits, Conservation and Education Division. The consulting agency is NMFS' Office of Protected Resources – Endangered Species Division. This ESA Section 7 consultation (Opinion) considers the effects of the proposed studies on endangered and threatened species and designated critical habitat.

Consultation History

On July, 13 2010, NMFS Office of Protected Resources – Permits, Conservation and Education Division requested consultation with NMFS Office of Protected Resources – Endangered Species Division on the proposal to issue Permit No. 15483 to Dr. Bruce Mate of Oregon State University for research on the effects of acoustic deterrents to gray whales (*Eschrictius robustus*) in central Oregon coastal waters.

On August 3, 2010, NMFS Office of Protected Resources – Endangered Species Division initiated formal consultation on this proposed action.

BIOLOGICAL OPINION

Description of the Proposed Action

NMFS Office of Protected Resources – Permits, Conservation and Education Division proposes to issue a permit for research on marine mammals, pursuant to the MMPA, as amended (MMPA, 16 U.S.C. 1361). The permit would exempt the applicant from the MMPA's and ESA's prohibition against activities that may result in "takes" of nonlisted gray whales (*Eschrictius robustus*) in Central Oregon coastal waters. It would also allow for "takes[1]" of ESA listed endangered Southern Resident Distinct Population Segment (DPS) of killer whales (*Orcinus orca*) and members of the ESA listed threatened Eastern DPS of Steller sea lions (*Eumetopias jubatus*). The proposed permit would last for five years.

The proposed permit would authorize takes by harassment of up to 20 Eastern DPS Steller sea lions and 70 Southern Resident DPS killer whales (SRKWs) as a result of the proposed activities over the five year length of the permit. The proposed permit would authorize activities in nearshore coastal waters west of Yaquina Head, Oregon.

Table 1 identifies the number of proposed "takes" by harassment of listed species to be authorized by the proposed permit. Individuals exposed may be of either sex or of any age.

Table 1. Proposed takes to listed species from the proposed activities.

Species	Total Individuals Permitted to be Disturbed Per Year
SRKW	14
Eastern DPS Steller Sea Lion	4

[1] "Take" is defined by the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

Although the investigators intend to conduct the experiment over the course of one season in 2011, the permit would be valid for five years from the date of issuance. The proposed activities are described below.

Audio Deterrent Experiments

The proposed activities would test the effects of audio deterrents on nonlisted gray whales in order to determine the efficacy of such deterrents to repel these animals from wave energy buoys. The activities are proposed to occur from January 1 – April 15, and in December during the migrations of gray whales off of the central Oregon coast.

The sound source will have peak efficiency in the 1-3 kHz range with a maximum source level of 170 dB re 1 μPa at 1 m. The proposed signal will consist of a pulse up to 1 sec in duration at a rate of 3 pulses per minute. The sound source will have a ramp-up procedure at the beginning of each playback to allow for target and nontarget species to move away from the area without being exposed to the full sound level of the experiment. The deterrent noises will begin at 120 dB and will increase by 5 dB every minute for ten minutes until the maximum level of 170 dB is achieved.

The audio deterrent device will be positioned directly west of Yaquina Head, Oregon, at the 50 m isobar during gray whale migrations. It will be anchored to the seafloor with a concrete block weighing approximately one ton. The underwater speaker will be suspended at 20 m in the water column by a surface buoy. The surface buoy will be connected to the anchor with a combination of synthetic rope and chain at a scope of approximately 2:1 and as such will have very little to no slack. As such, any entanglement risk for any animal, listed or otherwise, will be negligible. The complete apparatus will be set into position by a vessel-mounted crane.

The acoustic output will be measured at the source prior to playback experiments via a calibrated hydrophone. Sound level measurements will be recorded away from the source in order to map the sound field in order to interpret the sound level at which target species are observed to respond. The acoustic device will operate during daytime hours only. Control phases of no sound and phases of active sound will occur on a 2 d rotation. Each day, experiments are proposed to occur for 6 h with a 2 h control period, resulting in a maximum total of 843.2 h of noise transmission. During the experiments, shore-based observers will track gray whales and observe any responses.

Mitigation Measures

The permit application supplied by the NMFS Office of Protected Resources – Permits, Conservation and Education Division lists several mitigation techniques that the applicants propose to reduce adverse effects to target and non-target species. These include:

1. A source level of 170 dB for the acoustic device. This level is well below the widely accepted injury criteria for all marine mammals exposed to anthropogenic noise (Southall et al., 2007).

2. The sound source will ramp-up slowly at the beginning of each experimental period, from 120 dB to 170 dB over 10 minutes, to ensure that no species are exposed to the full source level without prior opportunity to move away from the source.

3. This work will occur at a time of year during which most listed baleen whales do not occur in nearshore Oregon waters. The nearshore location of the study also means that there is very little chance that deep-water cetaceans will be exposed.

4. This work will occur at non-breeding times of year for listed pinnipeds encountered in the area

In addition to these measures, the following are some of the conditions of the proposed permit that also apply:

1. Researchers must suspend permitted activities in the event serious injury or mortality[2] of protected species occurs. The Permit Holder must contact the Chief, NMFS Permits, Conservation and Education.

2. If authorized take is exceeded, Researchers must cease permitted activities and notify the Chief, Permits Division as soon as possible, but no later than within two business days and the Permit Holder must also submit a written incident report. 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.

3. Researchers shall consider a marine mammal to have been taken if it enters the ensonified zone when the source is on. The ensonified zone is defined as the area from the source out to where the signal attenuates to 120 dB.

4. Researchers will follow the ramp-up protocols described in the application each time the source is turned on.

5. Researchers will turn off the source if observers detect marine mammal behaviors indicative of level A harassment[3], either during or immediately after exposure to the sound, and will consult the Chief, Permits Division before resuming.

[2] This 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 dependant young by starvation following research-related death of a lactating female; deaths resulting while attempting to avoid researchers. Note that for marine mammals, a serious injury is defined by regulation as any injury that will likely result in mortality.

[3] Under the 1994 Amendments to the MMPA, Level A harassment is statutorily defined as, any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild

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

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

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

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

When individual, listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions are likely to reduce the abundance,

reproduction, or growth rates (or increase the variance in these measures) of the populations those individuals represent (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 listed Resources* sections of this Opinion) as our point of reference. If we conclude that reductions in individual fitness are not likely to reduce the viability of the populations those individuals represent, we would conclude our assessment.

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

To conduct these analyses, we rely on all of the evidence available to us. This evidence 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, Conservation and Education Division when it initiates formal consultation and the general scientific literature. We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies such as the Minerals Management Service, U.S. Coast Guard and U.S. Navy whose operations extend into the marine environment.

During the consultation, we conducted searches of peer reviewed scientific literature, master's theses, doctoral dissertations, government reports and commercial studies. These searches included the use of literature search engines such as *Science Direct*, *Ingenta Connect*, *JSTOR*, and *Google Scholar* as well as the use of NOAA and university libraries. These searches focused on identifying recent information on the biology, ecology, distribution, status, and trends of the threatened and endangered species considered in this opinion. We considered the results of these searches based on the quality of their study design, sample sizes and study results.

Action Area

The proposed sound source will be west of Yaquina Head, Oregon at a depth of 20 m below the sea surface in 50 m deep water. The approximate generalized ambient noise levels at the low end of the proposed frequency spectrum for nearshore waters in the California Current is 85 dB (Wenz, 1962; Richardson et al., 1995).

In order to calculate the areal extent to which the proposed playbacks would remain above ambient noise levels, and therefore salient and detectable by listed species, we employed a modified transmission loss formula. Sound intensity decreases as the inverse square of the range for spherical spreading. Noise intensity values at a certain radial distance (r) from sound sources may be calculated by using the following spherical transmission loss formula:

$$\text{Spherical Transmission Loss} = 20 \log_{10} (r) \text{ dB}$$

Although multiple factors may affect the spreading of sound in seawater, this formula gives us a reasonable approximation of the extent to which the proposed sound will travel while remaining above ambient noise levels. Using this formula, the resulting linear distance from the noise source to be attenuated to < 85 dB was calculated to be approximately 20 km. Based on a radius of 20 km, the expected total circular planar area that would be exposed to these sounds would be 1,257 km^2. However, because the noise source is located at the coastline, the extent of this noise into the ocean would only be one half of this area, or roughly 628 km^2.

