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

Biological Opinion

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

Activity Considered: Biological Opinion on the proposal to issue permit amendment No. 13602-01 to Dr. Terrie Williams for research on Hawaiian monk seals, Guadalupe fur seals, Steller sea lions, and Southern Resident killer whales at Long Marine Laboratory and other marine mammal captive facilities in the U.S., pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

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

Approved by: _____

Date: FEB - 2 2011

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

This document represents the NMFS' biological opinion (Opinion) of the effects of the proposed research on non-releasable Hawaiian monk seals and opportunistic energetic assessments on rehabilitating Guadalupe fur seals, Steller sea lions, and Southern Resident killer whales, and has been prepared in accordance with Section 7 of the ESA. This Opinion is based on our review of the Permits, Conservation, and Education Division's draft Environmental Assessment, draft permit amendment 13602-01, Dr Williams' application, the most current marine mammal stock assessment reports, recovery plans for listed species, scientific and technical reports from government agencies, peer-reviewed literature, biological opinions on similar research, and other sources of information.

Consultation History

The current permit No. 13602 was issued to Dr. Williams in 2009. The permit did not include takes of threatened or endangered species, and so no section 7 consultation was conducted. The Permits Division issued a Categorical Exclusion for the issuance of the permit.

On November 29, 2010, the Endangered Species Division received a request for formal consultation from the Permits Division on the issuance of scientific research permit amendment that would authorize research to be conducted on permanently captive Hawaiian monk seals and rehabilitating Guadalupe fur seals, Steller sea lions, and Southern Resident Killer whales. Consultation was initiated on December 20, 2010.

Description of the proposed action

The National Marine Fisheries Service's Permits, Conservation, and Education Division proposes to amend an existing permit to Dr. Terrie Williams of Long Marine Laboratory pursuant to the ESA and Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 *et seq*., Section 104).

The Permits Division proposes to authorize Dr. Williams to opportunistically conduct energetic assessments on rehabilitating ESA-listed marine mammals under NMFS jurisdiction in rehabilitation at Long Marine Laboratory in California, using methods described in the original application for Permit No. 13602. Species could include Guadalupe fur seals and Steller sea lions, and less likely, Southern Resident killer whales (see Table 1). Up to 10 animals per species per year may be included in the research.

Permit 13602 authorizes up to 10 accidental mortalities or serious injuries per year for all rehabilitating individuals of any species (currently only non-listed species). The applicant is not requesting to increase the limit on overall mortalities and proposes a limit on the number incidental mortalities of ESA-listed rehabilitating animals to two over the life of the permit.

Additionally, the Permits Division proposes to authorize Dr. Williams to conduct research on non-releasable (i.e., permanently captive) Hawaiian monk seals as follows (see also Table 2):

- Conduct physiological research (energetic assessments) on up to 18 captive Hawaiian monk seals, up to 3 seals at any given time at Long Marine Laboratory, and up to 15 other non-releasable, captive adult monk seals held in facilities at the Waikiki Aquarium (Honolulu, HI), Sea Life Park (Waimanalo, HI), and Sea World (San Antonio, Texas) or at other facilities in the U.S.;
- Monitor the health of non-releasable seals potentially held at LML over the duration of the permit, as per veterinary specifications to include: growth and body condition (body mass, length, girth, and blubber thickness) and blood parameters (health panels as determined necessary by attending veterinarian, blood volume via Evans blue dilution);
- Conduct deuterium oxide studies in conjunction with blubber ultrasound measurements to validate the use of ultrasound as a measure of body condition, using all Hawaiian monk seals in captivity; and

- Conduct thyroid stimulating hormone (TSH) challenge studies on all captive monk seals to validate use of fecal TSH measurements to monitor metabolic function.

Table 1. Proposed research on rehabilitating ESA-listed species.

Species **Life stage** **Sex**	**Number of animals**	**Number of takes per individual per month**	**Take action**	**Location**
ESA-listed species could include but not limited to: Guadalupe fur seals, Steller sea lions, and Southern Resident killer whales. All life stages M/F	10 animals per species per year with no more than 6 animals of any species (including ESA-listed and non-listed species) in rehab at Long Marine Lab at any one time	30 20 20 20 20 20 20 20 20 20	BC RO2 RPPO2 AO2 DO2 EXO2 TNZ BG HR/SR HF/BT	Long Marine Laboratory via The Marine Mammal Center or NMFS Stranding Coordinator

Table 2. Proposed research on permanently captive Hawaiian monk seals.

Species **Life stage** **Sex**	**Number of animals**	**Number of takes per individual per month**	**Take action**	**Location**
Hawaiian monk seal All M/F	18 seals	30 20 20 20 20 20 20 20 20 20 1[1] 1[1] 1[1]	BC RO2 RPPO2 AO2 DO2 EXO2 TNZ BG HR/SR HF/BT TBV D20/ULT TSH	LML (up to 3 seals), Waikiki Aquarium, Sea Life Park, Sea World, or other facilities permitted to hold monk seals

- BC = Body condition and morphometrics via weight, tape measurements, ultrasound; RO2 = Resting metabolic rate at ambient water temperature; RPPO2 = resting metabolic rate post-prandial; AO2 = active metabolic rates; DO2 = diving metabolic rate; EXO2 = swimming exercise metabolic rates; TNZ = resting metabolic rate to determine thermal neutral zone; BG = blood gases, pH and lactate determination; HR/SR = heart rate and stroke swimming rate; HF/BT = heat flow and body temperature measurements; TBV = total blood volume; D20/ULT = deuterium oxide, blood sampling, ultrasound; TSH = thyroid stimulating hormone administration and fecal sampling

[1] TBV (via Evan's blue), D20/ultrasound, and TSH challenge will only be performed 1 time each per animal per year

Permit No. 13602 authorizes accidental mortality or serious injury of up to one animal per year of any species for permanently captive animals (currently only non-listed species). The applicant is not requesting to increase mortalities of captive animals, only to include captive Hawaiian monk seals in the list of species for which the accidental mortality of one individual is authorized.

Dr. Williams would also be authorized to receive and use tissues (brain and skeletal muscle) from Hawaiian monk seal carcasses and other ESA-listed species that would be used for an assessment of oxygen stores and aerobic dive limits.

The proposed energetic measurements on rehabilitating and captive marine mammals would provide two tools to aid in recovery of listed species: (1) a metabolic/energetics profile that would enable caloric (prey) demands to be predicted based on age of the animal, and (2) swim stroke costs that would enable the impact of different foraging strategies to be defined for seals in food rich and food poor areas. Key physiological measurements for use with ESA-listed marine mammals would include methods currently in practice at Long Marine Laboratory on non-listed marine mammals (captive and rehabilitating), authorized under Permit No. 13602.

Physiology methods descriptions for rehabilitating and permanently captive animals

Body condition, morphometrics and caloric intake (BC): To assess the general body condition and dietary demands of each subject, the following parameters would be monitored at monthly intervals, and at the beginning and end of the experimental period: morphometrics (body mass from a digital scale, length and girths using a tape measure) and blubber deposition (from surface ultrasound, Sonosite, Inc.).

Body mass measurements would either involve trained haulout behaviors by animals onto a platform scale (cetaceans and large pinnipeds) or placement in a kennel on a scale (small or untrained pinnipeds). Ultrasound would be performed on trained animals or using light restraint for untrained animals.

Oxygen consumption - resting and active metabolic rates (RO2, RPPO2, TNZ, AO2, DO2, and EXO2): Resting and active metabolic rates would be determined for post-absorptive (12 hour overnight fast) animals as in previous studies (Yeates *et al.* 2007; Williams *et al.* 2004). The rate of oxygen consumption would be measured by open flow respirometry designed for aquatic mammals. Air is pulled through a metabolic dome and sub-samples of dome exhaust are drawn through a series of columns filled with a desiccant and a CO_2 scrubber before entering an oxygen analyzer.