Exposure Analysis

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

Listed Species that May be Adversely Affected

The proposed permit would authorize a study of the responses of nonlisted gray whales when exposed to controlled underwater noises. Listed nontarget marine mammals may

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

Mammals		
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
North Pacific right whale	*Eubalaena japonica*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Reptiles		
Green turtle	*Chelonia mydas*	Endangered
Olive ridley turtle	*Lepidochelys olivacea*	Endangered
Leatherback turtle	*Dermochelys coriacea*	Endangered
Loggerhead turtle	*Caretta caretta*	Threatened
Fish		
Bocaccio	*Sebastes paucispinis*	
Puget Sound/ Georgia Basin DPS		Endangered
Canary rockfish	*Sebastes pinniger*	
Puget Sound/ Georgia Basin DPS		Threatened
Chinook salmon	*Oncorhynchus tshawytscha*	
Two Evolutionarily Significant Units (ESUs)		Endangered
Seven ESUs		Threatened
Coho salmon	*Oncorhynchus kisutch*	
One ESU		Endangered
Three ESUs		Threatened
Green sturgeon	*Acipenser medirostris*	
Southern DPS		Threatened
Pacific eulachon/smelt	*Thaleichthys pacificus*	
Southern DPS		Threatened
Steelhead trout	*Oncorhynchus mykiss*	
Two ESUs		Endangered
Eight ESUs		Threatened
Yelloweye Rockfish	*Sebastes ruberrimus*	
Puget Sound/ Georgia Basin DPS		Threatened

Listed Species and Critical Habitat Not Likely to be Adversely Affected

Sei and North Pacific right Whales

Sei and North Pacific right whales right whales occur in the range of the action area. However, only five sei whale sightings were made off California, Oregon and Washington during ship and aerial surveys from 1991-2005 (Hill and Barlow, 1992; Carretta and Forney, 1993; Mangels and Gerrodette, 1994, Forney, 2007). Similarly, right whale sightings are very rare in the eastern north Pacific despite extensive survey efforts (see NMFS, 2006c; Wade et al., 2006). In addition, these species are typically found well south of the action area during the proposed timing of the playback experiments (Masaki, 1977; Gambell, 1985; Brownell Jr et al., 2001; Gregr, 2009). Because of the scarcity of these species in the proposed action area and the targeted nature of the proposed research activities, these species are very unlikely to be exposed to the proposed activities and therefore effects to them from the proposed activities are not likely.

Humpback, Fin, Blue and Sperm Whales

The proposed activities are localized to the nearshore waters of Oregon where humpback, fin, blue and sperm whales are not likely to be present (Carretta et al., 2007). Because of this, humpback, fin, blue and sperm whales are not expected to be affected from the proposed actions.

Sea Turtles

Green, Olive ridley, leatherback and loggerhead sea turtles may be present in the action area during the proposed activities. Studies of green and loggerhead sea turtles demonstrate that these species are sensitive to sounds at low frequencies with a maximum efficiency at about 250 to 700 Hz (Ridgeway et al., 1969; Lenhardt et al., 1983; Lenhardt et al., 1985; Bartol et al., 1999). While the hearing ability and sensitivity for leatherback sea turtles is largely unknown, these species share a similar auditory anatomy. It is therefore reasonable to assume that they have similar hearing ranges.

Because these activities are targeted specifically to marine mammals and because the sounds of the proposed playback activities are at frequencies higher than the hearing ranges of sea turtles, it is extremely unlikely that noise from these proposed actions will affect sea turtles. The proposed activities are thus not likely to adversely affect marine turtles. These species are therefore not considered further in this consultation.

Marine and Anadromous Fish

Listed fish may occur in the action area. However, proposed audio playback and prey survey activities are unlikely to affect listed fish species because the frequencies used in these activities are at a higher level than the optimal hearing range of below 380 Hz for many anadromous fish (Hawkins & Johnstone, 1978). The proposed activities are therefore not likely to adversely affect listed fish species. These species are therefore not considered further in this consultation.

Critical habitat

The proposed activities may occur within the critical habitat of listed steelhead trout and Pacific salmon. Critical habitat designated for steelhead trout and Pacific salmon includes multiple riverine and nearshore marine areas along the U.S. west coast[4] The Primary Constituent Elements (PCEs) for these species include adequate spawning sites, food resources, water quality and quantity and riparian vegetation.

The proposed activities also occur within the critical habitat of the southern DPS of the green sturgeon which includes coastal U.S. marine waters within 60 fathoms (fm) depth from Monterey Bay, California, north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; the lower Columbia River estuary; and certain coastal bays and estuaries in California, Oregon, and Washington (74 FR 52300). The PCEs for green sturgeon include adequate water depth, food, water flow, passage, substrates, sediment quality and water quality.

The proposed activities involve audio playbacks and shore based monitoring activities. These actions should therefore have no effect on any listed species' PCEs and therefore have no effect on the conservation value of any species' critical habitat. The proposed activities are not likely to destroy or adversely modify the critical habitat of any listed species. Critical habitat will therefore not be considered further in this consultation.

Species Likely to be Adversely Affected

NMFS has determined that the actions considered in this Opinion are likely to adversely affect the following listed resources provided protection under the endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.; ESA):

Killer whale, Southern Resident DPS	*Orcinus orca*	Endangered
Steller sea lion, Eastern DPS	*Eumetopias jubatus*	Threatened

The biology and ecology of these species are described in the *Species Descriptions* Section below, and will contribute to the effects analysis for this Opinion.

Experimental noises are proposed to be actively transmitted for a maximum of 843.2 h over 136 d. Based on our analysis, the expected total planar area that would be exposed to these sounds would be roughly 628 km^2. Forney (2007) estimated a mean killer whale population density of 0.0013 animals/km^2 off of Oregon and Washington resulting in a potential for 111 individuals to be exposed to salient noises emitted during the 136 d course of the experiments. However, it should be noted that this estimate relies on an assumption of an even distribution throughout the action area for all times of year; an unlikely scenario. Thus, this estimate should be considered highly conservative.

The most recent available mean density estimates for Steller sea lions off of Oregon and Washington is reported to be 0.011/km^2 (Bonnell et al., 1992). Using this value, we

[4] See for details: http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm

estimate that 7 Steller sea lions could be present in the action area during each playback experiment potentially resulting in 952 exposures throughout the course of the experiments. Again, this estimate relies on an assumption of an even distribution throughout all times of year and thus should be considered highly conservative.

Species Descriptions

Killer Whale, Southern Resident DPS (SRKW)

Species Description, Distribution, and Population Structure

The Southern Resident killer whale (*Orcinus orca*) is a toothed whale and is the largest member of the dolphin family. Based on genetic research, it is believed that multiple subspecies of killer whales exist worldwide (Krahn et al., 2004; Reeves et al., 2004; Waples and Clapham, 2004; Jefferson et al., 2008). Resident killer whales in the Northeast Pacific are distributed from Alaska to California, with four distinct communities recognized: southern, northern, southern Alaska, and western Alaska (Krahn et al., 2002; Krahn et al., 2004). The SRKW occurs in the northeastern Pacific Ocean along the west coasts of the United States and Canada. Resident whales exhibit advanced vocal communication and live in highly stable social matriarchal groupings called pods. They frequent a variety of marine habitats and their range does not appear to be limited constrained by depth, temperature or salinity (Baird, 2000).

The SRKW DPS consists of three pods, designated J, K, and L, that reside for part of the year in the inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound), principally during the late spring, summer, and fall (Bigg, 1982; Ford et al., 2000; Krahn et al., 2002). Pods have visited coastal sites off Washington and Vancouver Island (Ford et al., 2000), and are known to travel as far south as central California and as far north as the Queen Charlotte Islands off British Columbia. The locations of SRKWs in the late fall, winter, and early spring are less well known.

Parsons (2009) noted that members of different pods interact, but members generally remain within their matrilinear group. Interaction between pods has increased over the past two decades, and may be the result of a common response among pods to the stress of a declining population (Parsons et al., 2009). The rate of intrapod interaction was lowest within L pod, which is the largest of the SRKW pods (Parsons et al., 2009).