For metabolic measurements, the animals would be conditioned over several weeks to enter a saltwater pool of known water temperature, over which a Plexiglas metabolic hood is mounted. The saltwater pool used for these tests would often be the routine holding pool of the animal. The size of the hood would be tailored for each species accounting for the approximate size of an exhalation. For example, the hood size is 114 cm wide x 175 cm long x 25 cm high for most pinnipeds and proportionately larger based on animal morphometrics for cetaceans.

Oxygen consumption measurements would be determined when animals are resting at ambient water temperature (RO2); resting after eating (RPPO2); at rest for thermal neutral zone determination (TNZ) by altering water temperature in the metabolic

chamber; (4) naturally active (AO2) (e.g., grooming); diving (DO2; for animals trained to dive); and exercised (EXO2) (i.e., after swimming).

Blood gases, pH and lactate concentration (BG): On the last dive of a test sequence or following exercise bouts, the animals would be stationed beside the pool ledge for blood sampling rather than below the metabolic hood. Pinnipeds would be sedated and/or restrained as necessary and sampled in the large extradural vein or caudal gluteal vein using standard blood sampling protocols for pinnipeds. For animals in rehabilitation, depending on the age, behavior and physical condition, a combination of manual restraint or sedation could be used when obtaining blood samples.

For animals in rehabilitation, the schedule of blood samples would be dictated by the need for medical evaluation rather than research. Sampling for blood parameters in rehabilitating animals would be limited to opportunistic data. In all cases, the attending veterinarian would determine the exact blood sampling procedure to use. Hawaiian monk seals in permanent captivity would be either trained for voluntary blood sampling or sedated and restrained as needed, per veterinary direction.

Heart rate and stroke rate (HR and SR): Diving and swimming marine mammals would wear either an electrocardiograph recorder or a heart rate-dive depth-accelerometer microprocessor throughout the tests. Because muscle noise can interfere with electrocardiograph (ECG) signals recorded by standard heart rate microprocessors, tests would be conducted with the ECG monitors.

For pinnipeds, heart rate would be monitored with the two electrodes placed either laterally by the front flippers or along the dorsal surface. Rather than suction cups, the electrodes would be held in place with a neoprene patch glued (using flexible neoprene glue for easy removal) to a shaved area (see Williams *et al.* 1991).

For cetaceans, heart rate signals would be obtained from two cross-thorax surface electrodes placed on the sternum between the pectoral fins and/or on the mid-lateral axillary area according to Williams et al. (1999a). Each electrode consists of a 3.0 cm diameter silver plate mounted in an 8.5 cm suction cup. Insulated wires from the electrodes would be connected to the monitors and records ECG signals continuously and a custom fitted neoprene vest or harness would be used to carry the ECG instrumentation.

Heat flow and body temperature (HF and BT): Thermal condition of resting and active animals would be determined by measuring heat flow and skin temperature with a handheld surface probe placed on the flukes, dorsal fin, pectoral fin and trunk of the sedentary animals before and after trial sessions. Body temperature would be determined at the same time using a flexible rectal probe. Details are according to Williams et al. (1999b) and Noren et al. (1999).

Body temperature could be monitored continuously during metabolic trials with an ingested stomach temperature pill. These small temperature recorders (< 63mm length x 21.5mm diameter depending on epoxy casting and size of the animal) would be introduced in a fish, which is then swallowed by the subject. Retention of the pill is generally 1-14 days with retrieval in the feces or regurgitate.

Tissue analysis: The applicant also requests the transfer and use of tissues (brain and skeletal muscle) from Hawaiian monk seal carcasses and other ESA-listed species that

would be used for an assessment of oxygen stores and aerobic dive limits. No live animals would be affected by this study.

Lethal take: Permit No. 13602 authorizes up to 10 mortalities or serious injuries per year for all rehabilitating individuals of any species (including non-listed species). The applicant is not requesting to increase mortalities and proposes a limit on the number incidental mortalities of ESA-listed rehabilitating animals to only two over the life of the permit.

In the event of unintentional death, the carcass would undergo a complete necropsy to determine cause of death, and to collect tissues for globin studies as well as for the UCSC marine mammal teaching collection. For animals at collaborating facilities, deposition of the carcass would be according to the attending veterinarian of that facility.

Additional studies on permanently captive Hawaiian monk seals:

Total blood volume via Evans blue (TBV): After an initial blood draw, Evans blue dye would be injected to a concentration of 3 mg/ml plasma and blood samples would be drawn approximately 10 and 20 minutes after injection.

Ultrasound (ULT): The proposed ultrasound validation study on permanently captive Hawaiian monk seals would collect measurements of fat and lean mass as a metric of energy balance. These findings would: validate a non-invasive method for determining body condition of wild monk seals; elucidate how these seals partition resources; and determine the proportions of fat and lean mass needed to maintain a healthy population.

Blubber depth would be measured using a portable imaging ultrasound. Eight ultrasound measurements would be taken from each animal (4 dorsal, 4 lateral). Animals would require mild restraint or would be trained to station for measurements. Measurements would take approximately 5 minutes depending on the position of the animal and could occur in conjunction with other procedures.

Deuterium oxide (D_2O): Body composition would be determined by deuterium assessment through the use D_2O, isotopically labeled water. This procedure requires an initial blood draw followed by an injection of deuterium oxide (up to 0.7g/kg +10% IM). Between 2 and 2 ½ hours after the injection, when the deuterium has equilibrated in the system, a second blood draw is required.

Fecal hormone validation studies (TSH): In order to validate the measurement of thyroid hormone metabolites [triiodothyronine (T3) and thyroxin (T4)] in the Hawaiian monk seal, a thyroid stimulating hormone (TSH) challenge would be performed to stimulate secretion of thyroid hormones by the thyroid gland respectively. All feces excreted prior to and after the injections would be collected and T3 and T4 extracted and assayed.

1) *Pre-administration:* Opportunistically collect all available fecal samples 2 weeks prior to hormone administration to establish baseline hormone values, though some fecal material may dissipate in the animal's holding pool before it can be collected.

2) *Dry holding:* Ensure that the animal is in dry holding for a 6-day time period to run this experiment: 2 days prior to injection of the hormone and 4 days after injection. During dry holding, all feces would be collected; seals would have

access to a spray mist, or similar access to water for cooling, and shade to avoid overheating.

3) *TSH administration:* Administer 2 injections of 0.1 ug /kg up to a maximum of 10 IU of TSH (synthetic TSH, e.g. Genzyme Corporation, Cambridge, MA, USA), 24 hours apart. A trained veterinarian would administer injections intramuscularly. Hormone would be administered on the third morning of the 6-day dry holding necessary for the challenge.

4) *Analysis:* Extract hormones and assay all samples at the Center for Conservation Biology at the University of Washington, Seattle, Washington.

Monk seal sedation or restraint: The requested work is with multiple facilities and animals. Each facility and animal has its own requirements for training and handling. Seals would be stationed for voluntary collection, restrained, or sedated dependant on consultation with the attending veterinarian and the facility protocols. Sedation for monk seals could include intravenous diazepam, intramuscular (IM) midazolam, and/or IM butorphenol (dosages to be determined by attending veterinarians).

Lethal take: Permit No. 13602 authorizes incidental mortality or serious injury of up to one animal per year of any species of permanently captive animals. The applicant is not requesting to increase mortalities of captive animals. Therefore, the permit would authorize mortality of up to one monk seal per year as a result of research procedures (note, only one mortality of any species in captivity would be authorized annually).

In the event of unintentional death, the carcass would undergo a complete necropsy to determine cause of death, and to collect tissues for globin studies as well as for the UCSC marine mammal teaching collection. For animals at collaborating facilities, deposition of the carcass would be according to the attending veterinarian of that facility.

Permit conditions

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

- Animals must be allowed to exit the testing situation.
- Research must be halted and re-evaluated should the animals exhibit signs of stress, pain, or suffering resulting from the authorized activities.
- For animals held in permanent captivity:
  - No marine mammal may be released into the wild unless such a release has been authorized under an amendment to this permit or a separate scientific research and/or enhancement permit issued for that purpose.
  - Prior to transport of any animal authorized under this permit, the permit holder must have a travel plan documented at the receiving facility, and the animal must be accompanied by a health certificate signed by the attending veterinarian within 10 days of the transport. The U.S. Department of Agriculture, Animal and Plant

Health Inspection Service (APHIS) must approve the facility receiving the animal.

- For rehabilitation animals held temporarily for research:
  - No marine mammals undergoing research in captivity that will be released to the wild may be on public display.
  - The permit holder must have a plan to provide permanent holding in the event that an animal is deemed non-releasable due to research activities and subsequent disposition of the animal must be decided in consultation with the NMFS Office of Protected Resources.
  - The protocol for disease screening prior to release and for behavioral de-conditioning of animals for release into the wild must be provided to the Chief, Permits Division.
  - The permit holder must ensure that, before release into the wild, animals used in captive experiments are isolated from unnecessary direct human contact to the maximum extent practical prior to release; exposed to live prey species and demonstrate that they will capture and eat live prey without humans visually present if possible; tagged for identification; off drugs (excluding sedation for transport) for at least two weeks prior to release; monitored for a minimum of two weeks following any intrusive research procedure or until site of procedure is healed; examined and approved by a qualified veterinarian; released in coordination with the Southwest Regional Administrator.
- Any public display of permanently captive animals must be conducted incidental to and not interfere with the scientific research. Such incidental public display may only occur as part of an educational program, a portion of which must describe the research activities; and for ESA-listed species, the educational program must provide information on the species population status, distribution, and threats to recovery. The marine mammals maintained under the authority of this permit must not be trained for performance or included in a public interactive program.
- The permit holder must apply for an amendment to breed or maintain more than the number and species authorized.
- The permit holder must submit annual, final, and incident reports, and any papers or publications resulting from the research authorized to the Permits Division.

Approach to the assessment

The NMFS approaches its Section 7 analyses of agency actions through a series of steps. The first step identifies those aspects of proposed actions that are likely to have direct and indirect physical, chemical, and biotic effects on listed species or on the physical, chemical, and biotic environment of an action area. As part of this step, we identify the spatial extent of these direct and indirect effects, including changes in that spatial extent over time. The result of this step includes defining the *Action area* for the consultation. The second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent

our *Exposure analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent. Once we identify which listed resources are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure (these represent our *Response analyses*).

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

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

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

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

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

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

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

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

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

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

Action Area

All proposed research would be conducted in a captive setting at the following facilities: Long Marine Laboratory, Santa Cruz, CA; Sea World, San Antonio, TX; Sea Life Park, Waimanalo, HI; Waikiki Aquarium, Honolulu, HI; and any other facility permitted to hold Hawaiian monk seals in permanent captivity in the U.S. Research on rehabilitation animals including Guadalupe fur seals, Steller sea lions, and Southern Resident killer whales would only take place at Long Marine Laboratory.

Status of listed resources

NMFS has concluded that the actions being considered in this biological opinion *may affect* the following species and critical habitat, under NMFS' jurisdiction, that are protected under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.; ESA):

Guadalupe fur seal	*Arctocephalus townsendi*	Threatened
Hawaiian monk seal	*Monachus schauinslandi*	Endangered
Southern Resident killer whale	*Orcinus orca*	Endangered
Steller sea lion – Eastern DPS	*Eumetopias jubatus*	Threatened
– Western DPS		Endangered

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

Guadalupe fur seal

Description of the species

Guadalupe fur seals are medium sized, sexually dimorphic otariids that are generally asocial with their conspecifics and other species (Belcher and T.E. Lee 2002; Reeves *et al.* 2002). Except for adult males, members of this species resemble California sea lions and northern fur seals. Distinguishing characteristics of the Guadalupe fur seal include the digits on their hind flippers (all of similar length), large, long foreflippers, unique vocalizations, and a characteristic behavior of floating vertically with their heads down in the water and their hind flippers exposed for cooling (Reeves et al. 2002).

Distribution

Guadalupe fur seals' historic range included the Gulf of Farallons, California to the Revillagigedo Islands, Mexico (Belcher and T.E. Lee 2002; Rick *et al.* 2009). Currently,

they breed mainly on Guadalupe Island, Mexico, 155 miles off of the Pacific Coast of Baja California. A smaller breeding colony, discovered in 1997, appears to have been established at Isla Benito del Este, Baja California, Mexico (Belcher and T.E. Lee 2002). All Guadalupe fur seals represent a single population.

There are reports of individuals being sighted in the California Channel Islands, Farallon Islands, Monterey Bay, and other areas of coastal California and Mexico (Belcher and T.E. Lee 2002; Carretta *et al.* 2002; Reeves *et al.* 2002). A single female gave birth to a pup on the Channel Islands in 1997.

Reproduction

Guadalupe fur seals are a polygamous species that exhibit strong breeding site fidelity (Belcher and T.E. Lee 2002). Males establish territories and may breed with as many as 12 females during a single breeding season (Reeves et al. 2002). Territorial males spend the majority of their time in the breeding colony fasting and resting and stay with the colony from 35 to 122 days (Reeves *et al.* 1992a; Belcher and T.E. Lee 2002). Guadalupe fur seals prefer to colonize on rocky haul outs near water and in caves for relief from heat during the summer breeding season. Breeding occurs shortly after females give birth (June to July), after which time, females forage for two to six day periods between nursing their pups during the nine month lactation period (Reeves et al. 2002).

Feeding

From examination of feces, their diet apparently consists of cephalopods, bony fish, and crustaceans (Belcher and T.E. Lee 2002).

Diving

The mean dive depth of Guadalupe fur seal lactating females is 55 feet, with a mean dive duration of 2.6 minutes. Mean surface interval between dives was two minutes. Dives were organized as outings lasting 2.5 hours. Foraging occurred during the night and transit during the day, with a maximum of 168 dives per day. Generally diving occurred at night, between eight in the evening and five in the morning (Croll et al. 1999). Little is known about Guadalupe fur seal behavior during non-breeding season. They appear to spend long periods foraging at shallow depths during this time, but little information is known on their distribution at sea (Belcher and T.E. Lee 2002).

Status and trends

Guadalupe fur seals were listed as threatened under the ESA on December 16, 1985 (50 FR 51252). Guadalupe fur seals were hunted to near extinction by the late 1800s, with pre-harvest population estimates of 20,000 to 100,000 individuals. By 1897, the Guadalupe fur seal was believed to be extinct until a small population was found on Guadalupe Island in 1926. The most recent estimate is 7,400 animals in 1993 with a population growth rate of 13.7% per year (Hanni et al. 1997).

Natural threats

Although currently protected from commercial harvest, natural genetic factors are seen as a significant threat to the continued survival of this species. Because few individuals remained after commercial hunting, relatively low genetic diversity means that remaining

individuals tend to be more susceptible to disease and inbreeding effects over subsequent generations (Bernardi *et al.* 1998; Weber *et al.* 2004). Sharks are known to prey upon Guadalupe fur seals, although mortality level is unknown (Gallo-Reynosa 1992).