Life History Information

Male SRKWs become sexually mature at a mean age of approximately 15 years and are thought to remain sexually active throughout their adult lives (Christensen et al., 1984; Perrin and Reilly, 1984; Duffield and Miller, 1988; Olesiuk et al., 1990). Females first give birth at a mean age of approximately 14.9 years and produce an average of approximately 5.4 surviving calves over a reproductive life span of about 25 years (Olesiuk et al., 1990; Matkin et al., 2003). Gestation periods, as observed in captive killer whales, average around 17 months (Asper et al., 1988; Walker et al., 1988; Duffield et al., 1995). The mean interval between viable calve births is four years (Bain, 1990). Older mothers tend to have greater calving success and they appear to be assisted in calf

rearing by grandmothers (Ward et al., 2009b). Some females may reach 90 years of age (Olesiuk et al., 1990). Mothers and offspring maintain highly-stable, lifelong social bonds and this relationship appears to be the basis for their matrilinear social structure (Bigg et al., 1990; Baird, 2000; Ford et al., 2000).

Although mating can occur year-round, most killer whale reproduction in the North Pacific has been observed to occur primarily from April to October (Olesiuk et al., 1990; Matkin et al., 1997), with a peak in calving occurring between September and March (Olesiuk et al., 2005; Jefferson et al., 2008). Killer whales are polygamous (Dahlheim and Heyning, 1999), and genetic data indicate that resident males mate with females outside of their own pods almost exclusively. This reduces the chances of inbreeding (Barrett-Lennard, 2000; Barrett-Lennard and Ellis, 2001).

Killer whales are apex predators and consume a varied diet but fish are their preferred prey (Scheffer and Slipp, 1948; Ford et al., 1998; Ford et al., 2000; Saulitis et al., 2000). Although the record is incomplete, data suggest that SRKWs have a strong preference for Chinook salmon during late spring to fall (Hanson et al., 2005; Ford and Ellis, 2006). Their winter and early spring diet is largely unknown. SRKWs spend about half of their time hunting prey. Approximately 95% of their time spent underwater is at depths of less than 30 m (Baird, 2000; Baird et al., 2003; Baird et al., 2005). They detect prey via echolocation and passive listening, and likely hunt through a combination of vision and echolocation (Barrett-Lennard et al., 1996; Baird, 2000). Maximum observed dive depths average 141 m (Baird et al., 2003). Baird *et al.* (2005) reported that although the deepest recorded dive for a SRKW is 264 m, they are probably capable of diving to at least 330 m. No significant differences in the diving behavior of the three Southern Resident pods has been observed (Baird et al., 2005).

Killer Whale Hearing and Acoustics

Killer whales produce numerous types of vocalizations for navigation, communication, and hunting (Ford, 1989; Barrett-Lennard et al., 1996; Ford et al., 2000; Miller, 2002). These vocalizations consist of different types of calls distinctive to each pod. These distinct vocalizations are known as a dialects (Ford, 1991). Within pods, matrilines have distinctive call patterns (Miller and Bain, 2000), and it is likely that individual whales learn their unique dialect through contact with their mother and other pod members (Ford, 1989, 1991; Miller and Bain, 2000; Yurk et al., 2002).

Most killer whale calls consist of both low-frequency components with tones between 250-1,500 Hz with harmonics to about 10 kHz, and high-frequency components with tones between 5-12 kHz and harmonics ranging to over 100 kHz (Bain and Dahlheim, 1994). Au et al. (2004) reported source levels of killer whale echolocation signals between 94 and 224 dB re 1 μPa. Hearing by odontocetes such as killer whales involves the lower jaw and head which transmit sound to the middle and inner ear (Mohl et al., 1999; Au, 2002). Killer Whale hearing is the most sensitive of any toothed whale tested, with a range of one to at least 120 kHz. Hearing sensitivity declines below 4 Hz and above 60 kHz is most sensitive in the range of 18-42 kHz (Szymanski et al., 1999) with the most sensitive frequency at 20 kHz.

Listing Status

The SRKW has been listed as endangered under the ESA since November 18, 2005 (70 FR 69903); critical habitat for this species was designated on November 29, 2006 (71 FR 69054). In April 2004, the Washington Department of Fish and Wildlife (WDFW) designated killer whales in Washington State as a "state endangered species" (WAC 232-12-297). SRKWs are also protected by the MMPA and Canada's Species at Risk Act (SARA).

Status and Trends of SRKWs

The only pre-1974 account of Southern Resident abundance is from Sheffer and Slipp (1948) and merely notes that the species was "frequently seen" during the 1940s in the Strait of Juan de Fuca, northern Puget Sound, and off the coast of the Olympic Peninsula, with smaller numbers along Washington's outer coast. Little information exists on the historic abundance of SRKWs. Until the mid- to late-1800s, the SRKW community may have numbered more than 200 animals (Krahn et al., 2002). Using the estimated abundance of SRKWs in 1971 of 67 whales, and factoring in various sources of mortality, NMFS estimated a minimum historical abundance of about 140 SRKWs (Olesiuk et al., 1990). The SRKW population had grown to 90 whales by September 2006, but declined in 2007 with the loss of five individuals and the gain of two new calves leaving the total number at 87, with 25 whales in J pod, 19 whales in K pod, and 43 whales in L pod (Center for Whale Research, unpublished data cited in NMFS, 2008b). At present, the Southern Resident population has declined to essentially the same size that was estimated during the early 1960s, when it was considered to be depleted (Olesiuk et al., 1990).

Photo-identification catalogs for SRKWs provide information on recent abundance and trends of these pods (see Dahlheim, 1997; Dahlheim et al., 1997; Ford and Ellis, 1999; Matkin et al., 1999). From 1974–2007, the SRKWs as a whole have gone through several periods of growth and decline. For example, the DPS appeared to experience a period of recovery by increasing to 99 whales in 1995, but then declined by 20 percent to 79 whales in 2001 before another slight increase to 83 whales in 2003 (Ford et al., 2000; Carretta et al., 2005). This abrupt decline and unstable population status continue to be cause for concern, particularly given the small size of the DPS which makes it potentially vulnerable to Allee effects (e.g., inbreeding depression) that could cause further population decline or preclude a substantial increase in abundance (see NMFS, 2008b). The intensity of factors affecting the species is increased by stochastic events such as the small number of reproductive age males and high mortality rates for this group and is a major reason that the SRKW was listed as endangered rather than threatened (NMFS, 2008b).

Using data from 1974–2003, Krahn et al. (2002; 2004) further analyzed the population dynamics of the DPS to identify demographic factors contributing to the latest decline in abundance. Changes in survival were not related to stochastic variation caused by the SRKW community's small size, such as random patterns in births or deaths or to annual

fluctuations in survival. Rather, the survival patterns were more likely influenced by external causes, such as changes in prey availability etc.

Eastern DPS Steller Sea Lions

Species Description, Distribution, and Population Structure

Steller sea lions (*Eumetopias jubatus*) are distributed around the North Pacific rim from northern Japan, through the Aleutian Islands, along the southern coast of Alaska, and south to California (Kenyon and Rice, 1961; Loughlin, 1997). The western DPS of Steller sea lions includes animals located west of Cape Suckling, Alaska (144°W) (62 FR 24345) while the Eastern DPS of Steller sea lions includes animals east of Cape Suckling, Alaska (144°W) south to California waters (55 FR 49204).

Steller sea lions require both terrestrial and aquatic resources for survival. Terrestrial sites called rookeries are used for pupping, nursing, and mating during the reproductive season. Haulouts are terrestrial areas used by all size and sex classes but are generally not sites of reproductive activity. The continued use of particular sites may be due to site fidelity, with animals often returning to the site of their birth (Calkins and Pitcher, 1982; Ban, 2005). Major Steller sea lion rookeries and haulouts occur in Oregon and California (Angliss and Outlaw, 2008). Although pups were observed at one haulout site in 1997 and 1998, Washington is the only western U.S. coastal state that does not presently contain a Steller sea lion rookery (Angliss and Outlaw, 2008).

Steller sea lions are not known to make regular migrations but do move considerable distances. Adult males may travel hundreds of kilometers after the breeding season (Calkins and Pitcher, 1982; Calkins, 1986; Loughlin, 1997) and adult females may travel out to waters of depths greater than 1000 m (Merrick and Loughlin, 1997). Immature Steller sea lions generally remain within 300 miles of rookeries their first year of life and travel further away in subsequent years (Raum-Suryan et al., 2004).