Anthropogenic threats

Due to small population size, this species is highly-susceptible to extinction risk by relatively small mortalities. Guadalupe fur seals have been found stranded with net abrasions, fish hooks, and other evidence of fishing gear interaction along the central and northern California coast (Hanni et al. 1997).

Critical habitat

NMFS has not designated critical habitat for Guadalupe fur seals.

Hawaiian monk seal

Biogeography

Hawaiian monk seals are found primarily in the Northwest Hawaiian Islands, which extend more than 2,000 km miles northwest of the Main Hawaiian Islands. Major breeding subpopulations occur at French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Atoll, and Kure Atoll (Carretta *et al.* 2001). Smaller groups are found at Nihoa and Necker Islands, seals have been observed at Gardner Pinnacles, Maro Reef, and Johnston Atoll, and several dozen seals are distributed throughout Main Hawaiian Islands (Carretta *et al.* 2001; NMFS 2007). Midway was an important breeding rookery at one time, but is no longer used (Reeves *et al.* 1992b). However, all Hawaiian monk seals represent a single population.

Reported sightings on each of the eight Main Hawaiian Islands have become increasingly common, and births have been reported on all of the Main Hawaiian Islands except Lanai and Hawaii. Sightings of Hawaiian monk seals have occurred on at least three occasions at the remote Pacific location of Johnston Atoll (excluding nine adult males relocated there from Laysan Island in 1984).

Approximately 10-15% of Hawaiian monk seals migrate among the breeding populations (Johnson and Kridler 1983). Inter-island movement appears to be more likely when the islands are close together. For example, movement between Kure Atoll, Midway Atoll, Pearl and Hermes Reef appear to be fairly common, while movement between French Frigate Shoals and Kure Atoll (a distance of 2,000 km) is not known to occur. The western subpopulations (Pearl and Hermes Reef, Midway Islands, and Kure Atoll) exhibit a higher degree of migration compared to the more isolated subpopulations at Laysan, Lisianski, and French Frigate Shoals (NMFS 2007).

Habitat and feeding

Virtually all terrestrial substrates, including emergent reefs and shipwrecks, are used by monk seals. Sandy beaches with shallow protected water near shore are the primary haul-out areas, for pupping, nursing, and resting, although pups are born on a variety of substrates (Gilmartin 1983). Seals use vegetation behind beaches as shelter from wind and rain.

At the breeding islands, monk seals feed on octopus, spiny lobster, eels, and bottom-dwelling and reef fish (Gilmartin 1983; Goodman-Lowe 1998; Rice 1960). Considered foraging generalists, monk seals exhibit significant differences in diet between islands, age, and sex groups (NMFS 2007). No research or monitoring effort has been identified that will effectively measure or index monk seal prey abundance at the major breeding atolls (NMFS 2007).

Reproduction

Hawaiian monk seals do not form breeding colonies or harems (Johanos *et al.* 1994; Kenyon and Rice 1959). Mating, which occurs in water and is rarely observed, is inferred from male-female association patterns and from mounting injuries (Johanos *et al.* 1994). Breeding is asynchronous, lasting from February through September (Johanos *et al.* 1994). In recent years, fewer than 200 individuals are born annually (NMFS 2007).

Females typically give birth for the first time between ages of 5 and 10 (Antonelis *et al.* 2006). Pupping patterns vary greatly and not all females give birth in consecutive years (Johanos *et al.* 1994; Kenyon and Rice 1959). Females that do give birth in consecutive years pup later each season, while females that skip a year or more give birth earlier the next season. The mean interval for births in consecutive years was found to be 381 days (Johanos *et al.* 1994). Birth rates vary depending on breeding location and year, with approximately 30-70% of all adult females giving birth in any given year (Harting et al. 2007)(Johanos *et al.* 1994; Ragen and Lavigne 1999).

Although nursing monk seal mothers generally avoid other adult seals, occasional pup switches do occur (Johnson and Johnson 1978; Boness 1990), and mothers sometimes foster a pup if her own is lost (Alcorn and Henderson 1984; Gerrodette *et al.* 1992). If switched pups are of similar size, survival for the first year is minimally affected; however if a larger pup switches with a small one, the larger pup will have a longer nursing period and the smaller pup's probability of survival will be reduced (NMFS 2007).

Threats to the species

Natural threats. Hawaiian monk seals appear to be threatened by the spread of infectious diseases, including leptospirosis, toxoplasmosis, and West Nile virus, although domestic animals and humans may be vectors for these diseases (which would make them anthropogenic rather than natural threats). The absence of antibodies to these diseases in monk seals would make them extremely vulnerable to potential infection.

Biotoxins such as ciguatera can cause mortality in phocids, but its role in mortality of monk seals was implicated and not confirmed, remaining unclear due to the lack of assays for testing tissues and the lack of epidemiological data on the distribution of toxin in monk seal prey.

The primary cause of adult female mortality affecting the recovery potential in the monk seal population during the 1980s and early 1990s was injury and death of female monk seals caused by "mobbing" attacks initiated by male monk seals. Although NMFS has developed and implemented measures to mitigate the effects of mobbing attacks, they are still considered a serious threat to Hawaiian monk seals. In recent years, low juvenile

survival, in part due to food limitation, has been evident at all subpopulations of Hawaiian monk seals in the Northwest Hawaiian Islands.

Monk seals, particularly pups, are also subjected to extensive predation by sharks predation, which appears to be a particular problem for the monk seals occupying French Frigate Shoals in the Northwest Hawaiian Islands. Sharks are known to injure and kill Hawaiian monk seals, and monk seal remains have been found in the stomachs of tiger sharks and Galapagos sharks.

Anthropogenic threats. Several human activities are known to threaten Hawaiian monk seals: commercial and subsistence hunting, intentional harassment, competition with commercial fisheries, entanglement in fishing gear, habitat destruction on breeding beaches, pollution, and unintentional human disturbance (Kenyon 1981, Riedman 1990, Reeves *et al.* 1992).

Marine debris and derelict fishing gear have been well documented to entangle monk seals, and monk seals have one of the highest documented entanglement rates of any pinniped species. Marine debris and derelict fishing gear continue to affect the Northwest Hawaiian Islands. The number of monk seals found entangled has not changed nor has the rate at which marine debris accumulates in the Northwest Hawaiian Islands declined.

Recovery actions. In June 2006, the Papahanaumokuakea Marine National Monument (71 FR 51134, August 29, 2006) was established in the Northwest Hawaiian Islands. The boundary of the Monument includes about 140,000 square miles of emergent and submerged lands and waters of the northwest Hawaiian Islands and regulating activities such as fishing that pose potential risks to the marine habitat of Hawaiian monk seals.

Status and Trends

The Hawaiian monk seal was listed as endangered under the ESA on November 23, 1976 (41 FR 51611). A recent five-year status review conducted by NMFS recommended that Hawaiian monk seals' should retain their classification as an endangered species (72 FR 46966, August 2007). Hawaiian monk seals are considered one of the most endangered groups of pinnipeds on the planet because all of their populations are either extinct (Caribbean monk seal) or close to extinction (Mediterranean and Hawaiian monk seals).

The first decline occurred in the 1800s when sealers, crews of wrecked vessels, and guano and feather hunters nearly hunted monk seals to extinction (Dill and Bryan 1912; Kenyon and Rice 1959). Following the initial collapse, expeditions to the Northwest Hawaiian Islands reported increasing seal numbers and partial recovery to slightly more than 1,000 individuals (Bailey 1952; Rice 1960).