Life History Information

Female Steller sea lions reach sexual maturity between three and eight years of age and remain reproductively active for approximately 10 years (Pitcher and Calkins, 1981; Calkins and Pitcher, 1982; York, 1994). They give birth to a single pup in late spring through early summer (Pitcher and Calkins, 1981) with a gestation period of about 50 to 51 weeks (Pitcher and Calkins, 1981). The Steller sea lions birth rate is estimated to be 55% to 70% or greater (Pike and Maxwell, 1958; Gentry, 1970; Pitcher and Calkins, 1981). Twinning has also been observed (Maniscalco and Parker., 2009).

Newborn pups are entirely dependent upon their mother for milk during their first three months of life and continue to be highly dependent upon them through their first winter (Porter, 1997; Trites et al., 2006). Mothers make their first foraging trip at about one week after giving birth (Merrick and Loughlin, 1997; Milette, 1999; Pitcher et al., 2001; Milette and Trites, 2003; Maniscalco et al., 2006) and may nurse their offspring for up to two years (Gentry, 1970; Sandegren, 1970; Pitcher and Calkins, 1981; Calkins and Pitcher, 1982; Trites et al., 2006). Females attending pups tend to stay within 20 nm of the rookery (Calkins, 1996; Merrick and Loughlin, 1997).

Males reach sexual maturity at about the same time as females (Loughlin et al., 1987), but are not large enough to effectively compete for mates until about eight to ten years of age (Pitcher and Calkins, 1981). The sex ratio of pups at birth is assumed to be about 1:1 but becomes biased towards females as they become juveniles (Pike and Maxwell, 1958; Calkins and Pitcher, 1982; Trites and Larkin, 1992; York, 1994).

Eastern DPS Steller sea lions are known to eat a wide variety of fish and invertebrates and occasionally birds and other marine mammals (Jones, 1981; Pitcher and Fay, 1982; Calkins and Goodwin, 1988; Olesiuk et al., 1990; Daniel and Schneeweis, 1992; Sinclair and Zeppelin, 2002; McKenzie and Wynne, 2008). Haulout selection appears to be driven at least in part by the availability of prey (Winter et al., 2009). Most adult Steller sea lions occupy rookeries during the pupping and breeding season, which extends from late May to early July (Pitcher and Calkins, 1981). Adult females generally return to the rookeries of their birth to pup and breed (Kenyon and Rice, 1961; Pitcher and Calkins, 1981).

While adult males rarely enter the water during the breeding season (Loughlin, 2002), females tend to hunt for one to two days and return to nurse pups (NRC, 2003a),. As pups mature and are weaned, they develop greater diving abilities up to roughly 10 years of age (Pitcher et al., 2005). Juveniles usually make shallow dives of around 50 feet, but much deeper dives in excess of 1,000 feet are known (Loughlin et al., 2003). Younger animals tend to stay in waters under 100 m in depth and stay within 20km from shore (Fadely et al., 2005). Nearly 90% of Steller sea lion sightings off Oregon and Washington have occurred within 21 km of shore and none have been made further than 40 km or in waters greater than 200 m deep (Bonnell et al., 1992). Bonnell (1992) estimated the fall mean density in this area to be approximately 0.011 animals/km^2 (Bonnell et al., 1992).

Steller Sea Lion Hearing and Acoustics

A recent audiogram study involving one male and one female Steller sea lion showed the maximum hearing sensitivity at 1-25 kHz (Kastelein et al., 2005). Although these results only represent the responses of two captive individuals, other eared seals exhibit similar responses and display maximum sensitivities of between 2-28 kHz (Schusterman et al., 1972; Moore and Schusterman, 1987; Babushina et al., 1991; Kastak and Schusterman, 1995). The high frequency cutoff for these species was observed to be around 40 kHz (Schusterman, 1981).

Listing Status

Steller sea lions were originally listed as threatened under the ESA on November 26, 1990 (55 FR 49204), following a decline in the U.S. of about 64% over previous three decades. In 1997 the Steller sea lion population was split into separate western and eastern stocks based on observed demographic and genetic dissimilarities (Bickham et al., 1996; Loughlin, 1997). These stocks are now listed under the ESA as the Eastern DPS and Western DPS. Only the Eastern DPS is expected to be affected by the proposed activities. Critical habitat has been designated for Steller sea lions on the major foraging sites, haulouts, and rookeries throughout their range (58 FR 45269). The critical habitat within the action area for this Opinion is located in Oregon.

Status and Trends of Steller Sea Lions, Eastern DPS

The decline of Steller sea lions was first witnessed in the eastern Aleutian Islands in the mid-1970s and then spread westward to the central Aleutian Islands and eastward to the western Gulf of Alaska in the late 1970s and early 1980s. Similarly, counts are frequently presented for the area from Kenai to Kiska Island, which is considered to encompass the center of abundance for the species. Population surveys suggest that the Eastern DPS is stable or increasing in the northern part of its range while the Western DPS is declining.

Loughlin et al. (1984) estimated the worldwide population of Steller sea lions was between 245,000 and 290,000 animals in the late 1970s and that 90% of the worldwide population of Steller sea lions was in the western DPS in the early 1980s (75% in the U.S. and 15% in Russia) and 10% in the Eastern DPS. Steller sea lions collected in the Gulf of Alaska during the early 1980s showed evidence of nutritional limitation (Calkins and Goodwin, 1988; Calkins et al., 1998; Pitcher et al., 1998).

After conducting a range-wide survey in 1989, Loughlin et al. (1992) noted that the worldwide Steller sea lion population had declined by over 50% in the 1980s, to approximately 116,000 animals, with the entire decline occurring in the range of the Western DPS. Between late 1970s and the mid-1990s, counts of the western population of sea lions fell 80% from 109,880 animals to 22,167 (Hauser et al., 2007). Fritz and Stinchcomb (2005) estimate that from 1991 to 2000, the number of animals in the western population declined by approximately 38%. Surveys by Fritz and Stinchcomb (2005) indicate that the current number of non-pups in the western population is 29,037.

The current minimum population estimate of the western stock of Steller sea lions in the western U.S. is 38,988 (Angliss and Outlaw, 2008). When combined with data on Steller sea lions in Russia the minimum estimate for the Western population is 44,780 (Angliss and Outlaw, 2007). According to several population models the western DPS has significant chance of going extinct within the next 100 years (York et al., 1996; Goodman, 2006; Winship and Trites, 2006). Individual rookeries such as those in the western Aleutian islands and the Gulf of Alaska have a much higher risk of failure (Winship and Trites, 2006).

The eastern stock appears to be more stable. Pup count data from 2002 through 2005 from across the range of the eastern population, multiplied by a factor of 4.5 (after Calkins and Pitcher, 1982) or 5.1 (after Trites and Larkin, 1996) results in a population estimate of 48,519 or 54,989 animals (Angliss and Outlaw, 2008). The current minimum population estimate is 44,404 animals (Angliss and Outlaw, 2008). NMFS calculates this estimate by adding non-pup counts taken in 2002 in Southeast Alaska, to counts of animals in Washington in 2002 as well as counts of pups and non-pups in Canada in 1998, Oregon in 2002, California in 2004, and southeastern Alaska in 2005 (Angliss and Outlaw, 2008).

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 *Environmental Baseline* for this Opinion includes the effects of many activities on the survival and recovery of ESA listed species in the action area; it focuses primarily on past and present impacts to these species. A number of human activities have contributed to the current status of listed marine species in the action area. Some of those activities, (e.g. commercial whaling and intentional shooting) no longer regularly occur. However, the effects from these activities may still persist. Other human activities are ongoing and appear to be directly or indirectly affecting these species. Additionally, unrelated factors may be acting together to affect listed species. 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; or all three factors may work to lower an animal's ability to suppress disease (Williams et al., 2002b; NMFS, 2008a).

Taken together, the components of the environmental baseline for the action area include sources of natural mortality as well as influences from natural oceanographic and climatic features in the action area. Circulation and productivity patterns influence prey distribution and habitat quality for listed species. The effects of climatic variability on these species in the action area and the availability of prey remain largely undetermined; however, it is likely that any changes in weather and oceanographic conditions resulting in effects on prey populations would have consequences for marine mammals.