A second decline occurred from the late 1950s to the mid-1970s; the population declined by roughly 50% by the 1980s (NMFS 1991). The total population in the French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Kure Atoll, and Midway, Necker, and Nihoa was estimated to be 1,501 in 1984, 1,976 seals in 1986, and 1,580 in 1992 (Ragen 1993). For the years 1985 to 1993 the mean beach counts declined by approximately 5% per year. This downward trend is expected to continue, mainly because of poor pup and juvenile survival in recent years.

The population dynamics at the different monk seal subpopulations have varied considerably, and current demographic variability among the island populations probably reflects a combination of different histories of human disturbance and management (Gerrodette and Gilmartin 1990; Ragen 1999), and varying environmental conditions (Baker *et al.* 2007; Baker and Thompson 2007; Craig and Ragen 1999; Polovina *et al.* 1994). The current status of the Hawaiian monk seal is dire, due to low juvenile survival and the number of aging breeding females in the population.

The total of mean, non-pup, beach counts at the main reproductive subpopulations in 2005 was approximately 67% lower than in 1958 (Carretta et al. 2007). A log-linear regression of estimated abundance from 1998 (the first year for which a reliable total abundance estimate was obtained) to 2006 estimates that abundance declined by 3.9% annually (Fig. 2)(NMFS 2007).

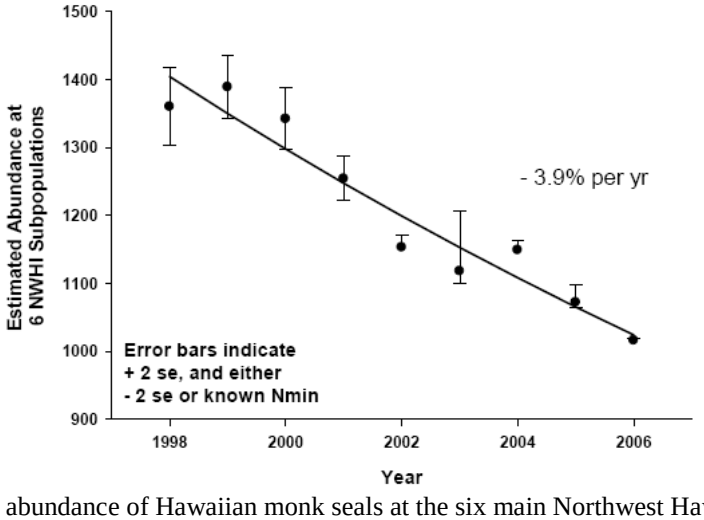

Figure 2. Trends in abundance of Hawaiian monk seals at the six main Northwest Hawaiian Islands subpopulations combined, 1998-2006. This graph does not include abundance estimates for Necker, Nihoa, or the Main Hawaiian Islands. Error bars indicate ±2 standard errors or known minimum abundance. The fitted trend line reveals an estimated decline of 3.9% (NMFS 2007).

The decrease in survival rates of immature animals, including a decline in survival from birth to weaning, and survival from weaning to age 2 years has contributed to a dramatically imbalanced age structure for all six of the main Northwest Hawaiian Islands subpopulations (Fig. 3) (NMFS 2007; NMFS 2009). Although studies show that the relationship between size of pups and first year survival vary between subpopulations and over time, site-specific analyses do support girth and year as predictors of first-year survival at each location. When conditions for survival are worse, the relationship between size and survival strengthens. The simplest explanation for this is food limitation (Baker 2008).

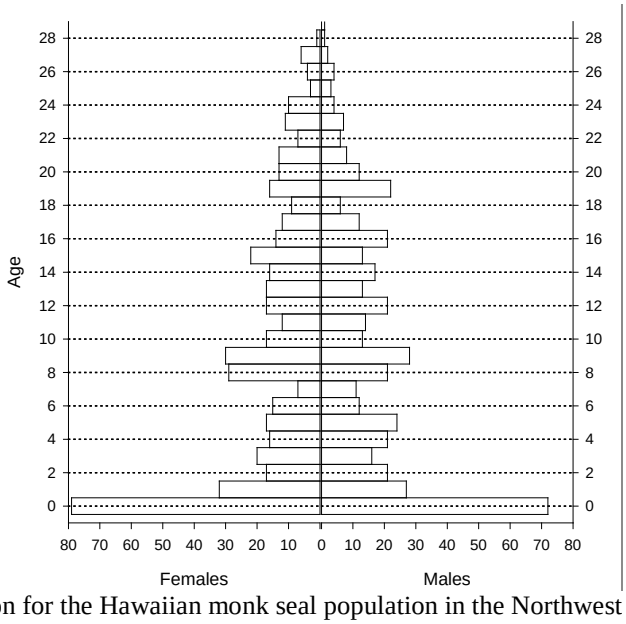

Figure 3. Age distribution for the Hawaiian monk seal population in the Northwest Hawaiian Islands (MMRP unpublished data in NMFS 2009).

The best estimate of the total population of Hawaiian monk seals is 1,146 seals and the minimum population size estimate for the Hawaiian monk seal is 1,129 seals (Carretta *et al.* 2009). A log-linear regression of estimated abundance from 1998 to 2006 suggests the population has declined on average -3.9% per year, and models predict that the total population of the species will fall below 1,000 monk seals within 5 years (NMFS 2007). Trends in abundance vary considerably among the six main subpopulations.

Critical Habitat

Critical habitat was originally designated on April 30, 1986 (51 FR 16047), and was extended on May 26, 1988 (53 FR 18988; CFR 226.201). The critical habitat includes all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and ocean waters out to a depth of 20 fathoms (37 m) around the following: Kure Atoll, Midway Islands, except Sand Island and its harbor, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, Nihoa Island.

The proposed research would not take place in designated Hawaiian monk seal critical habitat.

Southern Resident killer whale

Description of the species

Southern Resident killer whales compose a single population that occurs primarily along Washington State and British Columbia. The listed entity consists of three family groups, identified as J, K, and L pods. They are found throughout the coastal waters off Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as the Queen Charlotte Islands, British Columbia. However, there is limited information on the range of Southern Residents along the outer

Pacific Coast, with only 25 confirmed sightings of J, K, and L pods between 1982 and 2006 (Krahn *et al.* 2004).

Southern Residents are highly mobile and can travel up to 100 miles per day (Erickson 1978; Baird 2000). Members of K and L pods once traveled a straightline distance of 584 miles from the northern Queen Charlotte Islands to Victoria, Vancouver Island, in seven days. Movements may be related to food availability.

Southern Resident killer whales spend a significant portion of the year in the inland waterways of the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound, particularly during the spring, summer, and fall, when all three pods are regularly present in the Georgia Basin (defined as the Georgia Strait, San Juan Islands, and Strait of Juan de Fuca) (Heimlich-Boran 1988; Felleman *et al.* 1991; Olson 1998; Osborne 1999). Typically, K and L pods arrive in May or June and primarily occur in this core area until October or November. Late spring and early fall movements of Southern Residents in the Georgia Basin have remained fairly consistent since the early 1970s, with strong site fidelity shown to the region as a whole (NMFS 2005). During late fall, winter, and early spring, the ranges and movements of the Southern Residents are less well known. Offshore movements and distribution are largely unknown for the Southern Resident population.