The baseline also includes human activities resulting in disturbance, injury or mortality of individuals. Historically, commercial harvest of Steller sea lions and the live capture of killer whales significantly affected these species. Although these activities are not conducted now as in the past, effects from these activities still persist today. Current anthropogenic activities and effects on individuals in the action area are thought to include habitat degradation (e.g., due to contaminants, risk of oil spills, underwater sound sources, changes in prey availability), interactions with fishing gear and with vessels and scientific research. Conservation and management efforts are ongoing and have a positive effect on the status of listed marine mammals within the action area.

The following discussion summarizes the natural and human phenomena in the action area that may affect the likelihood that these species will survive and recover in the wild. These include natural mortality; oceanographic and climate conditions; commercial harvest and live capture; habitat degradation; environmental contaminants and the risk of oil spills; noise; changes in prey availability; interactions with fishing gear and vessels and scientific research and conservation efforts.

Natural and Anthropogenic Stressors

Natural Mortality

SRKWs

The causes of natural mortality in SRKWs are largely unknown. Individual and mass live-strandings and entrapments of killer whales are considered rare (Dahlheim and Heyning, 1999). However, disease has been observed to drive animals ashore (Walsh et al., 2001). Perrin et al (2002) reported lethal stranding events involving SRKWs occurring in 1995 and 1996 off Northern Vancouver Island and the Queen Charlotte Islands. A similar event occurred in 2002 off Long Beach in Washington state (as reported in NMFS, 2008b). SRKWs have no natural predators and little is known about disease in this species (Gaydos et al., 2004), although some mortality from disease has been observed. Disease epidemics have never been reported in killer whales in the northeastern Pacific (Gaydos et al., 2004).

Eastern DPS Steller Sea Lions

Killer whale predation may significantly reduce Steller sea lion populations (Frid et al., 2009). Sleeper sharks are also significant predators of Steller sea lions and, when combined with killer whale attacks, may restrict their foraging ability (Frid et al., 2009). The reduction in Steller sea lions at multiple rookeries and haulouts indicates that predation by killer whales and other sources of natural mortality may contribute to the decline in local areas (Barrett-Lennard et al., 1995). Evidence indicates that these animals are also exposed to diseases and carry parasites (Dailey and Hill, 1970; Gerber et al., 1993). However, it is unclear whether these factors are impeding recovery.

Commercial Harvest, Live Captures and Intentional Shooting

Except for a limited amount of harvesting of Steller sea lions by native people of Alaska, commercial harvesting, live captures and intentional shooting are no longer permitted on any listed species in the proposed action area. However, prior exploitation may have altered the population structure and social cohesion of the species such that effects on abundance and recruitment continue for years after harvesting ceases.

SRKWs

In contrast with large whale species, killer whales were not heavily targeted in the 19th and early 20th centuries because of their limited amounts of oil and their difficulty to capture (Scheffer and Slipp, 1948). However, harvest statistics show that killer whales were killed on an average of about 43-56 individuals annually from the 1940s to 1981 (Ohsumi, 1975; Øien, 1988; Hoyt, 1990) before ceasing in the early 1990s. These harvests probably had little impact on populations in the northeastern Pacific (Baird, 2001; Reeves et al., 2003).

From 1962-1977, 275-307 killer whales were captured in Washington and British Columbia waters. Of these, 55 were transferred to aquaria, 12 or 13 died during capture operations, and 208-240 were released or escaped back into the wild (Bigg, 1975; Asper and Cornell., 1977; Olesiuk et al., 1990). The practice of live-captures declined significantly after 1971, with only eight whales removed (Bigg, 1975; Asper and

Cornell., 1977; Olesiuk et al., 1990). The live-capture of killer whales in the northeastern Pacific stopped altogether after 1977. Forty seven of the whales retained or killed during live-capture activities were SRKWs (Olesiuk et al., 1990). By 1971, these captures contributed to the reduction of the population to approximately 67 individuals (Olesiuk et al., 1990).

Killer whales have historically been killed by humans because they were perceived to interfere with fishing activities (Klinowska, 1991; Matkin et al., 1997). Shootings of SRKWs were probably once relatively common in the proposed action area (Scheffer and Slipp, 1948; Olesiuk et al., 1990; Baird, 2001). These shootings still occasionally occur (Klinowska, 1991; Matkin and Saulitis, 1997; Reeves et al., 2003) but are not considered to significantly affect the fitness of SRKWs as a species (Carretta et al., 2001).

Eastern DPS Steller Sea Lions

Steller sea lions were commercially harvested prior to 1973. However, commercial harvest was probably not a major factor in the Steller sea lion decline (Shima et al., 2000). However, Eastern DPS Steller sea lions have been subject to commercial exploitation and killing as a means of predator control which has reduced their abundance (Bonnot, 1928; Rowley, 1929; Scheffer, 1945; Bonnot and Ripley, 1948; Scheffer, 1950; Pearson and Verts, 1970; Bigg, 1988; Atkinson et al., 2008). Prior to 1972, over 45,000 Steller sea lions were intentionally killed in Alaska during state-sanctioned commercial harvest and predator control programs (Merrick et al., 1987). These killings may have depressed recruitment in the short term and may explain declines in Steller sea lions at some sites in the eastern Aleutian Islands and Gulf of Alaska. However, they do not appear to explain overall declines experienced in all regions (Loughlin and York., 2000). With the enactment of the MMPA in 1972, such activities were made illegal except for subsistence hunting. Both the ESA and the MMPA contain provisions that allow Alaska Natives to harvest Steller sea lions. Today, anecdotal reports of shootings continue (Loughlin and York., 2000).

Disturbance

Disturbance in Terrestrial Areas

Disturbance in Steller sea lion haulouts and rookeries can potentially cause disruption of reproduction, stampeding or increased exposure to predation. In order to decrease the likelihood of such disturbances, "no transit zones" were established under the ESA in 1990 for vessels within three nautical miles of rookeries. In 2002, NMFS implemented the North Pacific Fishery Management Council's recommendation to require a Vessel Monitoring System on federally licensed groundfish vessels involved in pollock, cod and Atka mackerel fisheries. The system tracks fishing vessels, providing real-time information on vessel location and violation of no-transit and no-trawl areas.

Noise

In addition to natural sources of noise, noise generated by human activity occurs and includes sound generated by commercial and recreational vessels, aircraft, commercial sonar, military activities, seismic exploration, in-water construction activities, and

acoustic harassment devices (AHDs). These activities all occur within the action area to varying degrees throughout the year.

Marine mammals generate and rely on sound to navigate, hunt and communicate with other individuals. As a result, anthropogenic noise can interfere with these important activities. The effects of sound on marine mammals can range from behavioral effects to physical damage (Richardson et al., 1995), although noise levels at which sound may adversely affect these animals are not well understood.

Commercial shipping traffic is a major source of low frequency anthropogenic noise in the action area (Richardson et al., 1995). Although large vessels emit predominantly low frequency sound, studies report broadband noise from large cargo ships that includes significant levels above 2 kHz, which may interfere with important biological functions of cetaceans (Holt, 2008). Commercial sonar systems are used on recreational and commercial vessels and may affect marine mammals (NRC, 2003b). Although, little information is available on potential effects of multiple commercial sonars to marine mammals, the distribution of these sounds would be small because of their short durations and the fact that the high frequencies of the signals attenuate quickly in seawater (Richardson et al., 1995).

On May 5, 2003, the U.S. Navy guided missile destroyer U.S.S. Shoup passed through the Strait of Juan de Fuca and Haro Strait operating its mid-frequency sonar during a training exercise. SRKWs were present at the time and exhibited unusual behaviors (Commander U.S. Pacific Fleet, 2003). NMFS concluded that the SRKWs were exposed to levels likely to cause behavioral disturbance, but not temporary or permanent hearing loss (see NMFS, 2005, 2006).

Seismic surveys using towed airguns also occur within the action area and are the primary marine benthic exploration technique. Airguns generate intense low-frequency sound pressure waves capable of penetrating the seafloor and are fired repetitively at intervals of 10-20 seconds for extended periods (NRC, 2003b). Most of the energy from the guns is directed vertically downward, but significant sound emission also extends horizontally. Peak sound pressure levels from airguns usually reach 235-240 dB at dominant frequencies of 5-300 Hz (NRC, 2003b). Most of the sound energy is at frequencies below 500 Hz. In the United States, all seismic projects for oil and gas exploration and most research activities involving the use of airguns with the potential to take marine mammals are covered by incidental harassment authorizations under the MMPA.