Feeding

Southern Resident killer whales are fish eaters, and predominantly prey upon salmonids, particularly Chinook salmon but are also known to consume more than 20 other species of fish and squid (Ford *et al.* 2000; Ford and Ellis 2006; Ford and Ellis 2005; Scheffer and Slipp 1948; Ford *et al.* 1998; Saulitis *et al.* 2000). Killer whales show a strong preference for Chinook salmon (78% of identified prey) during late spring to fall (Ford and Ellis 2006; Hanson *et al.* 2005). Chum salmon are also taken in significant amounts (11%), especially in autumn. Chinook are preferred despite much lower abundance in comparison to other salmonids (such as sockeye) presumably because of the species' large size, high fat and energy content, and year-round occurrence in the area.

Reproduction

Female Southern Resident killer whales give birth to their first surviving calf between the ages of 12 and 16 years and produce an average of 5.4 surviving calves during a reproductive life span lasting about 25 years (Matkin *et al.* 2003; Olesiuk *et al.* 1990). Females reach a peak of reproduction around ages 20-22 and decline in calf production gradually over the next 25 years until reproductive senescence (Ward et al. 2009a). Older mothers tend to have greater calving success than do their younger, less-experienced counterparts (Ward et al. 2009b). Calving success also appears to be aided by the assistance of grandmothers (Ward et al. 2009b). The mean interval between viable calves is four years (Bain 1990). Males become sexually mature at body lengths ranging from 17 to 21 feet, which corresponds to between the ages of 10 to 17.5 years, and are presumed to remain sexually active throughout their adult lives (Christensen 1984; Perrin and Reilly 1984; Duffield and Miller 1988; Olesiuk *et al.* 1990). Most mating is believed to occur from May to October (Matkin *et al.* 1997; Nishiwaki 1972; Olesiuk *et al.* 1990). However, conception apparently occurs year-round because births of calves are reported in all months. Newborns measure seven to nine feet long and weigh about 440 lbs (Ford

2002; Clark *et al.* 2000; Nishiwaki and Handa 1958; Olesiuk *et al.* 1990). Mothers and offspring maintain highly-stable, life-long social bonds and this natal relationship is the basis for a matrilineal social structure (Ford *et al.* 2000; Baird 2000; Bigg *et al.* 1990). Some females may reach 90 years of age (Olesiuk et al. 1990).

Status and trends

Southern Resident killer whales have been listed as endangered since 2005 (70 FR 69903). In general, there is little information available regarding the historical abundance of Southern Resident killer whales. Some evidence suggests that, until the mid- to late-1800s, the Southern Resident killer whale population may have numbered more than 200 animals (Krahn et al. 2002).

More recently, the Southern Resident population has continued to fluctuate in numbers. After growing to 98 whales in 1995, the population declined by 17% to 81 whales in 2001 (-2.9% per year) before another slight increase to 84 whales in 2003 (Ford *et al.* 2000; Carretta *et al.* 2005). The population grew to 90 whales in 2006, although it declined to 87 in 2007 (NMFS 2008). The most recent population abundance estimate of 87 Southern Residents consists of 25 whales in J pod, 19 whales in K pod, and 43 whales in L pod (NMFS 2008).

The recent decline, unstable population status, and population structure (e.g., few reproductive age males and non-calving adult females) continue to be causes for concern. Moreover, it is unclear whether the recent increasing trend will continue. The relatively low number of individuals in this population makes it difficult to resist/recover from natural spikes in mortality, including disease and fluctuations in prey availability (NMFS 2008).

Critical habitat

Critical habitat for the DPS of Southern Resident killer whales was designated on November 29, 2006 (71 FR 69054). Three specific areas were designated; the Summer Core Area in Haro Strait and waters around the San Juan Islands; Puget Sound; and the Strait of Juan de Fuca, which comprise approximately 2,560 square miles of marine habitat. Three essential factors exist in these areas: water quality to support growth and development, prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth, and passage conditions to allow for migration, resting, and foraging. Water quality has declined in recent years due to agricultural run-off, urban development resulting in additional treated water discharge, industrial development, oil spills. The primary prey of southern residents, salmon, has also declined due to overfishing and reproductive impairment associated with loss of spawning habitat. The constant presence of whale-watching vessels and growing anthropogenic noise background has raised concerns about the health of areas of growth and reproduction as well.

The proposed research would not take place in designated Southern Resident killer whale critical habitat.

Steller sea lion

Description of the species

Steller sea lions are distributed along the rim of the North Pacific Ocean from San Miguel Island (Channel Islands) off Southern California to northern Hokkaido, Japan (Loughlin *et al.* 1984; Nowak 2003). Their centers of abundance and distribution are in Gulf of Alaska and the Aleutian Islands, respectively (NMFS 1992). In the Bering Sea, the northernmost major rookery is on Walrus Island in the Pribilof Island group. The northernmost major haul-out is on Hall Island off the northwestern tip of St. Matthew Island. Their distribution also extends northward from the western end of the Aleutian chain to sites along the eastern shore of the Kamchatka Peninsula. For management purposes, two stocks have been designated (eastern and western), but they represent a single population. These stocks likely have some taxonomic basis at the sub-species level in both genetics and skull morphology (Phillips et al. 2009). The eastern DPS of Steller sea lions includes animals east of Cape Suckling, Alaska (144°W), south to California waters (55 FR 49204). The western DPS of Steller sea lions includes animals west of Cape Suckling, Alaska (144°W; 62 FR 24345).

Steller sea lions are not known to make regular migrations but do move considerable distances. Adult males may disperse hundreds of miles after the breeding season (Calkins and Pitcher 1982, Calkins 1986, Loughlin 1997). Adult females may travel far out to sea into water greater than 3,300 feet deep (Merrick and Loughlin 1997).

Reproduction

Most adult Steller sea lions occupy rookeries during the pupping and breeding season and exhibit a high level of site fidelity. During the breeding season, some juveniles and non-breeding adults occur at or near the rookeries, but most are on haulouts (Rice 1998; Ban 2005; Call and Loughlin 2005). Adult males may disperse widely after the breeding season.

Female Steller sea lions reach sexual maturity and first breed between three and eight years of age and the average age of reproducing females (generation time) is about 10 years (Pitcher and Calkins 1981; York 1994; Calkins and Pitcher 1982). They give birth to a single pup from May through July and then breed about 11 days after giving birth. The gestation period is believed to be about 50 to 51 weeks (Pitcher and Calkins 1981). Generally, female Steller sea lion will nurse their offspring until they are one to two years old (Gentry 1970; Trites *et al.* 2006; Pitcher and Calkins 1981; Sandegren 1970; Calkins and Pitcher 1982). Males reach sexual maturity at about the same time as females (three to seven years of age, reported in Loughlin et al. (1987), but generally do not reach physical maturity and participate in breeding until about eight to ten years of age (Pitcher and Calkins 1981).

Feeding

Steller sea lions are generalist predators that eat various fish (arrowtooth flounder, rockfish, hake, flatfish, Pacific salmon, Pacific herring, Pacific cod, sand lance, skates, cusk eel, lamprey, walleye, Atka mackerel), squids, and octopus and occasionally birds and marine mammals (Brown *et al.* 2002; McKenzie and Wynne 2008; Jones 1981;

Sinclair and Zeppelin 2002; Pitcher and Fay 1982; Calkins and Goodwin 1988; Daniel and Schneeweis 1992; Olesiuk *et al.* 1990). Diet is likely strongly influenced by local and temporal changes in prey distribution and abundance (McKenzie and Wynne 2008; Sigler *et al.* 2009). Haulout selection appears to be driven at least in part by local prey density (Winter et al. 2009).

Status and trends

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 species was split into two separate distinct population segments (DPSs) based on demographic and genetic differences (Loughlin 1997; Bickham *et al.* 1996), and the western DPS was reclassified to endangered (62 FR 24345) while the eastern DPS remained threatened (62 FR 30772). The Steller sea lion is also listed as endangered on the 2007 IUCN Red List (Gelatt and Lowry 2008).

Between late 1970s and the mid-1990s, counts of the western population of sea lions fell from 109,880 animals to 22,167 animals, a decline of 80% (NMFS 1995; Hauser *et al.* 2007). The minimum population estimate for the western population is 44,780 (Angliss and Outlaw 2007; Fritz and Stinchcomb 2005). According to several population models the western DPS has significant chance of going extinct within the next 100 years (York *et al.* 1996; Winship and Trites 2006; Goodman 2006), and many individual rookeries have higher risks of extinction (e.g., western Aleutian island rookeries and Gulf of Alaska; Winship and Trites 2006).

The eastern stock seems to be more stable than the western stock. The current minimum population estimate is 44,584 animals (Angliss and Outlaw 2008).

Critical habitat

Critical habitat was designated on August 27, 1993 for both eastern and western DPS of Steller sea lions in California, Oregon, and Alaska (58 FR 45269). Steller sea lion critical habitat includes all major rookeries in California, Oregon, and Alaska and major haulouts in Alaska. Essential features of Steller sea lion critical habitat include the physical and biological habitat features that support reproduction, foraging, rest, and refuge, and include terrestrial, air and aquatic areas. Specific terrestrial areas include rookeries and haul-outs where breading, pupping, refuge and resting occurs. More than 100 major haulouts are documented. The principal, essential aquatic areas are the nearshore waters around rookeries and haulouts, their forage resources and habitats, and traditional rafting sites extending 3,000 feet (0.9 km) seaward of state and Federally managed waters. Air zones extending 3,000 feet (0.9 km) above terrestrial and aquatic habitats are also designated as critical habitat to reduce disturbance in these essential areas. Specific activities that occur within the habitat that may disrupt the essential life functions that occur there include: wildlife viewing, boat and airplane traffic, research activities, timber harvest, hard mineral extraction, oil and gas exploration, coastal development and pollutant discharge, and others.

In California, the major Steller sea lion rookeries are found on: 1) Año Neuvo Island, 2) Southeast Farallon Island, 3) Sugarloaf Island and Cape Mendocino. The major rookeries in Oregon are found on the following sites: 1) Rouge Reef: Pyramid Rock, 2) Orford

Reef: Long Brown Rock, and 3) Orford Reef: Seal Rock. In Southeast Alaska, the major Steller sea lion rookeries are found on: 1) Forrester Island, 2) Hazy Island, and 3 White Sisters. There are also major haul-out sites in Southeast Alaska designated as critical habitat for Steller sea lions.

The proposed research would not take place in designated Steller sea lion critical habitat.

Environmental Baseline

By regulation, environmental baselines for Opinions include the past and present impacts of all state, federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR §402.02). The *Environmental baseline* for this Opinion includes the effects of several activities affecting the survival and recovery of Guadalupe fur seals, Hawaiian monk seals, Southern Resident killer whales, and Steller sea lions in the action area.

Currently there is one Hawaiian monk seal (male) held at Long Marine Laboratory, under Marine Mammal Health and Stranding Response Program Permit No. 932-1905. Up to a total of 3 Hawaiian monk seals could be held at any one time over the duration of the permit. Additionally, Sea Life Park, Hawaii has 3 Hawaiian monk seals (2 males, 1 female), held under Permit No. 898-1764-01; Waikiki Aquarium has 2 males under Permit 455-1760-01; and Sea World San Antonio has 6 females under Permit No. 116-1786-01.

Animals temporarily held for rehabilitation at Long Marine Laboratory are kept for a maximum of 6 months, unless a waiver is granted. There are currently no listed species being held at Long Marine Laboratory for the purposes of rehabilitation.

Effects of the proposed actions

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

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

Potential stressors

The assessment for this consultation identified several possible direct stressors associated with the proposed permitted activities. These are the body condition and morphometrics assessment; resting, active, diving, and swimming metabolic rate tests; blood gasses, pH, and lactate determination; heart rate and stroke swimming rate; and heat flow and body temperature measurements. Additional stressors for captive Hawaiian monk seals are total blood volume via Evans blue; deuterium oxide, blood sampling, and ultrasound; and thyroid stimulating hormone administration and fecal sampling. Monk seals would also be restrained or sedated.

Exposure analysis

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

All life stages of male and female Guadalupe fur seals, Steller sea lions (eastern DPS only), Southern Resident killer whales, and Hawaiian monk seals could be exposed to the proposed action. Most rehabilitating animals will be from California, but some could originally be from Oregon and Washington. The proposed research would only be conducted on Hawaiian monk seal that are in permanent captivity and on the other ESA-listed species that are in rehabilitation. The proposed numbers of procedures that could be taken administered on a monthly basis are provided in Tables 1 and 2, and activities could take place year-round. Animals in rehabilitation are not kept in captivity for more than 6 months, unless a waiver is granted by NMFS to extend the captivity period.

Response analysis

As discussed in the *Approach to the Assessment* section of this Opinion, our response analyses determine how the Guadalupe fur seals, Steller sea lions, Southern Resident

killer whales, and Hawaiian monk seals are likely to respond upon being exposed to the stressors associated with the proposed administration of de-worming medication. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal (or physiological), or behavioral responses that might reduce the fitness of individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

Non-invasive methods

Body condition, morphometrics, metabolic rates, heart rate and stroke rate, heat flow and body temperature would be measured using non-invasive methods. Measurements would be performed voluntarily by the animals, or during the routine care of the animals in rehabilitation. Most of the captive animals that would be involved in this study are trained to participate in the medical and research behaviors described to minimize potential stress. Daily training sessions would incorporate these behaviors and ensure the overall wellbeing of the animals. Particular care would be paid to behavioral changes that may occur during sensitive periods such as molt or reproductive activities. For animals trained to participate in the research, experimental sessions would be terminated in the event of refusal by the animal.

Baker and Johanos (2002) studied the effects of research activities from 1983 to 1998 (including tagging, instrumentation, and blood sampling) on the survival, migration, and condition of Hawaiian monk seals in the wild. Their study suggests that if Hawaiian monk seals are released alive, there are no apparent differences in their health condition or behavior when compared with monk seals that have not been handled. Even re-sighting rates after one year did not differ between the experimental (monk seals that had been handled) and control groups. We believe that the effects of restraint and handling on captive or rehabilitating marine mammals will have similar or lesser effects.

Body mass would be measured on a platform scale and length and girth would be taken using a tape measure. Blubber deposition would be determined using a surface ultrasound. Ultrasound is wholly non-invasive and involves light, momentary pressure on the animal's skin. Water may be used to ensure proper transducer-skin contact. A portable ultrasound instrument would be used and a trained technician will be conducting the procedures. Use of ultrasound is common in humans and domesticated animals for diagnostic use, including during pregnancy to monitor fetal development. Ultrasound is also routinely used in pinnipeds to measure blubber thickness as an indication of body condition (Mellish *et al.* 2004) and is generally considered a safe imaging modality (Merritt 1989).

Researchers would measure resting and active metabolic rates by training animals to enter a saltwater pool and mounting a Plexiglas metabolic hood over the pool. It is unlikely that the animals would experience stress during the tests, as pool used for these tests would often be the routine holding pool of the animal.

Heat flow would be measured with a handheld surface probe, and body temperature would be determined using a flexible rectal probe. Non-trained animals could also receive an ingestible stomach temperature pill, introduced in a fish. Retention of the pill is generally 1-14 days.