Acoustic harassment devices are another source of underwater noise that may occur in the action area and may be disruptive to listed marine species. AHDs used at salmon aquaculture farms emit signals intended to displace nuisance harbor seals and sea lions (Petras, 2003). These signals can also cause responses in cetaceans (Olesiuk et al., 2002). Morton and Symonds (2002) describe one AHD model that broadcast a 10 kHz signal at 194 dB re 1 μPa at 1 m and was potentially detectable above ambient levels in open water for up to 50 km.

Pollution

Pesticides and Contaminants

Exposure to pollution and contaminants has the potential to cause adverse health effects in marine species. In the eastern North Pacific, marine ecosystems receive pollutants from a variety of local, regional, and international sources and their levels and sources are therefore difficult to identify and monitor (Grant and Ross, 2002). Marine pollutants come from multiple municipal, industrial and household sources as well as from atmospheric transport (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 in long-lived higher trophic level animals (Waring et al., 2004), including immune system abnormalities, endocrine disruption and reproductive effects (Krahn et al., 2007). Recent efforts have led to improvements in regional water quality and monitored pesticide levels have declined, although the more persistent chemicals are still detected and are expected to endure for years (Mearns, 2001; Grant and Ross, 2002).

Organochlorines, such as polychlorinated biphenyls (PCB), dioxins, furans and dichlorodiphenyltrichloroethane (DDT) are found in the action area (Ross et al., 2000; CBD, 2001; Krahn et al., 2002; Cullon et al., 2009; Krahn et al., 2009). These compounds are persistent in the environment and have the potential to bioaccumulate in fatty tissues (Haraguchi et al., 2009; Krahn et al., 2009). Southern Resident killer whales may accumulate these toxins in their tissues, which has the potential to cause physical and physiological problems (Krahn et al., 2009). Levels are much higher in field-sampled individuals than those found in a captive killer whales (Bennett et al., 2009).

PCBs and DDT, have been observed in Steller sea lions in greater concentrations than any other pinniped during the 1980s, although these levels appear to be declining (Barron et al., 2003; Hoshino et al., 2006). The levels of these compounds have been found to have twice the burden in individuals from Russia than from western Alaska (Myers et al., 2008). In addition, heavy metals have also been identified in Steller sea lion tissues, but are in concentrations lower than other pinnipeds (Noda et al., 1995; Kim et al., 1996; Castellini, 1999; Beckmen et al., 2002). Contaminant burdens are transferred to the fetus *in utero* as well as through lactation (Lee et al., 1996; Myers et al., 2008) meaning that new generations start with a higher level of contaminants than their parents.

Hydrocarbons

Exposure to hydrocarbons released into the environment via oil spills and other discharges pose risks to marine species. Marine mammals are generally able to metabolize and excrete limited amounts of hydrocarbons, but exposure to large amounts of hydrocarbons and chronic exposure over time pose greater risks (Grant and Ross, 2002). Acute exposure of marine mammals to petroleum products causes changes in behavior and may directly injure animals (Geraci, 1990). Cetaceans have a thickened epidermis that greatly reduces the likelihood of petroleum toxicity from skin contact with oiled waters (Geraci, 1990). However, they may inhale these compounds at the water's surface and ingest them while feeding (Matkin and Saulitis, 1997).

Hydrocarbons have the potential to negatively affect Steller sea lions. Potential effects include pelage fouling, inhalation of contaminant vapor and ingestion of oil or oil-contaminated prey. Hydrocarbons also have the potential to impact prey populations, and therefore may affect listed species indirectly by reducing food availability. Roughly 30 individuals died as a result of the Exxon *Valdez* oil spill and contained particularly high levels of polycyclic aromatic hydrocarbons contaminants (Calkins et al., 1994; Loughlin et al., 1996). Subsequently, premature birth rates increased and pup survival decreased after this event (Calkins et al., 1994; Loughlin et al., 1996).

Marine Debris

Types of marine debris include plastics, glass, metal, polystyrene foam, rubber, and derelict fishing gear from human marine activities or transported into the marine environment from land. The sources of this debris include littering, dumping and industrial loss and discharge from land. Marine debris can damage important marine habitat, such as rookeries and haulout sites by making them inhospitable to the species that rely on them. Marine animals can also become entangled in marine debris, or ingest it, which may lead to injury or death.

While SRKW entanglements with marine debris are rare (Carretta and Chivers, 2004; Angliss and Outlaw, 2005), Steller sea lions become entangled in a variety of debris including many types of fishing gear, loops of line, and packing bands (Loughlin and Nelson, 1986) which may cause mortality.

A study conducted in the Aleutian Islands during June-July 1985 to investigate the rate of entanglement found that a approximately 0.07% of observed sea lions were entangled in marine debris (Loughlin and Nelson, 1986). A follow-up study noted no entangled pups and only one entangled juvenile out of a total of 3,847 sea lions examined (Loughlin and Nelson, 1986). However, these studies cannot fully evaluate the frequency of entanglement because most entangled animals die at sea and are never observed.

Prey Availability

SRKWs

Reductions in prey may require marine mammals to spend more time and energy foraging, which in turn could have negative effects on reproductive rates and mortality. Human activities have had impacts on the abundance of many prey species in the northeastern Pacific during the past 150 years (Slaney et al., 1996; Gregory and Bisson, 1997; Press, 2003; Schoonmaker et al., 2003). Salmon, a major prey item for both SRKWs and Steller sea lions, have declined due to degradation of aquatic ecosystems resulting from human activities (Slaney et al., 1996; Gregory and Bisson, 1997; Press, 2003; Schoonmaker et al., 2003). A 50% reduction in killer whale calving has been correlated with years of low Chinook salmon abundance (Ward et al., 2009a). In addition, competition with non-native species all have the potential to affect populations of prey (Wonham and Carlton, 2005).

It is difficult to assess whether SRKWs have adequate prey resources to support their survival and recovery because there is insufficient information on the food habits and seasonal ranges of killer whales. In addition, uncertainties about the historic and current abundance levels of many localized populations of prey and the cyclic nature of large-scale changes in ocean conditions further complicate the issue (see NMFS, 2008b). However, despite these limitations, some general trends are apparent, including the significant reduction in natural breeding populations of most salmonid species along much of the west coast of North America during the past 150 years, especially from Washington to California. This phenomenon may have reduced the region's ability to support historical numbers of Southern Residents (Krahn et al., 2002).

Eastern DPS Steller Sea Lions

Steller sea lions may compete with Commercial fisheries for prey. Significant evidence supports the idea that the western DPS is declining as a result of observed reductions in growth, birth, and survival rates because of changes in diet, presumably from this competition (Calkins and Goodwin, 1988; Calkins et al., 1998; Pitcher et al., 1998; Trites and Donnelly, 2003; Atkinson et al., 2008). As a result, limitations on fishing grounds, duration of fishing season, and monitoring programs have been established to prevent Steller sea lion nutritional deficiencies as a result of inadequate prey availability. However, in contrast with the Western DPS of Steller sea lion, no evidence suggests that Steller sea lions in the Eastern DPS were nutritionally limited during the 1970s and 1980s (see NMFS, 2008c).

Interactions with Fishing Activities

Drowning from accidental entanglements in fishing equipment is a minor source of mortality for killer whales (Carretta and Chivers, 2004; Angliss and Outlaw, 2005). In Washington, Sheffer and Slipp (1948) documented several deaths of animals caught in gillnets between 1929 and 1943. However, killer whales are usually able to avoid nets by swimming around or underneath them (Jacobsen, 1986; Matkin, 1994).

Steller sea lions may become entangled and drown in commercial fishing gear (Atkinson et al., 2008). Steller sea lions have been incidentally caught in a variety of commercial fishing gear including gillnets (Wynne, 1990), trawls (Loughlin and DeLong, 1983), and longlines (Angliss and Outlaw, 2005). Steller sea lions may also ingest baited hooks set by commercial or recreational trollers (Angliss and Outlaw, 2005). The minimum estimate of lethal takes from fishing between 1996 and 2000 averaged 29.5 animals a year (Angliss and Outlaw, 2005) and was 3.6 in 2005 for the Eastern DPSs (Angliss and Outlaw, 2005). It is estimated that 0.26% of Steller sea lions have marine debris around their necks or are hooked by fishing gear (0.07%) (FOC, 2008; Raum-Suryan et al., 2009).

Ship Strikes and Other Vessel Interactions

Ship strikes of killer whales are considered rare, but do occur and can result in serious injury and mortality (Ford et al., 2000; Baird, 2001; Carretta et al., 2005). Prior to 1950, Scheffer and Slipp (1948) noted several collisions between killer whales and boats, but gave no information on effects to the whales from these encounters. One such mortality was reported between the 1960s and 1990s (Baird, 2002). In 2006 a killer whale was killed after being struck by a tug boat (Gaydos et al., 2007). Also that year, the death of a

stranded individual was attributed to blunt trauma likely from a vessel strike (Gaydos et al., 2007). Five additional accidents between vessels and killer whales have been documented in the region since the 1990s (Baird, 2001) but no mortality was reported from these events. In coastal waters, there are no known incidents of collisions with vessels.

In addition to physical injury or mortality, several studies indicate vessels may contribute to short-term behavioral changes in resident killer whales (Kruse, 1991; Kriete, 2002; Williams et al., 2002a; Bain et al., 2006b). Commercial whale-watching has increased in recent years (Osborne et al., 1999; Erbe, 2002; MMMP, 2002; Koski, 2004; Koski, 2006, 2007). Although regulated, there are concerns over behavioral changes these activities may cause (Kruse, 1991; Kriete, 2002; Williams et al., 2002a; Foote et al., 2004; Bain et al., 2006a; Bain et al., 2006b; Wiley et al., 2008; Noren et al., 2009).

Although more research is needed, there is concern these short-term behavioral responses could lead to biologically significant consequences, particularly given the substantial proportion of time SRKWs spend in proximity to vessels (Bain et al., 2006a; Noren, 2006). Potential impacts on SRKWs resulting from the physical presence of vessels or increased underwater sound levels from these vessels may include effects on foraging efficiency, communication, energy expenditure, as well as effects from chronic stress responses such as reduced immune function (Gordon and Moscrop, 1996; Holt, 2008).

Vessel traffic also disturbs hauled-out Steller sea lions to varying degrees. Reactions of Steller sea lions to occasional disturbance range from no reaction to the complete and immediate departure from the haulout area (Calkins and Pitcher, 1982). As with other marine mammals, the consequence of this type of disturbance on the overall population of Steller sea lions is difficult to measure.

Scientific Research

SRKWs

SRKWs have been the subject of scientific research activities in the action area as authorized by NMFS permits. Most of this research is conducted in the inland waters of Washington State. Approved permits include a variety of activities including close approaches for vessel and aerial surveys, photo-identification, behavioral observation, video and acoustic recording, biopsy, breath sampling, and suction cup tagging (see NMFS, 2006). No mortalities or serious injuries are authorized for SRKWs under any permits. A complete list of all active research permits for the SRKW is located in Appendix A.

Repeated disturbance of individuals is probable under these permits. It is difficult to assess the effects of such disturbance on the species. However, NMFS has taken steps to limit repeated harassment through conditions included in the permits requiring coordination among permit holders and limiting the repeated harassment of individuals under each permit.

Eastern DPS Steller Sea Lions

Intentional lethal sampling of eastern Steller sea lions was a primary means of collecting samples for scientific research before the MMPA was implemented. These activities were discontinued once the species was listed as threatened under the ESA. Activities authorized under the MMPA and ESA are highly regulated and closely monitored and may include the incidental taking or harassment in the course of research, including counting, capturing, and handling animals. These activities may result in inadvertent or indirect eastern Steller sea lion mortality. The NMFS Permit office reviews permit applications, which are also reviewed by the Marine Mammal Commission and made available for public review through notice in the Federal Register. Investigators are required to submit annual plans and reports of research activities and real-time reports of research-related mortality. A complete list of all active research permits for the SRKW is located in Appendix B.

Oceanographic Features and Climatic Variability

Climatic variability and change may be affecting listed species through change in habitat and prey availability. However, these effects are not well understood. Possible effects of climatic variability for marine species 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). Naturally occurring climatic patterns, such as the Pacific Decadal Oscillation and the El Niño and La Niña events, are identified as major causes of changing marine productivity worldwide and may also therefore influence listed species' prey abundance (Mantua et al., 1997; Francis et al., 1998; Beamish et al., 1999; Hare et al., 1999; Benson and Trites, 2002). Gaps in information and the complexity of climatic interactions complicate the ability to predict the effects of climate change and variability may have to these species (Kintisch, 2006; Simmonds and Isaac, 2007).

Conservation and Management Efforts

Several conservation and management efforts have a positive effect on listed marine mammals in the action area. Recovery plans under the ESA help guide the protection and conservation of listed species and final plans are in place for SRKWs and Steller sea lions. NMFS implements conservation and management activities for these species through its Regional Offices and Fishery Science Centers in cooperation with states, conservation groups, the public, and other federal agencies.

For the SRKW, increased law enforcement in coordination with Washington State has been enacted to prohibit the approach of killer whales within less than 100 yards. Recovery of killer whales has also been incorporated into several related conservation plans including Pacific salmon recovery programs and the Puget Sound Partnership Action Agenda. Increased monitoring, education and outreach programs have also been enacted.

The revision and implementation of the Steller sea lion recovery plan was finalized in 2008. In addition, several monitoring and research programs are currently in place to help understand threats and trends of the Eastern DPS of Steller sea lions. Agreements between NMFS and the Aleut Communities of St. George and St. Paul islands have been enacted to help conserve and manage subsistence marine species with special focus on Steller sea lions. A cooperate agreement has also been enacted between NMFS and the Alaska Sea Otter and Steller Sea Lion Commission for education and outreach concerning the Eastern DPS of Steller sea lions.

Effects of the Proposed Action

Pursuant to Section 7(a)(2) of the ESA, federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. Direct adverse effects of the permitted activities on listed species that are within the action area would include disruption of feeding, breeding, resting and other behaviors. Some displacement may result from these activities. The duration of the behavioral disruptions and displacements are expected to vary by species and type of disturbance.

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 based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. As described in the *Approach to the Assessment* section, for any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, and lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(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 studies 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 of listed species during activities. The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. However, the MMPA of 1972, as amended, defines harassment as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal population in the wild or has the potential to disturb a marine mammal or marine mammal population in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [16 U.S.C. 1362(18)(A)]. The latter portion of this definition (that is, "...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering") is almost identical to the U.S. Fish

and Wildlife Service's regulatory definition of "harass[5]" pursuant to the ESA. For this Opinion, we define harassment 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.

Potential Stressors

The assessment for this consultation identified effects from recorded playback activities as a potential stressor to be authorized under proposed permit. This stressor has the potential to harass SRKWs and members of the Eastern DPS of Steller sea lions. The following section describes this stressor in greater detail, describes the probability of interactions then describes the probable responses of listed species based on the evidence available.

Response Analyses

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 that might reduce the fitness of individuals. The proposed activities have the potential to produce disturbances that may affect listed marine mammals.

The responses by animals to human disturbance are similar to their responses to potential predators (Harrington and Veitch, 1992; Lima, 1998; Gill and Sutherland, 2001; Frid and Dill, 2002; Frid, 2003; Beale and Monaghan, 2004; Romero, 2004). These responses include interruptions of essential behavior and physiological processes such as feeding, mating, nursing, resting, digestion etc. This can result in stress, injury and increased susceptibility to disease and predation (Frid and Dill, 2002; Romero, 2004; Walker et al., 2006).

Risks to listed individuals are measured in terms of changes to an individual's "fitness." Fitness is defined as the individual's growth, survival, annual reproductive success and lifetime reproductive success. When listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). As a result, if the assessment indicates that listed plants or animals are not likely to experience reductions in their fitness, we conclude our assessment. If possible reductions in individuals' fitness are likely to occur, the

5 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).

assessment considers the risk posed to populations to which those individuals belong, and then to the species those populations represent.

Playbacks of Audio Deterrents

These proposed playback activities have the potential to adversely affect listed species. Sounds will be actively transmitted for 6.2 hours per day for 105 days between January 1 through April 15 and again for 31 days in December, resulting in a maximum total of 843.2 h over 136 d of noise transmission. Based on our analysis, the expected total planar area that would be exposed to these sounds would be roughly 628 km^2.