Animals would wear an electrocardiograph recorder or a heart rate-dive depth-accelerometer microprocessor to measure heart rate and stroke rate. For pinnipeds, the electrodes are attached either laterally by the front flippers or along the dorsal surface using a neoprene patch glued to a shaved area. The neoprene glue can be removed easily. Cetaceans' heart rates would be obtained from two cross-thorax surface electrodes place on the sternum with a suction cup. A custom fitted neoprene vest or harness would be used to carry the ECG instrumentation.

Previous open water swim tests conducted under previous permits with dolphins and seals demonstrate that there was no significant difference in physiological responses with and without the instrumentation at speeds up to 2.9 $m.s^{-1}$ (Williams *et al.* 1993), and so we assume there would be little additional energetic cost associated with the instrumentation.

Invasive methods

Blood gases, pH, and lactate concentration would be collected using standard blood sampling protocols. As discussed earlier, Baker and Johanos' (2002) work on the effects of research activities (including blood sampling) on the survival, migration, and condition of Hawaiian monk seals in the wild suggest that these actions do not have long term effects on the survival of the individual. Swelling or infection at the injection site could occur, but because the animals would be in captivity, veterinaries would be present to treat any adverse reactions to injection.

Deuterium oxide requires an initial blood draw, followed by an injection of deuterium oxide, and a second blood draw 2 to 2.5 hours later. Deuterium oxide is a stable, relatively non-toxic and naturally occurring isotope. Up to 20-25% of body water can be replaced by deuterium oxide in mice before toxic effects are observed. The use of deuterium oxide increases the amount of time an individual animal must be handled due to the need for blood sampling prior to and after administration. However, for captive Hawaiian monk seals, the animals would be released in between sampling and in some cases the animals would voluntarily participate in the sampling.

No adverse reactions have been recorded for the use of deuterium oxide for the assessment of fat and lean body mass in mammals including a wide range of pinniped species. Examples include gray seals (Reilly and Fedak 1990), ringed seals (Lydersen *et al.* 1992), and Antarctic fur seals (Arnould *et al.* 1996). This technique has been used safely in both captive and field settings and is safe for both phocids and otariids. Potential adverse effects are associated with injection and blood sampling, where swelling or infection could occur at the injection site.

Evans blue dye is a diazo dye used for determination of blood volume on the basis of dilution of a standard solution of the dye in plasma following intravenous injection. No adverse reactions have been recorded for the use of Evans blue dye for the assessment of blood volume in mammals including a wide range of pinniped species. These include successful studies on New Zealand sea lions (Costa *et al.* 1998) and elephant seal pups (Thorson and Boeuf 1994). Potential adverse effects are associated with those accompanying any injection or blood sampling, such as swelling or infection (i.e., abscess) at the injection site.

A thyroid stimulating hormone (TSH) challenge would be performed to stimulate secretion of thyroid hormones by the thyroid gland respectively. All feces excreted prior to and after the injections would be collected and T3 and T4 extracted and assayed. No adverse reactions have been recorded for the use of TSH to assess physiological response to hormone stimulation in numerous animals (Wasser *et al.* 2010; Wasser *et al.* 2000). TSH has been used safely with a number of captive and rehabilitating pinnipeds including harbor seals, elephant seals (Yochem *et al.* 2008) and Steller sea lions (Keech *et al.* 2010; Hunt *et al.* 2004). Potential adverse effects are associated with injection and dry holding. Only feces will be collected and dry holding will occur under the supervision of husbandry staff and an attending veterinarian.

Risk of Mortality

Some procedures such as blood sampling may require restraint and sedation for captive animals, including animals in rehabilitation. Any capture event for a wild animal is stressful and can lead to death. Therefore, the applicant has requested accidental mortality of up to one Hawaiian monk seal annually and up to two rehabilitating ESA-listed species over the duration of the permit. In both cases (permanently captive and rehabilitating), the total number of permitted accidental deaths of listed and non-listed animals would not increase.

The Hawaiian monk seals in permanent captivity have already been removed from the wild population; therefore, death of one of these seals will have no effect on survival of the species in the wild. Animals would not be captured from the wild to replace a captive seal that may die as a result of research.

The ESA-listed species in rehabilitation have also effectively been removed from the wild population; if not removed for rehabilitation, they would likely die due to injury, illness, or other debilitating condition (e.g., starvation). If an individual is successfully rehabilitated and returned to the wild population, the population would likely benefit.

The research conducted on captive ESA-listed species could provide information to improve the survival for the wild populations, which could result in a benefit the species.

Cumulative effects

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area considered by this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

The action area includes the facilities at Long Marine Laboratory, Santa Cruz, CA, for all target species of this research; and, Sea World, San Antonio, TX; Sea Life Park, Waimanalo, HI; Waikiki Aquarium, Honolulu, HI; and any other permitted facility in the U.S. for Hawaiian monk seals in permanent captivity. No state, local, or private actions are reasonably certain to occur within the facilities. Any action that could affect the maintenance of the captive or rehabilitating ESA-listed species would require federal involvement and section 7 consultation.

Integration and synthesis of the effects

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

The proposed research would be conducted on permanently captive Hawaiian monk seals and rehabilitating Guadalupe fur seals, Steller sea lions, and Southern Resident killer whales, as well as other non-listed species. The researchers would conduct body condition and morphometrics assessments; resting, active, diving, and swimming metabolic rate tests; blood gasses, pH, and lactate determination; heart rate and stroke swimming rate; and heat flow and body temperature measurements. Captive Hawaiian monk seals would have additional procedures: total blood volume via Evans blue; deuterium oxide, blood sampling, and ultrasound; and thyroid stimulating hormone administration and fecal sampling.

From the perspective of population dynamics, individuals deemed non-releasable are no longer members of the wild population. For the purposes of this action, we treat the captive population of Hawaiian monk seals as separate from the wild population. Nevertheless, we remain concerned about the welfare of the individuals. The proposed action is likely to adversely affect the individual captive animals; however the action will not adversely affect the reproduction, numbers, and distribution of the wild population of Hawaiian monk seals. The research could, however, increase our understanding of the species and provide a means to improve the survival of the Hawaiian monk seals. Therefore the proposed action will not reduce the Hawaiian monk seals' likelihood of surviving and recovering in the wild.

For the other ESA-listed species (Guadalupe fur seal, Steller sea lion, and Southern Resident killer whale), the animals would be released after being rehabilitated. The proposed action is likely to adversely affect the individuals. We also considered that, without intervention, an injured or ill animal would most likely die in the wild. As discussed above, the research could allow researchers to better protect and improve the survival of populations in the wild.

Conclusion

After reviewing the current *Status of listed resources*; the *Environmental baseline* for the *Action area*; the anticipated effects of the proposed activities; and the *Cumulative effects*, it is the NMFS' Opinion that the activities authorized by the proposed issuance of scientific research permit amendment No. 13602-01, as proposed, is not likely to jeopardize the continued existence of Guadalupe fur seals, Hawaiian monk seals, Southern Resident killer whales, or Steller sea lions. Critical habitat is not expected to be adversely modified or destroyed as a consequence of the proposed actions.

Incidental take statement

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

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

Conservation recommendations

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

In the case of the proposed permit No. 13602-01, we do not have any conservation recommendations beyond the conditions included in the proposed permit.

Reinitiation notice

This concludes formal consultation on the proposal to issue scientific research permit No. 13602-01 to Dr. Terrie Williams for research on Hawaiian monk seals, Guadalupe fur seals, Steller sea lions, and Southern Resident killer whales at Long Marine Laboratory and other marine mammal captive facilities in the U.S. 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 take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, the NMFS Permits Division must immediately request reinitiation of Section 7 consultation.

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