SRKW

Forney (2007) estimated a mean killer whale population density of 0.0013 animals/km^2 off of Oregon and Washington resulting in a potential for 111 individuals to be exposed to salient noises emitted during the 136 d course of the experiments. This value is highly conservative because the killer whale density estimates did not distinguish between transient and resident killer whales. This estimate also relies on an assumption of an even distribution throughout the action area for all times of year. This is highly unlikely and as such, this estimate should be considered highly conservative. Furthermore, not all of these exposures will result in "take."

Studies on the effects of playback experiments on toothed whales are scarce (Deeke, 2006). While it is reasonable to assume that SRKWs could respond to these playbacks, these sounds are at frequencies and at levels commonly used and encountered by SRKWs (Diercks et al., 1971). Therefore, no injury, mortality or significant deleterious behavioral response is expected to occur. The proposed activities should therefore not result in the reduction of fitness to any individual SRKW.

Eastern DPS Steller Sea Lions

The most recent available mean density estimates for Steller sea lions off of Oregon and Washington is reported to be 0.011/km^2 (Bonnell et al., 1992). Using this value, we estimate that 7 Steller sea lions could be present in the action area during each playback experiment potentially resulting in 952 exposures throughout the course of the permit. These estimates rely on an assumption of an even distribution of the population throughout the action area for all times of year which is highly unlikely. Because of this, these estimates should be considered extremely conservative and not all of these exposures will result in "take."

Data are lacking on the effects of playbacks on Steller sea lions (Deeke, 2006). However, there are numerous studies on the responses of other pinnipeds to such noises. These responses include diving to avoid detection (Deeke et al., 2002; Deeke, 2006). This occurs presumably because the sounds are unfamiliar, or are perceived as a threat (Deeke et al., 2002).

While responses to playback experiments could potentially incur a physiological cost by disrupting normal behaviors and result in additional energy expenditure, they are

expected to be temporary and, because they are at frequencies and levels commonly encountered naturally, would not be expected to directly cause any physical injury or mortality. These activities are proposed to occur at non-breeding or pup rearing times of year for Steller sea lions and should therefore not affect reproductive activities for this species. The proposed playback experiments are therefore not expected to reduce the fitness of any individual Steller sea lion.

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. After reviewing available information, NMFS is not aware of effects from any additional future non-federal activities in the action area that would not require federal authorization or funding and are reasonably certain to occur during the foreseeable future.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, and natural mortality) will continue to influence listed whales as described in the *Environmental Baseline*. We also expect current anthropogenic effects will also continue, including the introduction of sound sources into marine mammal habitat, changes in prey availability, vessel traffic and scientific research. Potential future effects from climate change on marine mammals in the action area are not definitively known. However, climatic variability has the potential to affect these species in the future, including indirectly by affecting prey availability.

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. This results in increased discharge of sediments and pollution into the marine environment. These activities are expected to continue to degrade the habitat of marine mammals as well as that of the prey on which they depend.

Integration and Synthesis of Effects

The following text integrates and synthesizes the *Status of the Species*, the *Environmental Baseline* and the *Effects of the Action* sections of this Opinion. This information, in addition to the known cumulative effects, is used to assess the risk the proposed activities pose SRKWs and members of the Eastern DPS of Steller sea lions.

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 individual, 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 reduce the viability of any species as a whole.

The proposed issuance of scientific research Permit No. 15483 may result in 111 individual kill SRKWs to be exposed to salient noises emitted during the 136 d course of the experiments. This value is highly conservative though because the killer whale density estimates from which this value was derived did not distinguish between transient and resident killer whales. The amount of SRKWs in this estimate would be much smaller. This estimate also relies on an assumption of an even distribution throughout the action area for all times of year. This is also extremely unlikely.

Furthermore, not all of these exposures will result in "take." While it is reasonable to assume that SRKWs could respond to these playbacks, these sounds are at frequencies and at levels commonly used and encountered by SRKWs (Diercks et al., 1971). Therefore, no injury, mortality or significant deleterious behavioral response is expected to occur. The proposed activities should therefore not result in the reduction of fitness to any individual SRKW.

We estimate that 952 exposures to Steller sea lions are possible throughout the course of the experiments. However, these estimates rely on an assumption of an even distribution of the population throughout the action area for all times of year which is highly unlikely. Because of this, these estimates should be considered extremely conservative.

Not all of these potential exposures would result in "take." The responses of pinnipeds to anthropogenic noise include diving to avoid detection (Deeke et al., 2002; Deeke, 2006). This occurs presumably because the sounds are unfamiliar, or are perceived as a threat (Deeke et al., 2002). While responses to playback experiments could potentially incur a physiological cost, they are expected to be temporary and, because they are at frequencies and levels commonly encountered naturally, would not be expected to directly cause any physical injury or mortality. The proposed playback experiments are not expected to reduce the fitness of any individual Steller sea lion.

Current and Historic Stressors

The current and historic stressors to these species are detailed in the *Environmental Baseline* section of this Opinion. These stressors include natural mortality, depletion of populations due to historic killing, depletion of prey, pollution, noise, fishing interactions, ship strikes, vessel interactions and scientific research. Of these factors, prey availability, especially that of Pacific salmonid species, has greatly contributed to the decline of

SRKWs. For Eastern DPS Steller sea lions, a major factor responsible for decline was historic intentional shooting and harvesting.

Human activities have reduced the abundance of prey species in the northeastern Pacific over the last 150 years (Slaney et al., 1996; Gregory and Bisson, 1997; Press, 2003; Schoonmaker et al., 2003). Salmon, a major prey item for both SRKWs and Steller sea lions, have declined due to human caused degradation of aquatic ecosystems (Slaney et al., 1996; Gregory and Bisson, 1997; Press, 2003; Schoonmaker et al., 2003). In fact, a 50% reduction in killer whale calving has been correlated with years of low Chinook salmon abundance (Ward et al., 2009a). The significant reduction in populations of most salmonid species along much of the west coast of North may have reduced the region's ability to support historical numbers of SRKWs (Krahn et al., 2002).

From 1912 through 1968, thousands of Steller sea lions in British Columbia were killed as a result of government control programs (Bigg, 1985). The population had been reduced by an estimated 70% and one rookery had been eliminated by the time the species was given protection in Canada in 1970 (Olesiuk, 2001; Olesiuk, 2008). Although the Eastern DPS population has stabilized and may be increasing (Angliss and Outlaw, 2008), threats from interactions with commercial fishing gear (Atkinson et al., 2008) and marine debris (Raum-Suryan et al., 2009) continue to pose threats to their recovery.

Possible Stressors from the Proposed Activities

The assessment for this consultation identified effects from recorded playback activities as a possible stressor associated with the proposed activities. 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 for SRKWs or members of the Eastern DPS Steller Sea Lions.

Expected Responses to Stressors from the Proposed Activities

As explained in the *Response Analyses* section of this Opinion, disturbances or behavioral responses that would result from the proposed playback experiments are also expected to be minor and temporary and not to have any long-term consequences to individual SRKWs or Eastern DPS Steller sea lions or the populations or species that they comprise.

Conclusion

After reviewing the current status of species; the environmental baseline for the action area; the anticipated effects of the proposed activities; and the cumulative effects, it is the NMFS' Opinion that the activities authorized by the proposed issuance of scientific research permit No. 15483, as proposed, are not likely to jeopardize the continued

existence of the endangered Southern Resident DPS of killer whales or the Eastern DPS of threatened Steller sea lions under NMFS' authority. Critical habitat that occurs within the action area is not expected to be affected by the proposed activities.

Incidental Take Statement

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibits the "take" of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by 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 permitted in the proposed research activities will be significantly harassed as part of the intended purpose of the proposed action. Therefore, the NMFS does not expect the proposed action will incidentally take threatened or endangered species.

Conservation Recommendations

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

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

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

2. *Estimation of Actual Levels of "Take."* For future permits authorizing activities similar to those contained in the proposed permit, the Permits Division should continue to review all annual and final reports submitted by investigators that have conducted such

research as well as any data and results that can be obtained from the permit holders. This should be used to estimate the amount of harassment that occurs given the level of research effort, and how the harassment affects the life history of individual animals. The results of the study should be provided to the endangered Species Division for use in the consultations on future research activities.

3. *Assessment of Permit Conditions*. The Permits Division should periodically assess the effectiveness of its permit conditions, including those for notification and coordination of research.

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

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

Reinitiation Notice

This concludes formal consultation on the proposal to issue scientific research permit No. 15483. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, NMFS' Permits, Conservation and Education Division must immediately request reinitiation of section 7 consultation.

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